September 16-20
Copenhagen, Denmark
CIRSE 2017

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PART 1

Abstracts of
Special Sessions
Controversy Special Session
Fundamental Courses
Honorary Lectures
Hot Topic Lectures
CIRSE Meets Lectures
sorted by presentation
numbers

Special Session

Therapy of in-stent stenosis

101.1

Relining of stents

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Learning Objectives

1. To learn about the indications, patient selection and contra-indications
2. To learn about the different types of available stents and techniques
3. To learn about the outcomes

No abstract available.

101.2

Atherectomy

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Learning Objectives

1. To learn about the indications, patient selection and contra-indications
2. To learn about the different types of available stents and techniques
3. To learn about the outcomes

In-stent restenosis (ISR) is a major problem following stenting for femoropopliteal arterial occlusive disease. Treatments include standard plain old balloon angioplasty (POBA) with or without repeat stenting (bare-metal stents, stentgrafts or drug-eluting stents), drug-eluting or cutting balloon angioplasty, cryoplasty and directional or laser atherectomy. The concept of atherectomy is to debulk the occlusive tissue in the stent before performing adjunctive balloon angioplasty and/or stenting to minimise and delay target limb revascularisation (TLR). Technical success reported with this technique is high, with a significant improvement in clinical symptoms. Shammass et al., in a retrospective study of 41 patients using the Silver-Hawk device (SA), showed technical success in 100% of patients. Compared with baseline, ABI at 1 month significantly improved to 0.91 ± 0.19 (Pb 0.05); however, this was not statistically different at 1 year (0.61 ± 0.28). Adverse events were reported: distal embolization (DE) requiring treatment 7.3%, stent thrombosis 4.9% and planned minor amputation in the non-index limb 2.4%. There were no device-related complications, death or amputation.

Schmidt et al. used Excimer laser atherectomy (ELA) to perform a prospective, multicentre study of 90 patients with ISR of nitinol stents and demonstrated that ELA combined with POBA resulted in 97% procedural success, 7% residual stenosis, 2.2% 30-day major complication rate and 64% 1-year freedom from TLR.

Another small study in 29 patients using the jet stream and rotational and aspiration system has demonstrated favourable results. Treated length was 19.5 ± 12.9 cm. The device success was reported in 76%, with an overall success of 91%. There was 9.4% embolisation requiring treatment, 3% major bleeding and 3% mortality. Patency was 72% at 6 months, and TLR was 41% at 12 months.

A recent multicentre randomised trial of atherectomy and POBA vs. POBA alone showed a significant benefit using atherectomy. A total of 169 atherectomy+POBA patients (62.7% male; mean age 68.5 ± 9.8 years) and 81 POBA patients (61.7% male; mean age 67.8 ± 10.3 years) were enrolled. Mean lesion length was 19.6 ± 12.0 cm versus 19.3 ± 11.9 cm, and 30.5% versus 36.8% of patients exhibited total occlusion.

Atherectomy combined with angioplasty demonstrated better procedural success (93.5% vs. 82.7%; $p < 0.01$), with significantly fewer procedural complications. At 6 months, freedom from TLR was 73.5% versus 51.8% ($p < 0.005$) and 30-day major adverse event rates were 5.8% versus 20.5% ($p < 0.001$), with a 52% reduction in TLR (hazard ratio: 0.48; 95% confidence interval: 0.31–0.74).

There have been few comparative studies comparing different types of atherectomy devices. ELA was utilized more frequently than SH in longer lesions (210.46104 vs. 126.2679.3 mm, respectively; $p < 0.001$), subacute presentation (55% vs. 14.6%, $p < 0.001$), TASC D lesions (47.5% vs. 12.2%), and patients with more angiographic thrombus (42.5% vs. 4.9%, $p < 0.001$). Final angiographic success (30% residual narrowing post-final treatment) was similar between ELA and SH (92.5% vs. 100%, respectively, $p < 0.12$). Bailout stenting was significantly higher with ELA than that with SH (50.0% vs. 24.4%, $p < 0.022$). At 1 year, TLR had occurred in 48.7% of the ELA patients vs. 31.7% of the SH patients ($p < 0.171$). Regression analysis confirmed that SH was a predictor of TLR at 1 year (hazard ratio 2.679, 95% confidence interval 1.015–7.073, $p < 0.047$).

Both SH and ELA overall have a high TLR rate in treating ISR of the femoral and popliteal arteries. A higher rate of delayed failure is seen with SH, and an earlier, steeper loss of TLR-free survival is seen with ELA.

Although a high acute procedural success can be achieved with atherectomy combined with POBA, adjunctive embolic protection is required in a significant number of patients and the TLR rate for femoropopliteal ISR at 1 year remains high.

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101.3

Drug-coated balloon

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Learning Objectives

1. To learn about the indications, patient selection and contraindications
2. To learn about the different types of available stents and techniques
3. To learn about the outcomes

After several non-randomized studies from Italy that have shown promising results of the In.Pact drug-coated balloon in the treatment of in-stent restenosis, the first two randomized trials have been published. In the Fair study, the In.Pact drug-coated balloon showed significantly less restenosis compared with the uncoated balloon at 6 months (15.4% vs. 44.7%). Unfortunately, the number of patients in the follow-up after 1 year was too low to draw a conclusion. In the Pacuba study, the Freeway drug-coated balloon showed better results at 1 year compared with POBA. One major limitation of this study was that the follow-up was less standardized. The third prospective randomized study (Copa Cabana) comparing POBA with the Cotavance drug-coated balloon is not published yet. Compared with the FAIR and PACUBA studies, the lesions were longer and the follow-up was performed up to 2 years. After 2 years, the patency rate of the drug-coated balloon-arm was significantly better compared with that of the uncoated balloon arm. These results are not in line with the data of Debate ISR. Debate ISR was the first study which showed a significant better result of the DCB short-term but no effect midterm. The effect did not sustain (catch-up). After 2 and 3 years, the In.Pact drug-coated balloon was not any better compared with POBA. One major limitation of this study was that the drug-coated balloon group was just compared to a historic control. In summary, there is high-level evidence that drug-coated balloons can reduce the high restenosis rate of in-stent restenosis. Nevertheless, long-term data are not yet conclusive. It might be that restenosis after drug-coated balloon treatment is just delayed.

101.4

Alternative treatments

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Learning Objectives

1. To learn about the indications, patient selection and contraindications
2. To learn about the different types of available stents and techniques
3. To learn about the outcomes

The issue of in-stent restenosis (ISR) remains one of the major limitations of endovascular treatment for atherosclerotic disease of the superficial femoral artery (SFA), although overall stenting rates of SFA are currently decreasing because the primary use of drug-coated balloon (DCB) technology in de novo lesions is increasing. Especially, in more complex cases, bail-out stenting rates after DCB angioplasty can be as high as 30%. Therefore, there will remain a need for treatment of ISR even in future.

In this session, several treatment options have been discussed (relining of stents, atherectomy, and DCB angioplasty). This presentation will discuss the alternative therapeutic modalities that include cutting-balloon angioplasty, cryoplasty, use of drug-eluting stents, and finally, a combination of atherectomy and DCB angioplasty. Advantages, disadvantages, and results of all these modalities will be dealt with.

Fundamental Course

Therapy of venous thrombo-embolic disease

102.1

Acute pelvic thrombosis

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Learning Objectives

1. To learn about clinical and radiological diagnosis of acute pelvic thrombosis
2. To learn about evidence for interventional treatment of acute pelvic thrombosis
3. To learn about access sites and interventional therapy options of acute pelvic thrombosis

Deep vein thrombosis (DVT) is a major health issue. About 25%–45% of DVT patients are reported to develop PTS within 2 years. Several studies have proven catheter-directed thrombolysis (CDT) to be more effective in removing thrombus and preventing PTS than systemic or regional lysis [1]. A Cochrane Database review analysing data from the 1960s up to now showed no advantage of mostly systemic thrombolysis over anticoagulation alone [2]. Locoregional treatment, however, provided an advantage in terms of complete thrombus removal and reduction in PTS.

Four recent studies investigated the use of percutaneous endovenous interventions (PEVIs) for thrombus removal, including mechanical thrombectomy, CDT and pharmacomechanical thrombolysis (PMT).

The TORPEDO trial was a randomised study comparing PEVI + anticoagulation and anticoagulation only for the reduction of venous thromboembolism and PTS [3]. Overall, 183 patients with acute symptomatic proximal DVT were randomised to receive PEVI + anticoagulation or anticoagulation only. At 6 months, PTS developed in 3.4% patients in the PEVI + anticoagulation group and 27.2% patients in the anticoagulation only group ($p < 0.001$). This advantage remained over 30.5 months (6.8% vs. 29.6%; $p = 0.001$).

CaVenT was an open-label, randomised controlled trial comprising 209 patients assigned to either receive conservative therapy or CDT [4]. At 24 months, 55.6% of the patients in the conservatively managed group presented with PTS compared with 41.1% of the patients in the CDT group ($p = 0.047$). Iliofemoral patency after 6 months was significantly better after CDT ($p = 0.012$), but there were also three major bleeds after CDT. At 5 years, 71% of the patients from the conservatively managed group and 43% from the CDT group presented with PTS ($p < 0.001$). Quality-of-life scores, however, did not differ between the treatment groups.

Early this year, the first data from the ATTRACT trial was presented. Overall, 692 patients with acute DVT above the knee either received standard treatment or PEVI + standard treatment. In total, 46.7% of patients receiving PEVI developed some kind of PTS compared with 48.2% of patients receiving standard treatment ($p = 0.56$). Patients who received PEVI were 25% less likely to develop moderate-to-severe PTS. There were slightly more number of bleedings in the PEVI arm.

The CAVA trial (NCT00970619) is still recruiting. It is designed to assess whether CDT can safely and effectively reduce PTS after 1 year. Patients are allocated to either receive anticoagulation alone or CDT + anticoagulation.

In conclusion, the role of PEVI in acute DVT is controversial. Nevertheless, there is evidence supporting PEVI in well-selected patients suffering from acute iliofemoral DVT.

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102.2

Chronic pelvic thrombosis

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Learning Objectives

1. To learn about clinical and radiological diagnosis of chronic pelvic thrombosis
2. To learn about evidence for interventional treatment of chronic pelvic thrombosis
3. To learn about access sites and interventional therapy options of chronic pelvic thrombosis

No abstract available.

102.3

IR treatment in acute pulmonary embolism

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Learning Objectives

1. To learn about indications for interventional treatment of PE
2. To learn about different interventional techniques for treatment of PE
3. To learn about advantages and disadvantages of different techniques for treatment of PE

Pulmonary embolism (PE) can be a life-threatening emergency. Accurate diagnostic techniques and patient-specific management strategies are necessary to ensure favorable clinical outcomes. Venous thromboembolism remains one of the most common conditions. PE is associated with a mortality rate of over 15% in the first 3 months after diagnosis. Venous thromboembolism is the fourth leading cause of death in the Western world and the third leading cause of cardiovascular death trailing myocardial infarction and stroke.

This presentation highlights the interventional options presently available to treat PE, a potentially lethal disease.

102.4

IVC filters: current evidence

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Learning Objectives

1. To learn about the evidence for filter placement (European and US sight)
2. To learn about the evidence for different filter types
3. To learn about the evidence for early and late filter removal

No abstract available.

Special Session

New tools for guiding and monitoring liver ablation

103.1

Radiopaque beads: useful tool or gadget

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Learning Objectives

1. To understand the properties of radiopaque beads
2. To learn when and how to use radiopaque beads
3. To learn about preliminary results of their use in clinical practice

Purpose

Targeting HCC during chemoembolization (TACE) has been indirectly assessed by the concurrent injection of iodinated contrast agents as a surrogate for bead deposition. Radiopaque drug eluting beads have the potential to provide increased control by enabling real-time visualization of bead deposition, potentially allowing for treatment modification.

Methods and Materials

Retrospective review of all patients with non-resectable HCC treated with LC Bead LUMI™ 70-150µm (Biocompatibles, Surrey, UK) was performed. Patient demographics including ECOG, BCLC state, CP scores and tumor size were recorded. All treatments were single session, performed as outpatient with each vial loaded with 50 mg doxorubicin per vial. All patients were treatment naive. Superselective catheterization was confirmed with CBCT for tumor targeting in all cases. Tumor response was assessed with mRECIST on post procedure MRI. Technical success (TS) and adverse events (AEs) were recorded.

Results

From 2/2016-5/2016, 10 consecutive patients were treated with LC Bead LUMI™. Median tumor diameter was 2.1 cm (range 1 - 8.6 cm). Demographics are provided in Table 1. Dose vials administered included: 1(n=9) and 2(n=1). TS was 100%. Mean time to follow up was 115 days (range 49-190 days), with one patient lost to follow up. The rates of CR, PR, SD and PD were 6 (66.7%), 2 (22.2%), 1 (11.1%) and 0 (0 %), respectively. There were no AEs up to 30 days.

Conclusion

Initial use of radiopaque drug eluting beads for TACE in patients with HCC is safe with excellent short-term response rates.

103.2

Elastography: entering reality?

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Learning Objectives

1. To understand the principles of liver elastosonography
2. To learn about the results of preclinical studies about elastosonography as a tool to monitor liver ablation
3. To learn about applications of elastosonography in clinical practice

Non-invasive monitoring of percutaneous thermal ablation is essential for preventing complications while ensuring treatment efficacy. Although ultrasound (US) or computed tomography (CT) is generally used for guiding the insertion of applicators into tumours, magnetic resonance (MR) imaging is currently the only modality with validated techniques for real-time temperature monitoring [1, 2].

Elastography is a non-invasive US- or MR-based technique that is able to assess the mechanical properties of tissues. During heating, an increase in tissue stiffness that is quantitatively measurable is observed [3]. Tissue elasticity changes after coagulation have been measured using various elastography techniques, including either US-based methods such as transient elastography (TE) and acoustic radiation force impulse (ARFI) techniques or MR elastography [4]. Although MR generally provides an excellent contrast between tumour and normal tissues and can be used to monitor thermal ablation therapies, this modality is expensive and not easily incorporated into real-time guidance [5]. Thus, US-based elastography methods have drawn increasing interest in the evaluation of tissue stiffness of tumours during thermal ablation [6]. Many US-based thermal ablation monitoring techniques are under investigation; however, among those techniques, ARFI techniques are unique and can provide real-time quantitative estimation and mapping of tissue stiffness [7]. Using ARFI techniques that propagate shear waves and generate localised displacements in tissues, shear wave velocity (SWV) is measured in m/s by choosing the exact location (region of interest) of measurements under B-mode US visualisation [8].

The fundamental principle of thermal ablation monitoring using US elastography is that a heat-ablated tissue is stiffer than a normal untreated tissue. Heat-induced cell necrosis in fact results in the elevation of the elastic modulus of proteins and soft tissue, including Young's modulus and SWV. Young's modulus, which is defined by cellular and higher levels of structural organisation of tissue, is greatly affected by pathological or physiological changes in the tissue structure. The elasticity of tissues results primarily from changes in configurational entropy. In thermal ablation, the entropy of protein is increased due to heat-induced denaturation, in which the native protein structure is transformed into a more random structure [9]. Because it strongly affects the tissue structure, thermal necrosis of a tissue should result in marked changes in tissue SWV. Actually, few papers studied the thermal effects on the elastic properties of liver tissues. Broses et al. (2011) showed that the quantitative stiffness changes of heated *in vitro* tissue samples are strongly correlated with the thermal dose. However, these preliminary works did not focus on the possibility of taking advantage of the temperature dependence of SWV of tissues to provide quantitative estimates of temperature changes [3]. The most complete study was conducted by Wu et al. (2001) who identified three patterns in *ex vivo* bovine muscle: (1) a reversible decrease of SWV with increasing temperature between 20°C and 60°C, (2) an irreversible increase in SWV at around 60°C corresponding to the threshold of denaturation and (3) an increase in SWV during cooling for tissues having undergone an irreversible thermal damage. The decrease in stiffness at up to 60°C was previously explained by collagen unfolding, and the increase in stiffness above 60°C was explained by collagen denaturation [5]. It is known that protein molecules begin to

uncoil (undergo denaturation) at roughly 38°C and begin to shorten at temperatures as low as 54°C. As the tissue coagulates, water in the cells is forced out. At 77°C, the cells have shrunk as much as they can, and most of the water in the cells that can be released through tissue coagulation has been released [9, 10]. Kiss et al. (2009) previously observed the thermal changes in the complex Young's modulus of *ex vivo* canine and porcine livers at 70°C and 75°C, respectively, as assessed by mechanical dynamic compression tests [11]. The contraction of tissue and fluid loss manifests itself as an increase in the complex modulus.

To investigate how heating produces changes in liver stiffness, we designed a two-phase *ex-vivo* experimental study. A homogeneously heated sample of *ex vivo* bovine liver tissue was used in the first phase of the experiments to reduce causes of variability in the measurements and precisely investigate the relationship between temperature and stiffness changes, as quantified using SWV. In the second phase, a sample of liver tissue was heated with a microwave (MW) antenna to reproduce in the laboratory a situation similar to clinical practice. The first phase of the study was aimed to (1) quantify the temperature dependence of liver tissue stiffness, as measured using SWV, (2) identify the threshold value of SWV related to coagulation, (3) assess the reproducibility of this measurement and (4) evaluate the irreversibility of stiffness changes. The second phase was aimed to (1) confirm the SWV threshold for coagulated tissue stiffness during MW ablation and (2) determine the reliability of pSWE in delineating the boundaries of the ablation zone. The results of this experimental study will be presented [12].

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103.3

3D navigation: do we need it?

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Learning Objectives

1. To understand the reasons why navigation can be a useful tool
 2. To learn about available navigation/3D systems
 3. To discuss about results of 3D navigation-assisted ablation
- It has been demonstrated by multiple studies that the most important prognostic parameter for local tumor control after thermal ablation is the size of the lesion. Unfortunately, the local recurrence rate for CRLM > 3cm ranges from 45% to 70%. Therefore, the sole use of thermal ablation is currently recommended for liver tumors < 3cm only. Moreover, even in lesions < 3cm, local recurrence rates up to 33% have been reported after conventional image-guided thermal ablation [1]. Unsatisfactory local tumor recurrence rates require modifications of the conventional US- and CT-guided approach. The likely reason for the high recurrence rate is the discrepancy between the geometry of the tumor and that of the necrosis that is induced by RFA. It is key to three-dimensionally achieve an appropriate safety margin of approximately 1cm. Therefore, intraoperative assessment of the ablation zone, ideally by fusion of the contrast-enhanced pre- and post-ablation imaging, is required. The size of the lesion that can be successfully treated within one session depends on the ablation technique (RFA, MW, IRE, and single needle vs. multi needle), the guidance technique (conventional US/CT guidance vs. sononavigation/stereotaxy/robotic guidance), and operator experience.

The maximum short axis ablation zone diameter that can be achieved at one probe position by application of the latest thermal ablation technology is approximately 4cm [2]. Thus, only lesions up to 2cm can be treated safely by one single probe position. If larger tumors have to be treated, multiple overlapping ablation zones are required. One probe has to be repositioned or multiple probes have to be positioned in a way to produce overlapping necrotic areas to cover the entire tumor. This is barely achievable by conventional freehand US, CT, or MRI guidance, requiring a change in current tumor ablation strategies.

Stereotactic radiofrequency ablation (SRFA) [3-5]

SRFA allows for the placement of multiple RFA probes in order to achieve an overlapping ablation zone, including a sufficient safety margin. Therefore, a frameless stereotactic navigation system and an aiming device are used.

Navigation systems show the actual position of the probe with respect to cross-sectional images of the preoperative CT/MRI dataset(s) in real time. Instruments and anatomic structures are assumed as rigid bodies. The key step is the registration, during which the spatial configuration of the real patient is correlated with the pre-operative images of the patient. This is done by indicating the reference points (e.g., skin fiducials) on the patient with the probe of the navigation system and selecting the respective points on the dataset. Alternatively, light-reflecting skin markers are automatically detected by the camera of the navigation system (CASCINA). After registration, the patient and the camera can be moved with respect to each other without losing spatial information.

SRFA Procedure

After oral intubation, the patient is rigidly immobilized on the CT table by a vacuum mattress. After placement of skin markers, a contrast-enhanced helical CT scan with a slice thickness of 2–3mm is obtained with respiratory triggering. The CT data are sent to the navigation system in the CT room. Thereafter virtual planning of the 3D distribution of the RFA probes is performed. Pathways for multiple

probes are planned on the 2D and 3D reconstructions of the CT data in order to cover the whole tumor volume by overlapping necroses. Once the trajectory is planned, the path of the probe in the patient can be visualized virtually and changed according to the anatomy of the patient. The trajectories for the different RFA probes are optimized to a distance of approximately 2cm.

After sterile washing and draping, registration is performed by indicating the skin fiducials on the patient with the navigation probe, thereby assigning each fiducial its corresponding position on the reconstructed 3D dataset.

Thereafter, an aiming device is attached to the fixation system and adjusted using the navigation system for every path. One after another, coaxial needles are advanced through the adjusted aiming device to the pre-planned depth, as indicated by the navigation system. Every needle placement is performed with respiratory triggering. For verification of correct needle placement, a native CT with the needles in place is obtained with respiratory triggering and the dataset superimposed to the plan. After verification of correct needle placement by means of image fusion, a maximum of three RFA probes with an active tip of 3cm are introduced into the coaxial needles to a pre-planned depth. Thereafter, the coaxial needles are retracted in order to avoid contact of the active uninsulated tip of the RFA probe with the coaxial needle. After removal of the ablation probes, a contrast-enhanced CT scan is obtained. The control CT scan is superimposed on the planning CT scan in order to verify complete ablation of the tumor, including the safety margin.

Accuracy of stereotactic needle (probe) placement in the phantom
Accurate needle placement is crucial for the success of percutaneous radiological needle interventions. Wallach et al. [6] compared three guiding methods using an optical navigation system: freehand, using a stereotactic aiming device and active depth control, and using a stereotactic aiming device and passive depth control. For each method, 25 punctures were performed on a non-rigid phantom. Five 1-mm metal screws were used as targets. The lateral error was significantly lower when an aiming device was used (2.3 ± 1.3 – 2.8 ± 1.6 mm with an aiming device vs. 4.2 ± 2.0 mm without). Accuracy of stereotactic needle (probe) placement in the patient
Schullian et al. [7] evaluated the targeting accuracy of CT-guided stereotactic liver punctures of primary and secondary liver tumors. The median lateral error was 2.5mm (range: 0–6.5mm) at the needle entry point and 3.2mm (range: 0.01–9.4mm) at the needle tip. The median angular error was 1.06° (range: 0° – 6.64°).

Beyer et al. [8] compared stereotactic IRE (SIRE) needle placement with non-navigated conventional IRE (CIRE) for percutaneous ablation of liver malignancies in a total of 20 patients. Accuracy of needle placement for SIRE was higher than that for CIRE (2.2mm vs. 3.3mm mean deviation, $P < 0.001$). SIRE demonstrated a significantly higher accuracy compared with CIRE.

Clinical results after stereotactic thermal ablation

Colorectal liver metastases

Large colorectal liver metastases can be effectively treated by SRFA. Our group reported 98 SRFA treatment sessions of 189 CRLMs in 63 consecutive patients [9]. LR was identified in 16% of the tumors (31/189), with no significant differences ($P = 0.635$) when comparing the tumor sizes <3cm (17.7%), 3–5cm (11.1%), and >5cm (17.4%). Using SRFA, the overall survival (OS) is not affected by tumor size. SRFA achieves overall and disease-free survival (DFS) rates similar to surgical resection. The median OS from SRFA treatment was 33.2 months after a mean follow-up of 25 months (range 2–66); the corresponding 1-, 3-, and 5-year survival rates were 87%, 44%, and 27%, respectively. The median OS was significantly different when comparing unresectable and resectable patients (27 vs. 58 months, $P = 0.002$) with OS rates of 92%, 66%, and 48% at 1, 3, and 5 years, respectively, in resectable patients. Tumor size did not affect OS and DFS. Due to the favorable outcome, SRFA challenges resection as the first-line local treatment of patients with CRLM.

Intrahepatic cholangiocellular carcinomas

Seventeen inoperable consecutive patients with 52 ICCs were treated with SRFA [10]. A median OS of 60 months was achieved. The two largest tumors with diameters >10cm were completely ablated. These SRFA data of irresectable ICCs are superior to the published data on resection. SRFA is a minimally invasive alternative to resection and may be considered as the first-line local treatment for selected patients with ICCs.

Metastatic melanoma to the liver

In a recent paper, we reported the results after SRFA: 20 patients with 75 melanoma liver metastases [11]. A median number of 2 lesions (range: 1–14) per patient, with a median size of 1.7cm (range: 0.5–14.5cm), were treated. Overall, 67 lesions were <3cm (89.3 %) and 8 lesions were >3cm (10.7 %). Per patient, a median of 1 ablation session was performed (range: 1–4), totaling to 34 sessions. There were no procedure-related deaths and all major complications (n=3) could be easily treated by pleural drainages. The primary and secondary success rates were 89.3% and 93.3 %, respectively. The overall local recurrence rate was 13.3%. Four of ten local recurrences were re-treated successfully by SRFA. During follow-up, 9/20 patients developed extrahepatic metastatic disease and 10/20 had liver recurrence at any location. The median OS from the date of SRFA was 19.3 months, with an OS of 64%, 41%, and 17 % at 1, 3, and 5 years, respectively, with no significant difference between patients with cutaneous and ocular melanoma. The median DFS after SRFA for all 20 patients was 9.5 months, with 37%, 9%, and 0 % at 1, 3, and 5 years, respectively. We concluded that due to the high local curative potential and the promising long-term survival rates associated with minimal morbidity and mortality, RFA seems to be an attractive alternative to resection in patients with melanoma liver metastases. Focal liver lesions in pediatric patients

SRFA may even be a good alternative to surgical resection of focal liver lesions in pediatric patients with inherited metabolic disorders [12]. SRFA was successfully applied for the removal of single large liver adenomas in a 22-year-old woman and a 20-year-old man with glycogen storage disease type Ia and of a suspicious lesion in a 16-year-old girl with tyrosinemia type I and α -fetoprotein elevation.

Conclusion
The application of 3D planning, fusion, and navigation techniques can significantly improve the results of thermal ablation. The local recurrence rates and survival rates after SRFA are comparable to those after resection. Therefore, SRFA challenges resection as the first-line local treatment for patients with primary and secondary liver tumors.

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103.4

Cone-beam CT: a revolution?

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Learning Objectives

- To understand how cone-beam CT works
 - To learn about different clinical settings in IO where cone-beam CT can be employed
 - To learn about results of cone-beam CT assisted procedures
- Cone-beam computed tomography (CBCT) is a new imaging modality that has recently been integrated into the angiography suite and that provides 3D images in addition to conventional 2D imaging methods such as fluoroscopy and DSA [1–3]. CBCT is based on the rotational movement of a C-arm equipped with a flat panel detector around the patient. Post-treatment of acquired images results in CT-like images of vessels and soft tissues that can provide additional information during treatment. Numerous studies have evaluated the usefulness of this new imaging modality for percutaneous ablation [4, 5] and intra-arterial procedures [6] and its added value in the angiography suite.
- Imaging techniques play a crucial role in all the steps of the treatment: planning the treatment, guiding the procedure, targeting the tumor, and assessing the treatment outcome.
- Although the CardioVascular and Interventional Radiological Society of Europe (CIRSE)/Society of Interventional Radiology (SIR) protocol guidelines recommend the use of CBCT for selective TACE [3], at the moment, there is no consensus on the use of CBCT in interventional oncology of the liver [7].
- Needle placement guidance and assessment of immediate post-procedural tumor destruction represent the most important roles of imaging during ablation procedures.
- Incomplete tumor ablation may be due to poor tumor targeting and failure to confirm sufficient margins at the end of the procedure. Nowadays, most tumor ablation procedures can be guided by a US or CT scan alone or both depending on the institutions, the patient characteristics, and the experience of the interventional radiologists; MR imaging is rarely used [8]. When both modalities are used, US is usually used for initial needle placement but not ablation monitoring because of gas production during the procedure.

Contrast-enhanced US (CEUS) provides additional information for the immediate detection of residual viable tumor areas [9] but is not routinely performed in all institutions. Contrast-enhanced CT provides an accurate assessment of the ablation zone but is not immediate because the patient must be transferred in the CT suite and targeting requires increased dose deposition.

Moreover, when tumors are isoechoic and/or located in the liver dome, tumor targeting can be difficult.

Image fusion and navigation technologies were applied to improve US detection and attempt a bridge between co-registration of real-time US with CT, MRI, and/or PET volumetric scans. However, as described by Lim et al [10], mistargeting may occur in case of peripheral tumor location due to the fact that stable anatomic landmarks (e.g., large vessels) are more remote and thus more difficult to use for locating the tumor.

Liver deformation due to device insertion or patient positioning and displacement by the patient's breathing motion or heartbeat may be more apparent in the peripheral liver than in the central liver. This affects the accuracy of the co-registration between pre-acquired tomographic images and real-time US.

The lack of direct assessment of ablation device positioning and consequent ablation zone with the techniques described has driven the exploration of the value of CBCT imaging, either as a primary image guidance modality or to augment US-guided liver tumor ablation. Therefore, CBCT has been proposed as an alternative technique in this setting for real-time needle guidance, sometimes associated with fusion imaging.

Morimoto et al [4] performed CBCT angiography following injection of a bolus of contrast into the proper hepatic artery. 3D images were post-processed and registered on fluoroscopic images. On the basis of software manipulations, the authors automatically calculated the best needle path by indicating both the skin entry point and the center of the target lesion. The software also computed the necessary C-arm angulation for real-time visualization of the progression of the needle along the virtual path on the fluoroscopic images. A technical success rate of 100% was reported [4].

In others studies, unenhanced CBCT and similar post-processing software for targeting was used, reporting a high technical success [8].

Assessment of the ablation zone and margins (at least 5 mm) represents the primary outcome after an ablation procedure to ensure tumor coverage. The most common risk factors for local tumor progression are tumor size, proximity to a major vessel, subcapsular location, and an insufficient ablative safety margin [11, 12]. The latter factor seems to play a major role because significant agreement (86.8%) was found between the exact sites of local tumor progression and an insufficient ablative margin [13].

Some studies have hypothesized that CBCT could be used to assess effective ablation and be an interesting alternative to MDCT in combination with US, especially in centers in which CT is not immediately available. Interventional radiology image acquisition requires intravenous injection of the contrast agent and synchronized acquisitions of CBCT after a delay similar to CT during portal venous or delayed phases (60–120 s). Iwazawa et al compared periprocedural CBCT and MDCT performed 3–7 days after the procedure and reported a sensitivity and specificity of 90% and 96.4%, respectively, for detecting insufficient safety margins; they concluded that CBCT and MDCT were nearly equivalent [5, 11]. Abdel-Rehim et al [12] evaluated the accuracy of contrast-enhanced CBCT in assessing the ablation zone compared to 1–2 months post-procedural contrast-enhanced MDCT, reporting an excellent correlation between ablation zone volumes with both techniques.

The utility of combining intravenous contrast-enhanced CBCT with ultrasound guidance to plan, implement, and iteratively modify and optimize probe positioning during hepatic tumor ablation was also evaluated by our group. The high rate of needle repositioning when

US was used as primary guidance modality warrants further exploration in larger randomized studies and comparisons with other techniques, including arterial injection contrast-enhanced CBCT, post-procedural contrast-enhanced CBCT, US-CT image fusion, and conventional CT-guided tumor ablation.

The radiation exposure associated with CBCT has been evaluated in several studies [8,14]. Although CBCT has been shown to increase abdominal dose levels, as compared with DSA or MDCT, it also changes the way the procedure is performed, which may compensate for this slight increase. A case-by-case evaluation of the benefit-risk ratio should be performed in all patients.

In conclusion, CBCT produces periprocedural 3D CT-like images providing additional information for planning the treatment, guiding the treatment, and assessing the treatment response for percutaneous procedures. On the basis of literature data, CBCT results in substantial modification of treatment in a significant number of cases. In addition, performance of liver ablation in the angiographic suite with US and CBCT guidance allows the management of complications without the need to move the patients to other rooms; this approach also allows the use of CT and US suites primarily for diagnostic examinations, optimizing the efficiency and use of the available resources and staffing.

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Special Session Lower GI bleeding

104.1

Work-up and patient selection

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Learning Objectives

1. To learn about clinical features of lower GI bleeding
2. To learn about strategies for work-up of patients with lower GI bleeding
3. To learn about optimal technique and imaging features of CT for lower GI bleeding

Traditionally, lower gastrointestinal bleeding (LGIB) has been defined as bleeding from a source distal to the ligament of Treitz. Currently, bleeding from the small intestine is considered a more distinct entity and LGIB is considered to be related to bleeding from the distal ileum, colon and rectum. Acute LGIB accounts for approximately 20% of the patients with GI bleeding with an annual incidence of 20–87/100,000. The incidence increases with age, mostly due to the increasing incidence of diverticulosis.

Causes for LGIB include haemorrhoids, anal fissures, rectal ulcers, radiation proctitis, diverticulosis, colorectal neoplasms/polyps, angiodysplasia, inflammatory bowel disease, ischaemic colitis and polypectomy. LGIB often stops spontaneously (in 80%–85% of patients) and has favourable clinical outcome. However, especially in the elderly, overt LGIB may cause significant morbidity and mortality.

A patient with overt LGIB generally presents with haematochezia, but those with severe upper gastrointestinal bleeding (UGIB) may also present with red blood per anum. In approximately 15% of patients with haematochezia, the source of bleeding is the upper GI tract.

To determine the severity and possible location in a patient with acute GI bleeding, the evaluation of the patient should include good history-taking, physical examination and laboratory investigations. In patients with haematochezia and haemodynamic instability, UGIB should be considered and upper endoscopy should be performed.

Based on haemodynamic instability and other factors, such as age and comorbidity, risk assessment should be performed to determine the appropriate diagnostic and therapeutic strategy, with haemodynamic resuscitation being the first treatment step if needed.

The correction of anticoagulation is essential in the treatment of LGIB along with the correction of INR and low platelet count in a multidisciplinary approach for each individual patient after taking thromboembolic risks into account. Direct oral anticoagulants (DOAC) also increase the risk of GI bleeding. In patients with normal renal function, the half-life of DOACs is short, and by withholding them, coagulant function rapidly returns to normal. However, specific reversal agents, such as idarucizumab and andexanet alfa, for these drugs are now available.

In patients with suspected LGIB, colonoscopy is the first choice but only after adequate colon cleansing. Without adequate colon cleansing, colonoscopy has very limited value. Rapid cleansing

with colonoscopy within 24 h is possible for high-risk patients. Colonoscopy offers a high diagnostic yield combined with therapeutic options.

Angiographic embolisation should be performed in patients with severe ongoing bleeding and haemodynamic instability if there is no time for rapid colon preparation and colonoscopy. The American Collage of Gastroenterology has recommended an initial upper endoscopy in these patients to exclude UGIB before angiography or CT angiography. Performing CT angiography before the angiographic procedure is recommended. CT may identify less likely origins of haematochezia in the upper GI tract of the small intestine. Angiographic embolisation can also be considered in patients with recurrent bleeding after colonoscopy.

A three-phase CT examination comprising unenhanced, arterial and portal venous phases of the entire abdomen is generally considered best for evaluating acute LGIB. The scan should be performed without oral contrast. Positive oral contrast may obscure bleeding, and water may dilute contrast extravasation. CT angiography has excellent sensitivity and can detect bleeding that exceeds the rate of 0.3–0.5 ml/min. Active bleeding appears on the CT scan as an intraluminal contrast blush in the arterial phase and with changing appearance of the hyperattenuating area in the portal venous phase. Hyperattenuating blood clots on the unenhanced CT are a sign of recent bleeding. Combining the three phases of CT and paying attention to the changing appearance of contrast extravasation between arterial and portal venous phases is essential for interpreting CT results. Multiplanar post-processing and maximum intensity projection can help to determine vascular anatomy and are very useful for planning a radiological intervention and for reducing interventional procedure time.

In recent studies, dual-source dual-energy CT angiography has been propagated to detect active GI bleeding. Using virtual unenhanced images can reduce radiation dose, and iodine mapping can potentially increase the sensitivity.

The detectable rate of active bleeding is slightly higher for catheter angiography (0.5 ml/min) than for CT angiography. Therefore, in patients with a negative CT scan, catheter angiography will most likely not reveal the source of bleeding. In case of a negative CT scan in a patient that presented with overt LGIB and hemodynamic instability, the bleeding has most likely stopped, but one should be alert for intermittent bleeding.

Technetium-99m-labelled red blood cell (RBC) scintigraphy can detect a low bleeding rate of 0.1 ml/min, and repeating scans after one initial injection is possible. Therefore, this technique is more suitable for intermittent and obscure bleeding. In general, it is not easily available in emergency situations and is less accurate in identifying the bleeding source compared with CT. Compared with RBC scintigraphy, CT angiography offers the advantage of potentially identifying the cause of bleeding.

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104.2

Technique and embolic agents

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Learning Objectives

1. To learn about the use of different embolic agents for embolisation of lower GI bleeding
2. To learn about pros and cons of different embolic agents for embolisation of lower GI bleeding
3. To learn tips and tricks for optimal use of the different embolic agents for lower GI bleeding

Lower gastrointestinal bleeding (LGIB) is defined as a bleeding distal to the ligament of Treitz, and it accounts for approximately 1/3 of the cases of GI bleeding. The most frequent aetiology is diverticulosis, whereas tumours, inflammatory diseases, angiodysplasia and other causes are less frequent (1,2). If LGIB is suspected, further interdisciplinary evaluation should be determined based on the clinical presentation. Endoscopy, capsule endoscopy and double balloon endoscopy can be used for evaluation and partially treatment. Imaging tools for further evaluation include computed tomography (CT), radionuclide red cell labelling and digital subtraction angiography. The sensitivity of angiography can be increased by provocative angiography using vasodilators/anticoagulation.

Embolisation is usually indicated if medical and endoscopic treatments fail or are not possible. Contraindication for embolisation in significant LGIB is only relative. Morbidity and mortality associated with embolisation is low compared with those associated with surgery. Clinical management includes supportive therapies, such as volumotherapy, and correction of coagulation disorders. Anaesthesiology or ICU support is often necessary in acute LGIB. Even if the bleeding source has been identified prior to an intervention, the quality of intraprocedural imaging is a key component of a successful procedure. Intraprocedural cone-beam CT and guidance techniques can facilitate superselective catheterisation for embolisation (3). A stable embolisation position should be established using a suitable combination of sheath, guiding catheter, catheter and/or microcatheter. Different types of coils, liquid embolic agents and particles have been used for embolisation and should be chosen carefully depending on the embolisation strategy (4-6). The use of vasoconstrictors has been reported. Methylene blue can be used to mark a bowel loop for surgery if embolisation is not possible. In the literature, outcome in terms of technical success and recurrence/ischaemia rate is generally favourable but varies in detail depending on clinical and technical aspects (7,8).

In this presentation, the current data on the technical aspects of LGIB embolisation, including those on embolisation strategy, catheterisation techniques and embolic agents, is reviewed.

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104.3

Outcomes of embolisation

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Learning Objectives

1. To learn about results of embolisation of lower GI bleeding
2. To learn about complications of embolisation for lower GI bleeding
3. To learn about factors predicting the outcome of embolisation for lower GI bleeding

How about the big picture?

Lower gastrointestinal bleeding (LGIB), i.e., bleeding distal to the ligament of Treitz, has an incidence of up to 87/100,000. Patients are usually elderly with substantial comorbidity. The panorama ranges from self-limiting lesions to life-threatening cases, including those with transfusion, embolotherapy, and open surgery.

How about technical and clinical success after embolotherapy?

Technical and clinical success of embolization with microcatheter technology is approximately 100% and 90%, respectively.

How about recurrence after treatment?

The recurrence of bleeding after interventions is approximately 15%. Uncorrected coagulopathy might partially be the reason for recurrence during the first few days after embolization. However, studies have indicated that clinical ischemic bowel complications do not increase if a reintervention is performed.

Which lesions are the most successful to treat and which are not?

Common sources of bleeding are diverticula, polyps, and hemorrhoids. The treatment of diverticular bleeding has been reported with a success range of 85%–97%, whereas angiodysplasia is more challenging to treat. The rate of rebleeding in the latter group is reported to be up to 40% in limited datasets.

How about complications after treatment?

Complications include groin hematoma, arterial dissections, and contrast-induced renal impairment. More specific complications are non-target embolizations with the risk of bowel necrosis. Complications may occur even by experienced hands and with superselective embolization techniques.

Will microsystems help to minimize complications?

Whether the catheter is in the target vessel or in its vicinity needs to be verified using contrast injection. Which embolic material

should be used? Many options may be present to consider. "Time," "coagulopathy," "difficulty in using the material," "technical skills," and "catheter position and bleeding point" should also be considered. Knowing what is available is also essential. What is best for this patient? What can be done? There should be a balance between more proximal and "safe" embolization, which lowers perfusion pressure in the bleeding area, with a more effective but risky distal embolization. The latter might cause ischemic damage in the target area. Embolization in general might cause target organ ischemia, and superselective embolization that helps avoid complications should be performed.

What are the rates of complications after treatment?

Most post-embolization ischemic complications have no clinical significance. The signs of ischemia can include self-limiting abdominal pain, which correlates with serum lactate levels. Bowel infarction is rare but has been observed in 0%–20% of patients.

How about surgery?

Surgery is less frequently performed in patients with LGIB than in those with upper GI bleeding. In general, surgery with an open intervention is performed only if no treatment has succeeded because of the associated morbidity and mortality.

Can outcome of embolization for LGIB be predicted?

Risk stratification to define high- and low-risk patients with LGIB is difficult and requires more research. The results in literature are limited by considerable variations in criteria for discharge and in the type of endotherapy. For more information, please refer to the recently published article on the study on LGIB in UK (1).

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104.4

Haemorrhoid embolisation

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Learning Objectives

1. To learn about the principles and concepts of haemorrhoid embolisation
2. To learn about the results and outcomes of haemorrhoid embolisation
3. To learn about potential complications of haemorrhoid embolisation and how to avoid them

Hemorrhoidal disease is the most common anorectal condition, with a prevalence of 4%–35%. One of its main chronic symptoms is rectal bleeding. Its recurrence can alter the quality of life and can, more rarely, cause anemia. Pain is less common, occurring only in the event of a complication (congestive exacerbation, external hemorrhoidal thrombosis, and fissures). The most common treatment involves hygiene and dietary measures, phlebotonics, and/or non-surgical outpatient treatment (infrared photocoagulation and elastic band ligation).

The hemorrhoidal arteriovenous network is a normal vascular formation. There is a clear distinction between the external hemorrhoidal network below the dentate line (under the skin of the anal margin dependent on the pudendal artery, which is a branch of the inferior rectal artery) and the internal hemorrhoidal network located in the upper part of the anal canal above the dentate line (in the submucosal space depending on the superior rectal artery).

Internal hemorrhoids are now considered to result from an increase in arterial blood flow from the superior rectal artery into the hemorrhoidal cushion (corpus cavernosum recti) (1). The replacement of muscle tissue by connective tissue causes an expansion of the vascular network of the anorectal submucosa, initiating a negative vicious

circle of progressive vascular dilation and venous insufficiency leading to hemorrhoidal hyperplasia. This hyperplasia causes an increase in blood pressure, arterial inflow, and anal pressure in the corpus cavernosum recti. The lower part of the rectum and the anal canal are known to be supplied with blood by the inferior and middle rectal arteries, both of which have origins (pudendal artery and iliac network, respectively) at some distance from the inferior mesenteric artery (2). By contrast, the mechanical function of the corpus cavernosum recti is dependent on the influx of arterial blood from the branches (superior rectal arteries) of the inferior mesenteric artery.

Ten years ago, proctologists developed a new type of treatment: elective transanal Doppler-guided hemorrhoidal artery ligation (DG-HAL). DG-HAL technique involves the identification and ligation of the superior rectal arteries under transanal Doppler guidance. The ligation of the superior rectal arteries provides a significant reduction in the arterial blood flow to the hemorrhoid and is effective in treating hemorrhoidal disease (3).

It was feasible that this technique could be compatible with embolization. Thus, we have previously reported that arterial ligation can be performed with coils in the terminal branches of the superior rectal arteries via the endovascular route (4).

The advantages of Emborrhoid and DG-HAL techniques over surgery are that it maintains the hemorrhoidal tissue in place, preserves anal continence without rectal wounds (no local care), causes significantly less pain, and avoids the complications of open surgery, thus allowing a faster return to activity.

"Emborrhoid" embolization is performed using the right femoral route. The inferior mesenteric artery is catheterized using a Simmons catheter. The superior rectal arteries are then catheterized using a microcatheter. Coils used for the embolization are 0.018-inch long, with 2–3 mm in diameter.

Technical success of the Emborrhoid technique has been reported in up to 90% of patients. Clinical success of the Emborrhoid technique has been reported in 74%–83% of patients with no complications (2, 5).

The main advantages of the Emborrhoid technique are as follows:

Patients feel absolutely no pain.

No major complication, especially no ischemic or continence complication, is related to the Emborrhoid technique.

This technique is available for outpatients.

Patient can return to activity the day after embolization.

Embolization allows a complementary treatment if essential.

The technique can be easily performed within an hour.

Endovascular treatment offers many benefits, including the complete visualization of all branches of superior rectal arteries and anastomoses with middle and inferior rectal arteries (6). Using the DG-HAL technique, all arteries may not be detected, which can lead to incomplete treatment especially if anastomoses are present.

Embolization eliminates the risk of direct anorectal trauma.

The results of our previous study (7) have confirmed the favorable clinical results of previous studies and have also objectively demonstrated that at 1 month after embolization, hemorrhoidal bundles significantly decrease in size; that embolization particles do not cause ischemia in histology; and that the sphincter exhibits a normal physiology 1 month after embolization.

We hypothesized that embolization is more effective with particles because they cause a more distal hemorrhoidal plexus embolization, thereby restricting the superior rectal arteries reloads by the middle rectal arteries.

A randomized controlled study is warranted for confirming the benefits of this technique.

Many patients suffer from hemorrhoids but do not complain to physicians because they do not wish to have an endorectal treatment. We believe that if a pain-free treatment for this condition is offered to outpatients, more patients will seek treatment.

Given the preliminary results reported in our studies, we believe that there is sufficient evidence to include embolization in therapeutic options for patients with bleeding related to hemorrhoidal disease. We have demonstrated that distal coil embolization of superior rectal arteries to stop chronic bleeding is safe and effective.

The results of our previous study (7) have demonstrated that embolization of superior rectal arteries with particles does not lead to ischemia. Particle embolization leads to more distal embolization of the hemorrhoidal plexus, lower than the anastomoses with the middle rectal arteries. New embolic agents may provide an opportunity for the development of the Emborrhoid technique.

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Controversy Special Session

Controversies in endovascular therapy

201.1

Drug-coated balloons (DCB) as an all-comers therapy: PRO

G. Tepe

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Learning Objectives

1. To learn the designs of the drug-eluting balloon trials in the popliteal artery
 2. To learn the current role of drug-eluting balloons in the popliteal artery
 3. To learn outcomes following DCBs in the popliteal artery
- There is no single treatment in endovascular therapy that has generated such a broad clinical database as drug-coated balloon (DCB) therapy for femoro-popliteal disease. In the first step, most DCBs have been tested on TASC A and B lesions against plain balloon angioplasty. Nevertheless, there are currently all-comers studies available which reflect the daily clinical reality. It has been shown

that all lesions including long lesions, total occlusions, and calcified stenosis benefit from DCB treatment. In a recently published multivariate analysis, the only predictors that reduced the effectiveness of DCBs were CLI and a lower dose of drug coating. This suggests that conventional treatment with no drug delivery has a higher restenosis rate. On the other hand, because no major side effects which can be attributed to DCBs have been described, a patient not being offered local drug treatment for the prevention of restenosis cannot be justified. This makes DCB an all-comers therapy.

201.2

Drug-coated balloons (DCB) as an all-comers therapy: CON

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Learning Objectives

1. To learn the designs of the drug-eluting balloon trials in the popliteal artery
2. To learn the current role of drug-eluting balloons in the popliteal artery
3. To learn outcomes following DCBs in the popliteal artery

The only drug available for drug-coated balloons (DCBs) is paclitaxel, which is a cytostatic drug. Paclitaxel delivered at the site of angioplasty initiates local apoptosis, long-lasting vessel wall necrosis, inflammation, and subsequent diminished local anticoagulation protection. Due to this local cytostatic action, the neointimal hyperplasia is blocked for some time. This blockage results in a better local vessel patency. However, in patients with intermittent claudication, which are the body (often more than 90%) of the studied patients, local vessel patency is often not directly related to the clinical outcome beyond 12 months. Intermittent claudication is a multifactorial disease in which SFA stenosis plays a role, which remains unclear. This is best illustrated by the fact that supervised exercise training (SET) has the same clinical outcome after 12 months as local PTA. No vessel, however, reopens during SET. Therefore, as long as a superior clinical benefit of DCBs has not been proven in a well-conducted randomized trial, standard PTA will be the first choice. There might be an exception for early restenosis after PTA, but this indication is more experimental than evidence based. Although using the word POBA (plain and old) for this technique makes it seem linguistically proven to be outdated and inferior, scientifically, standard PTA is still the first choice.

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201.3

Stent graft is the technique of choice for treatment of popliteal aneurysms: PRO

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Learning Objectives

1. To learn the designs of the stent graft trials for popliteal aneurysm treatment
2. To learn the current role of stent grafts for popliteal aneurysm treatment
3. To learn outcomes following stent grafts for popliteal aneurysm treatment

No abstract available.

201.4

Stent graft is the technique of choice for treatment of popliteal aneurysms: CON

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Learning Objectives

1. To learn the designs of the stent graft trials for popliteal aneurysm treatment
2. To learn about the current role of stent grafts for popliteal aneurysm treatment
3. To learn outcomes following stent grafts for popliteal aneurysm treatment

No abstract available.

201.5

Catheter-directed thrombolysis or pharmaco-mechanical thrombectomy always for ilio-femoral DVT: PRO

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Learning Objectives

1. To learn about the devices which can be used for ilio-femoral thrombolysis
2. To learn about differences in clinical results after ilio-femoral thrombolysis and conservative treatment
3. To learn about the possible drawbacks of ilio-femoral thrombolysis

No abstract available.

201.6

Catheter-directed thrombolysis or pharmaco-mechanical thrombectomy always for ilio-femoral DVT: CON

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Learning Objectives

1. To learn about the devices which can be used for ilio-femoral thrombolysis
2. To learn about differences in clinical results after ilio-femoral thrombolysis and conservative treatment
3. To learn about the possible drawbacks of ilio-femoral thrombolysis

No abstract available.

Fundamental Course

Therapy of variceal bleeding (TIPS and BRT0)

202.1

Indications for TIPS in variceal bleeding

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Learning Objectives

1. To understand pathophysiology and prognosis of oesophageal and gastric variceal bleeding
2. To learn about strategy in management of patients with variceal bleeding
3. To learn about current indication criteria for TIPS in acute and recurrent variceal bleeding

Variceal bleeding is a major cause of death in patients with cirrhosis. Treatment depends on the stage of the disease with a potential indication of TIPS in acute bleeding and in the secondary prophylaxis of rebleeding. In case of acute bleeding, TIPS increases survival in patients with a high risk of early rebleeding. These patients are defined by a greater portosystemic pressure gradient or by their Child-Pugh class and presentation at endoscopy. Thus, compared with medical treatment, TIPS doubled survival from 35% to 70% in patients with a pressure gradient of >20 mmHg (1) and improved survival from 60% to 90% in patients with Child-Pugh class B and active bleeding at endoscopy or Child-Pugh class C (2). Interestingly, HE was not different during a follow-up of 2 years. With respect to secondary prophylaxis, results of more than 10 randomized studies with bare stents did not show a survival benefit of TIPS (3). This was recently confirmed by 2 studies using covered stents. A German multicenter study implanted 8-mm Viatorr stents together with the option of variceal embolization (4). A Dutch study implanted 10-mm Viatorr stents with additional embolization in 24% of patients (5). Although rebleeding rates were higher in the medical groups, survival was not different. In addition, hepatic encephalopathy increased significantly by TIPS. These studies clearly demonstrate that early (within 1–4 days after bleeding) but not delayed TIPS implantation has a positive effect on survival. If patients are stabilized without having had an early rebleed, TIPS cannot prolong survival, although it effectively prevents rebleeding. Obviously, during long-term follow-ups after the index bleed, most patients die from causes other than variceal bleeding; therefore, prevention of variceal bleeding seems to play a secondary role. This explains the recommendation of using TIPS as the secondary prophylaxis only if patients fail medical treatment (6).

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202.2

Adjunctive embolotherapy of variceal bleeding in TIPS

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Learning Objectives

1. To learn about angiographic anatomy of gastro-oesophageal varices
2. To learn about indications and various techniques for gastro-oesophageal varices embolisation
3. To review results of variceal embolisation as an adjunctive therapy in the literature

Takase et al (1) studied the relationship between the embolization range and rebleeding rate by performing percutaneous transhepatic portography before and after endoscopic sclerotherapy. They found that embolization of both esophageal varices and their feeder vessels is essential in lowering the recurrence rate after sclerotherapy. The data from our angiographic follow-up study (2) support the findings of Takase et al (1). Majority of our patients had shunt stenosis with recurrence of portal hypertension, but the patients who had originally undergone embolization during angiography seldom demonstrated a filling of collateral vessels, and these patients were free of rebleeding in most cases. The long-term rebleeding rate after 4 years in patients undergoing TIPS in combination with adjunctive embolotherapy of gastroesophageal collateral vessels was only 19% in comparison with 47% in patients undergoing TIPS creation alone, and this difference was statistically significant (2). Our data analysis showed an independent overall effect of variceal embolotherapy on rebleeding ($P < .001$).

A meta-analysis to compare the incidence of shunt dysfunction, variceal rebleeding, encephalopathy, and death between patients treated with TIPS alone and those treated with TIPS combined with variceal embolization was conducted in a study by Qi et al (3). Six articles were included in the study. Types of stents were covered ($n = 2$), bare ($n = 2$), mixed ($n = 1$), and unknown ($n = 1$). Varices were angiographically embolized by coils in six studies. Additional liquid agents were employed in three studies. Compared with the TIPS alone group, the TIPS combined with variceal embolization group had a significantly lower incidence of variceal rebleeding (OR 2.02, 95% CI 1.29–3.17, $P = 0.002$) but a similar incidence of shunt dysfunction (OR 1.26, 95% CI 0.76–2.08, $P = 0.38$), encephalopathy (OR 0.81, 95% CI 0.46–1.43, $P = 0.47$), and death (OR 0.90, 95% CI 0.55–1.47, $P = 0.68$). The authors conclude that adjunctive variceal embolization during TIPS procedures might be beneficial in the prevention of variceal rebleeding. A further remarkable conclusion in this study was that only 2 of the 6 studies they included had a high study quality (2, 4); thus, they recommend additional well-designed randomized, controlled trials with a larger sample size and use of covered stents to confirm these findings.

Our data and analysis of literature suggests that the combination of treating portal hypertension (TIPS) and adjunctive embolotherapy of gastroesophageal collateral vessels significantly lowers the rebleeding rate in comparison with TIPS alone.

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202.3

Balloon-occluded retrograde transvenous obliteration for the management of gastric varices

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Learning Objectives

1. To learn about anatomy of gastric varices relevant to BRTO
2. To learn about indications and technique in acute and recurrent gastric variceal bleeding
3. To learn about results and complications

Because most gastric varices drain into the inferior phrenic vein, which later joins the left renal vein to form the gastrosplenic shunt (GRS) (80%–85% of cases) or the inferior vena cava just below the diaphragm to form the gastrocaval shunt (GCS) (10%–15% of cases), transvenous obliteration of gastric varices can be performed.

The basic clinical indications for BRTO are gastric variceal bleeding (impending, prior, current, or active) and hepatic encephalopathy. The relative contraindications include uncorrected coagulopathy associated with liver failure, segmental portal hypertension due to splenic/portal vein thrombosis, and uncontrolled esophageal variceal bleeding. Before BRTO, planning MDCT or MRI is performed to identify the target varicose veins and portosystemic shunt and to verify the patency of possible venous approaches. After advancing a balloon catheter into GRS/GCS through the jugular or femoral vein, venography under balloon inflation at GRS is performed. When the entire gastric varices are revealed, sclerosant agents can be injected. If not, a catheter should be advanced deeper into GRS/GCS or small retroperitoneal collaterals (azygos, hemiazygos, ascending lumbar, cardiophrenic veins, etc.) should be obliterated using coils or a small amount of sclerosant until the target varices appear (downgrading technique). The patient's habitus change is also sometimes useful. As a sclerosant agent, liquid ethanolamine oleate has been traditionally used, although it may cause hemolysis and require haptoglobin to prevent renal failure. The authors succeeded in reducing the complications by introducing foam povidone-iodine (3%) diluted 5 times by air after replacing blood by CO₂ on venography. US has developed BRTO using foam STS with lipiodol. C-arm CT is very useful to confirm the sclerosant into the target varices during BRTO. To prevent spillage of sclerosant into systemic vein, indwelling of the balloon catheter for several hours has been recommended, although it is a burden for the patient and has a potential risk of infection and logistic problems. Now, vascular plugs or glue can be applied instead of long inflation of a balloon catheter.

Portal decompression with TIPS alone is reported to control bleeding from gastric varices in 50%–63% of cases, whereas BRTO is reported to control bleeding in 87%–100%. The relapse rate is also very low (0%–10%). However, catastrophic complications, including shock, hemolysis, renal tubular dysfunction following hemoglobinuria, and ARDS, are reported after the administration of ethanolamine oleate. Using foam, the net doses of sclerosant can be reduced, leading to less hemolysis and intravascular coagulation. Hemoglobinuria is also rarely observed despite no use of haptoglobin. Aggravation of portal hypertension is more or less inevitable by BRTO.

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202.4

TIPS versus BRTO for the management of gastric varices

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Learning Objectives

1. To learn about possible failure and complications of TIPS and BRTO and relevant results of these methods in variceal bleeding management
2. To review contradictions in the literature on variceal bleeding control between TIPS and BRTO
3. To learn when to prefer BRTO over TIPS

Creation of TIPS is commonly used to manage bleeding gastric varices (GV), with reported low rebleeding rates. A BRTO procedure has been described as an alternative treatment method for the management of bleeding GV, especially for varices in the gastric fundus or cardia, which are often associated with spontaneous gastrorenal shunts.

A few studies have compared the effectiveness of TIPS and BRTO in treating gastric varices. In general, TIPS is preferred when patients have associated high-risk esophageal varices (EV), ascites, or hydrothorax. In these cases, portal hypertension decompression is the preferred method. However, simply embolizing the inflow of the shunt

with coils or plugs may not be sufficient because GV may recruit additional inflow veins to maintain the patency of varices. It has also been shown that GV bleed at a lower pressure than EV. Thus, for patients with GV and a gastroduodenal shunt, it is recommended to embolize the entire varix with a sclerosant rather than simply embolizing the inflow vein. This can be done through an antegrade approach using TIPS or by performing a simultaneous or subsequent BRTO.

BRTO is recommended to obliterate GV in patients with isolated GV (i.e., no EV, ascites, or hydrothorax) or encephalopathy. The rebleeding rate is equivalent between both procedures, with less incidences of encephalopathy when performing a BRTO procedure. It is worth noting that patients will have sequelae of worsening portal hypertension after BRTO. Thus, close surveillance of EV with endoscopy is recommended. In addition, approximately 7%–10% of patients will have significant ascites or hydrothorax requiring TIPS placement after BRTO.

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Special Session Therapies for HCC based on size criteria

203.1

Surgical options and realistic need

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Learning Objectives

1. To learn about suitable surgical techniques
2. To understand indications and contra-indications for resection and LTX within and beyond BCLC
3. To learn about the outcome of surgery in comparison to other therapies

No abstract available.

203.2

IO in small tumours

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Learning Objectives

1. To learn about suitable ablative techniques
2. To understand indications and contra-indications for ablation within and beyond BCLC
3. To learn about the outcome of ablation in comparison to other therapies

If liver transplantation in patients with small HCC is not possible, alternative curative therapies, namely thermal ablation and surgical resection, can be performed. Although surgery provides better disease free survival, overall 3- and 5-year survivals are similar between surgery and minimally invasive ablation. However, this conclusion does not reflect the complexity in decision-making for patients with very early or early HCC. The main predictive factors for similar results between surgery and ablation are the size of the tumor (in favor of surgery) and the liver function (in favor of ablation). Depending on expertise and technical aspects, complete treatment of HCC may be achieved with ablation, with a maximum size ranging from 2 to 3 cm or even up to 5 cm if ablation is combined with transarterial chemoembolization. However, other important factors, such as comorbidity of the patient with cirrhosis, location of the HCC in the liver, compliance of the patients, and the possibility of patient follow-up by the physician, influence the clinical results, with one advantage of ablation being the repeatability of the treatment. Patients with HCC are the best example for a systematic presentation and discussion in an interdisciplinary liver tumor board. In addition, at centers specializing in interventional oncology, advantages of ablation, such as minimal invasiveness, low complication rates, and the possibility to repeated ablation in case of a new HCC or even relapse, play important roles in the final decision.

203.3

IO in intermediate sized tumours

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Learning Objectives

1. To learn about suitable ablative techniques
2. To understand indications and contra-indications for ablation within and beyond BCLC
3. To learn about the outcome of ablation in comparison to other therapies

Hepatocellular carcinoma (HCC) represents one of the few cancers for which locoregional treatments are considered useful in curing and/or prolonging survival, which is included in international guidelines (1-3). This is due to the unique nature of HCC that manifests in most patients with underlying virus- or alcohol-related cirrhosis. Therefore, treatment choice in patients with HCC is based not only on tumour staging, as in the great majority of cancers, but also on the careful evaluation of liver function and physical status. Another specific feature of HCC is that it is the only tumour that can be cured by organ transplantation, with the aim of treating both cancer and underlying liver disease (1-3). These characteristics configure a complex scenario and prompt the need for close cooperation among interventional oncologists, surgeons, hepatologists and anaesthesiologists.

Decision-making for the treatment of HCC is supported by guidelines endorsed by the following societies worldwide: European Association for the Study of the Liver (EASL) and the European

Organisation for Research and Treatment of Cancer, American Association for the Study of Liver Diseases (AASLD), Asian Pacific Association for the Study of Liver, and Korean Liver Cancer Study Group and the Japan Society of Hepatology (1-5). Differences in recommendations among guidelines mirror the differences in cancer epidemiology, techniques availability and expertise in various countries.

The Barcelona Clinic Liver Cancer (BCLC) classification has emerged during recent years as the standard classification that is used for the clinical management of patients with HCC (6,7). This classification links stage stratification with a recommended treatment strategy and defines the standard of care at each tumour stage. It has been endorsed by an EASL panel of experts and the AASLD guidelines (1,2). According to the BCLC staging system, refined in 2016, image-guided tumour ablation is recommended in patients with very early- and early-stage HCC (7). Despite the widespread implementation of surveillance programmes, more than half of the patients with HCC are diagnosed late, when curative treatments cannot be applied. In addition, in a high proportion of patients, the disease recurs after a curative therapy. For patients presenting with multinodular HCC and relatively preserved liver function, the absence of cancer-related symptoms, and no evidence of vascular invasion or extrahepatic spread, i.e. patients classified as having intermediate-stage HCC according to the BCLC staging system, transcatheter arterial chemoembolisation (TACE) is the current standard of care. Although antitumour activity and promising survival results have been reported in cohorts of patients with advanced HCC treated with radioembolisation, systemic treatment with the multikinase inhibitor sorafenib is still recommended for such patients (1,2,7).

Patients with solitary intermediate-sized HCC (3-5 cm), even if not specifically categorised by current guidelines, can be considered as a specific subset of patients early-stage HCC. The tumour size make ablation alone unlikely to be a radical treatment with current techniques, but theoretically, TACE does not represent a treatment option at this stage. When clinically significant portal hypertension and abnormal bilirubin levels contraindicate surgical treatment, a combination of TACE followed by RFA has been used to minimise heat loss due to perfusion-mediated tissue cooling and increase the therapeutic effect of RF ablation (8). The results of a recent meta-analysis have shown that RFA plus TACE significantly improve the overall 1- and 3-year survival rates compared with those by RFA alone in patients with a single HCC of >3 cm (9). TACE with drug-eluting beads has also been performed after an RF ablation procedure to increase tumour necrosis by exposing the peripheral part of the tumour to high drug concentration, whereas only sub-lethal temperatures may be achieved in a standard RF ablation treatment (10). Further research to determine optimal methods of combining chemotherapeutic regimens (both agent, route of administration, time interval between TACE and RFA or vice versa) with RF ablation is needed. It has been suggested that a single-step 'combined' approach, with both procedures performed in the same session, enables the achievement and amplification of the synergistic effects of RFA and TACE (11). Moreover, initial reports have suggested that with the use of current MWA devices, percutaneous ablation of HCCs of up to 5 cm can be achieved with high efficacy (12,13).

Researchers and companies are also exploring new strategies for increasing the results of ablation. A phase III, randomised, double-blinded, placebo-controlled study (HEAT trial) investigating the efficacy and safety of lyso-thermosensitive liposomal doxorubicin in combination with RFA compared with those of RFA alone in the treatment of non-resectable HCC has recently been completed (14). When heated to $\geq 40^{\circ}\text{C}$ during an RFA procedure, lyso-thermosensitive liposomal doxorubicin produces high drug concentration in the surrounding margins of the ablation zone. RFA plus lyso-thermosensitive liposomal doxorubicin did not improve the efficacy of normal practice RFA. However, among the 285 patients with a solitary lesion who received at least 45-min RFA dwell time, the hazard ratio

for overall survival was 0.63 (95% CI: 0.41–0.96; $p = 0.04$) (49). The OPTIMA study is currently ongoing to test the hypothesis that adding lyso-thermosensitive liposomal doxorubicin to a standardised RFA lasting ≥ 45 min increases survival compared with that by standardised RFA alone (15).

Patients with large solitary tumours (>5 cm) deserve a special mention. Even if these patients cannot be considered as having early-stage HCC because they do not qualify for transplantation, no upper limit of size for surgical resection is specified in the BCLC flowchart, and these patients should not escape surgical referral because their tumours are too large (16). It has been suggested that patients with large solitary tumours may benefit from surgery because of decreased surgical mortality and because patients with operable large solitary tumours may be a self-selected group with low tendency for multifocal disease (16). Different ablative modalities are not currently providing sufficient ablation volume to successfully treat these tumours, and when tumour size is >5 cm, the advantages of combination therapies appear negligible (17). On the other hand, the results of TACE as a stand-alone therapy for tumours of >5 cm, which are characterised by heterogeneous structure and vascularisation, are suboptimal, with a high rate of incomplete response and postembolisation syndrome (18). In this setting, transarterial radioembolisation, in which the main antitumour effect is provided by radiation and the embolic effect of microparticles containing radio-nuclide (yttrium-90) is negligible, has been suggested as a treatment option (19).

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203.4

IO in "early-advanced" tumours

J.-F.H. Geschwind

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Learning Objectives

- To learn about suitable ablative techniques
- To understand indications and contra-indications for ablation within and beyond BCLC
- To learn about the outcome of ablation in comparison to other therapies

No abstract available.

Special Session

Uterine fibroid embolisation

204.1

Minimally invasive surgical alternatives

T.H. Hess

Gynäkologie, Kantonsspital Winterthur, Winterthur, Switzerland

Learning Objectives

- To learn different minimally invasive surgery techniques
- To learn about patient selection
- To learn about outcome (including re-intervention)

No abstract available.

204.2

Comparison to HIFU

M. Matzko

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Learning Objectives

1. To learn about MR-HIFU technique
2. To learn how to best select patients (including exclusion criteria)
3. To learn about outcomes (including re-intervention)

No abstract available.

204.3

Fertility

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Learning Objectives

1. To learn about possible fertility impairments after UFE and how to prevent them
 2. To learn which fibroids are likely to influence fertility
 3. To learn about the possible role of UFE to enhance fertility
- Current evidence confirms that uterine fibroid embolisation improves the quality of life and is a safe, efficacious and cost-effective treatment for symptomatic fibroids. However, the current data are insufficient to provide strong evidence on its utility in women desiring fertility. Uterine fibroids are implicated as a cause of subfertility even if the uterine cavity appears hysteroscopically normal. Fibroids are implicated as the sole cause of infertility in less than 3% of such patients. The fibroid location may be important as submucosal fibroids are implicated in decreased fertility and increased pregnancy loss. Despite this, many women with large fibroids conceive without difficulty. There seems to be no recognisable adverse impact on fertility on using uterine artery embolisation in the management of women with post-partum haemorrhage. However, women with symptomatic fibroids who present for treatment tend to be older and to have completed their families, making comparison with long-standing surgical procedures, such as myomectomy, difficult. A systematic review of the literature in 2013 that compared the cumulative pregnancy rate following UFE with the age-adjusted rate in the general population (mean age, 36 years) and concluded that 68% rate was comparable. However, a review in 2010 highlighted higher spontaneous abortion and post-partum haemorrhage rates in the UFE population than in the controls with non-UFE fibroids. Whether UFE can be used to increase fertility is an interesting question and may depend on the position and size of the fibroids and how they may be impacting fertility. The beneficial effect of myomectomy is also weak. A literature on myomectomy reports pregnancy rates of 8%–46%, whereas those after UFE are 8%–47%. It is acknowledged that UFE may transiently occlude arterial flow to the ovary, but despite this the incidence of clinically apparent injury to ovarian reserve is low, with most women experiencing amenorrhoea being over 45 years of age. The method of embolisation may have an effect. It is possible that aiming for stasis may increase the risk of occlusion of the ovarian arteries, but there is no evidence to support this theory. All studies conclude that further research is needed in this area. The results of one more RCT (the FEMME trial) that assesses ovarian reserve after UFE and myomectomy are awaited.

204.4

Adenomyosis

T. Bilhim

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Learning Objectives

1. To learn how to diagnose adenomyosis
2. To learn about technical differences compared to UFE
3. To learn about outcome after embolisation

Adenomyosis may be present in 9%–31% of uteri after hysterectomy and involves ectopic growth of endometrial tissue within the myometrium, typically near the endometrial–myometrial junction zone (JZ). The prevalence of symptoms attributable to adenomyosis can be as high as 70% in women aged 40–50 years. Typical symptoms of adenomyosis include dysmenorrhea, metrorrhagia, and menorrhagia, which are non-specific and overlap with those of other disorders, such as uterine leiomyomas, endometriosis, or uterine malignancies. Thus, imaging using transvaginal sonography and magnetic resonance (MR) as main techniques plays a critical role in the diagnosis. The sensitivity and specificity rates of MR in the diagnosis of adenomyosis are 78%–88% and 67%–93%, respectively. The following imaging findings are suggestive of adenomyosis: asymmetric enlargement of the uterus wall, widening of the JZ (≥ 12 mm), and < 3 -mm-large cystic lesions within the thickened JZ and myometrium. These changes may be diffuse or focal (1).

Technically, uterine artery embolization (UAE) for adenomyosis does not substantially differ from that for uterine fibroids. Uterine arteries are accessed bilaterally, and embolic agents are injected distally to the cervicovaginal branches through 4-5 Fr catheters and/or 2.5-3.0 Fr coaxial microcatheters. To allow a deeper penetration, some authors prefer to reduce the size of embolic particles in UAE for adenomyosis compared with that of embolic particles used in UAE for fibroids. A wide range of embolic agents and their particle sizes have been reported in the literature: non-spherical polyvinyl alcohol particles of 255–900 μ m; trisacryl gelatin microspheres (Embospheres) of 500–700 μ m and 700–900 μ m; polyvinyl alcohol hydrogel spheres (Bead Block) of 700–900 μ m; calibrated polyzene F-coated hydrogel microspheres (Embozene) of 500, 700, and 900 μ m. Most authors prefer to start embolization with smaller particles to allow a deeper penetration of the embolic agents and increase the particle size when judged necessary. The use of additional embolic agents as gelfoam to complete UAE varies according to operator and institutional preferences. The reported end point of embolization is usually complete stasis of contrast in the distal ascending segment of the uterine artery on both pelvic sides without detectable residual flow (residual flow in only the lower uterine segment). To achieve greater ischemia, some authors advocate a more aggressive end point in UAE for adenomyosis than in that for fibroids. When using microspheres, some centers opt to check the stability of the end point after 3–5 minutes to see if additional embolic agents are needed (1–6).

Outcomes are different if pure adenomyosis or adenomyosis and fibroids are present. The reported improvement rates for pure adenomyosis are 83.3% after a median follow-up of 9.4 months and 64.9%–70% after a median follow-up of 5 years. An average JZ thickness reduction is of 33%, tumor volume reduction is of 77%, and uterine volume reduction is of 42%. More than 70% of patients show devascularization of adenomyosis on MR imaging after UAE, with a JZ thickness reduction of 19.8%–61.4%. Treatment success rates after 5 years are reported to reduce to 55%–57%. During long term, dysmenorrhea and bulk-related symptoms remain controlled in 75%–93% of patients. However, menorrhagia control is achieved in only 55% of patients. If adenomyosis and fibroids are present, success

rates tend to be higher, with clinical success of 92.9% after a median follow-up of 10.7 months and of 82.4% after a median follow-up of 34.2 months. Approximately 13%–18% of women undergo hysterectomy after failed UAE (1–6).

UAE allows long-term preservation of the uterus in majority of patients with adenomyosis, with most patients remaining asymptomatic. Best results after UAE are observed in uterine adenomyosis with predominant uterine leiomyomas as opposed to predominant uterine adenomyosis with minor fibroid disease or pure adenomyosis. The outcome after UAE in patients with adenomyosis has been correlated to the vascularity of the lesion measured during angiography before embolization and to the baseline thickness of the JZ, with thicker baseline JZ correlating with poorer outcomes (2–6). Further research to compare the efficacy and safety of UAE with conventional hysterectomy and medical management is warranted.

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Special Session Importance of R&D in IR

301.1

From an idea to a product

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Learning Objectives

1. To learn how to protect an idea
 2. To learn how to choose collaborators
 3. To learn from successful examples
- As a procedural-based specialty, interventional radiologists practice within a diverse field that is well suited for innovation. Ideas often start by observing which techniques, devices, or processes are lacking or in need of improvement. The journey from the inception of the concept of the device to a commercial product can be a long process and approached using various routes. This presentation will compare different strategies by four interventional radiologists, who as physician-inventors, successfully commercialized their technologies.

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301.2

Research data mandatory for guidelines

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Learning Objectives

1. To learn how guidelines are put together
2. To learn about the growing importance of guidelines
3. To learn about new guidelines with IR involvement

No abstract available.

301.3

New concepts beyond simple IR

J.-F.H. Geschwind

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Learning Objectives

1. To learn about ways to learn from others
2. To learn how to adapt new concepts in today's regulated medicine
3. To learn about promising examples of new concepts

No abstract available.

301.4

What NIBIB can offer to IR research

K. Kandarpa

Research Sciences & Strategic Directions, NIH/NIBIB, Bethesda, MD, United States of America

Learning Objectives

1. To learn about NIBIB
2. To learn how to apply for a grant
3. To learn how a European IR can get involved

The mission of the National Institute of Biomedical Imaging and Bioengineering (NIBIB/National Institutes of Health, USA) is to lead the development and accelerate the application of biomedical technologies for improving human health. NIBIB has a unique role as it supports the convergence of technology with the physical, engineering, and biomedical sciences, which thereby enhances the mission of other NIH institutes. Medical Imaging has evolved from being purely anatomical to one that currently provides functional information, which includes organ physiology and motion. Image-guided therapy has also evolved into "information-guided" therapy by incorporating a variety of measurements of tissue properties (e.g., typing, viability, deformation, and "omics"). This presentation will provide examples of such advances and a glimpse into the future. Research grant funding mechanisms available through NIBIB/NIH for interested interventional radiologists, information on the types of NIH grants and resources available, and eligibility criteria for them will be discussed.

Special Session

Varicose vein: time for IR

302.1

Setting up a varicose vein service

J.A. Brookes

University College Hospital, Multidisciplinary Endovascular Team, London, United Kingdom

Learning Objectives

1. To learn about the necessary infrastructure and personnel
2. To learn how to communicate with referring physicians
3. To learn how to organise an outpatient clinic

No abstract available.

302.2

Clinical evaluation including Doppler ultrasound

M.L. Åkesson

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Learning Objectives

1. To learn about clinical symptoms of venous insufficiency
2. To learn about Duplex criteria for venous reflux
3. To learn about classification of varicose veins

Varicose veins are a common manifestation of venous incompetence in the lower limb and appear as dilated, elongated or tortuous superficial veins. Venous disease of the legs causes considerable morbidity and is also costly, with approximately 2% of national healthcare resources being spent on treatment. The goal of varicose vein surgery is not only to remove reflux but also to minimize visible varicose veins.

The preoperative clinical examination should inspect the leg for oedema, eczema, healed leg ulcer or persistent ulcer as well as for the distribution of the varicose vein from the groin and distally. The preoperative anamnesis should include symptoms and durability and also carefully cover thromboembolic disease and a family history. Heterozygous APC resistance will require prophylactic and postoperative LWH treatment. In homozygous APC resistance, the risk of accidental deep thrombosis is increased and treatment risks should be carefully considered. Information about the patient's use of compression stockings and the effect of this use is important information. The patient should be informed about the different treatment techniques and the risk of different treatment options, such as postoperative bleeding and the risk of thrombosis.

A preoperative ultrasound duplex investigation should be performed by the operating physician to verify venous insufficiency and preoperatively plan on which vessels to be treated. In addition, ultrasound is important for the identification of potential complications and risks. The operator must have a good knowledge of venous ultrasound diagnostics and duplex techniques. These skills are required as the entire treatment procedure is guided by ultrasound monitoring.

Based on the information provided above, a classification can be made according to CEAP (CEAP is the acronym for clinical severity, etiology, anatomy and pathophysiology). The CEAP classification of varicose veins indicates symptom degree of varicose disease. Simplified equivalent varicose veins without any symptoms correspond to CEAP1. Varicose veins with symptoms such as pain, tingling and cramps correspond to CEAP2. Swelling and/or oedema correspond to CEAP3. Inflammation and/or eczema correspond to CEAP4. A leg ulcer healed with previous compression therapy corresponds to CEAP5, whereas an open leg ulcer corresponds to CEAP6.

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302.3

Different techniques for truncal ablation

L. Oguzkurt

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Learning Objectives

1. To learn about the specific features of laser ablation
2. To learn about the specific features of radiofrequency ablation
3. To learn about the specific features of sclerotherapy

Varicose vein of the leg is a very common problem and mostly caused by insufficiency of saphenous veins. Insufficiency of saphenous veins causes not only a cosmetic problem but also complaints such as pain, fatigue, heaviness, night cramps, skin changes, and leg ulceration in rare cases. The endovenous ablation of the incompetent saphenous veins is now the first line of treatment. There are several options for successful endovenous treatment of insufficiency of saphenous veins including laser, radiofrequency, and steam (thermal) ablations or mechanicochemical, foam, or glue (nonthermal) ablations. All these treatment methods are proved to be effective in treating insufficiency of saphenous veins. Some of these methods require tumescent anesthesia and some do not. Thermal ablation methods are the most commonly used techniques with a very high degree of experience in the last two decades. Ultrasound-guided foam sclerotherapy is not as effective as thermal ablation methods but is very simple, quick, and cheap. Mechanicochemical ablation and, the rather new, glue-based vein sealing system are effective, do not involve tumescent anesthesia, and are devoid of complications related to heat. Sclerotherapy, mostly with foam, is usually performed as part of the main ablation treatment at the same or a later session. Compressive stockings are usually used for 1–4 weeks after the treatment and are good to palliate pain and discomfort but do not increase the effectiveness of the treatment procedure.

Complications are usually minor and self-limited. Thermal ablation methods could cause pain, bruising, tenderness, and phlebitis over the treated vein. Neural damage to the saphenous nerve is rare but possible when one ablates the great saphenous vein distally. Deep vein thrombosis and pulmonary embolism are extremely rare but may occur. Recurrences occur but are usually easily treated with different ablation methods.

Anatomical and clinical results of endovenous ablation of saphenous veins are very good with improvement in cosmetic problems and clinical complaints and increased quality of life scores.

302.4

Therapy for venous ulcers

A. Jawien

Department of Vascular Surgery and Angiology, University of Nicolaus Copernicus, Collegium Medicum, Bydgoszcz, Poland

Learning Objectives

1. To learn about the clinical appearance of venous ulcers
2. To learn about compression therapy
3. To learn about the basics of local wound therapy

No abstract available.

Fundamental Course

Basics of drug-eluting technology

901.1

Mechanism of action

S. Spiliopoulos

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Learning Objectives

1. To learn the mechanism of action of DEBs and DES
2. To learn about drug (paclitaxel) dose findings
3. To learn about potential risks of paclitaxel

Outcomes of endovascular treatment are compromised by clinical recurrence due to restenosis. [1] According to extensive preclinical data and level I evidence based on the meta-analysis of multicenter randomized clinical trials, drug-eluting technologies are currently the most effective endovascular solutions for the reduction of restenosis rates following percutaneous peripheral procedures. [2, 3] The concept of drug elution is based on the delivery of antirestenotic agents within the vessel wall layers in order to inhibit neointimal hyperplasia using endovascular devices [drug-eluting stents (DES) and drug-coated balloons (DEB)]. Restenosis is a complex, reparative vessel response to injury and is mainly generated by a combination of inflammation and proliferation. Therefore, various drug elution options include anti-inflammatory (dexamethasone, tranilast, etc.) and antiproliferative (mainly the olimus family and paclitaxel) agents. [4, 5] The olimus family (sirolimus, everolimus, zotarolimus, etc.) and paclitaxel are the most widely investigated agents and have clearly demonstrated the most valid results in the management of peripheral arterial disease. [2, 3, 6] These cytostatic (olimus) and cytotoxic (paclitaxel) agents inhibit smooth muscle cell proliferation, one of the main mechanisms of neointimal hyperplasia formation, by interrupting the cell cycle. Endovascular drug-delivery devices, e.g., DES and DCB, are specifically designed to deliver these agents within the vessel wall using distinct elution technologies, while drug pharmacokinetics and pharmacodynamics play an important role in device design so as to effectively attain a durable antirestenotic effect. The aim of this lecture is to analyze the mechanism of action of the abovementioned antirestenotic agents and endovascular devices. Moreover, the pathophysiology of restenosis will be presented in order to explicate the goal of drug-elution technology.

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901.2

Differences between drugs (beyond paclitaxel)

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Learning Objectives

1. To learn about the alternatives to paclitaxel
2. To learn how drugs beyond paclitaxel might effect vessel wall
3. To learn about potential risks of drugs beyond paclitaxel

No abstract available.

901.3

Differences in drug carriers for DCB

G. Tepe

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Learning Objectives

1. To learn how DEBs and DES deliver drugs into the vessel wall
2. To learn how coating techniques of DEBs and DES influence the final drug concentration in the vessel wall
3. To learn how coating techniques of DEBs and DES effect peripheral embolisation of drug particles

There are currently at least 12 CE-approved DCBs available. They all deliver paclitaxel (PTX). Nevertheless, they differ with respect to two major variables: a) the additive which helps in delivering PTX and b) the dose of PTX in DCBs.

There is either no additive in order to deliver PTX and the coating is amorphous or crystalline or additives which differ significantly in their chemistry, origin, and properties are present. A summary of different coatings is displayed in the table. The dose on the balloon ranges from 2 µg/mm² to 3.5 µg/mm². In order to decide if a DCB is efficacious, clinical data have to be obtained. It might be that DCBs work in the short term but lose their efficacy at 2 years. Therefore, at least a 2-year data is mandatory.

DIOR I, Elutax, Advance 18 Ptx

Additive: None

Property of additive: -

Clinical outcome: No or poor efficacy

(Paccocath) SeQuent Please, Cotavance

Additive: X-ray contrast agent

Property of additive: Approved for intraarterial administration, very low toxicity, foreign substance, hypersensitivity reactions possible

Clinical outcome: Efficacious

In.Pact Admiral etc.

Additive: Urea

Property of additive: Small endogenous molecule, non-toxic, non-immunogenic

Clinical outcome: Efficacious

Dior II, Freeway

Additive: Shellac

Property of additive: No known effect

Clinical outcome: Moderately effective

Legflow

Additive: Shelloic acid

Property of additive: -

Clinical outcome: -

Lutonix/ Moxy

Additive: Surfactant

Property of additive: Dissolves paclitaxel, damage to cell membranes

Clinical outcome: Moderately effective

Pantera Lux, Passeo

Additive: Plasticizer

Property of additive: Chemical compounds for completely different purpose, surfactant

Clinical outcome: Efficacious

Ranger, Danubio

Additive: Plasticizer

Property of additive: Chemical compounds for completely different purpose, surfactant

Clinical outcome: Early promising data

Stellarex

Additive: PEG

Property of additive: Polymer, non-toxic

Clinical outcome: Efficacious

SeQuent Please OTW

Additive: Antioxidant

Property of additive: Potentially beneficial, protection of membranes etc.

Clinical outcome: Efficacious

Orchid

Additive: Lubricant

Property of additive: Endogenous constituent, small proportion of coating

Clinical outcome: Efficacious

Chocolate Touch

Additive: Antioxidant

Property of additive: Potentially beneficial, protection of membranes etc.

Clinical outcome: Efficacious

901.4**What happens when the drug is gone?**

J.A. Reekers

Department of Radiology, Academic Medical Centre, Amsterdam, Netherlands

Learning Objectives

1. To learn how DEBs and DES behave when the drug is gone
2. To learn how DEBs and DES need support when the drug is gone
3. To learn the DEBs and DES compared to BMS when the drug is gone

The effect of local administration of paclitaxel, a cytostatic drug, on the vessel wall locally is well known. Local apoptosis, local vessel wall necrosis, lasting inflammation, disturbed neointima formation, and accelerated neoatherosclerosis are observed. The anatomic result is better local patency. Although it is clear that this better local patency has not been proven in any study yet, also to be related to better clinical outcome, the fact that no data are available about long-term complications is more troublesome. We know that it sometimes takes years before the normal vessel wall architecture is restored and the regimen of double antiplatelet therapy can be stopped. As long as we have no clear view on late outcomes of local DCB treatment, we should maintain a rigid follow-up of all our patients who have undergone DCB. Long-term complications of paclitaxel as a cytostatic drug are, however, well known. Sirolimus is another drug which can be used to block local intimal hyperplasia. It is an immunosuppressive drug with proven little local vessel wall damages. The problem with sirolimus is that it cannot be applied on a balloon because of coating and release problems.

Special Session**Radioembolisation: results and new perspectives****903.1****Sirflox and Foxfire: latest global results**

T.K. Helmberger

Institut für Diagnostische und Interventionelle Radiologie und Nuklearmedizin, Klinikum Bogenhausen, Munich, Germany

Learning Objectives

1. To understand the study designs and their limitations
2. To learn about the single and combined results of the different studies
3. To understand the implications for future treatment strategies

No abstract available.

903.2**Radioembolisation: implications in management of hepatic metastases**

R.J. Lewandowski

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Learning Objectives

1. To understand the rationale, indications and contra-indications for RE
2. To learn about the results according to disease stage and therapy timelines
3. To understand how RE can fit into smart individualised therapy regimens

Many patients with metastatic cancer are negatively impacted by the extent of their liver involvement. Controlling liver disease in these patients may improve the quality of life and survival. Although surgical resection offers the best long-term survival outcomes, most patients at presentation are not surgical candidates. In appropriately selected patients, there appears to be a role for other loco-regional therapies, such as radioembolization.

Radioembolization is established in published cancer guidelines for the treatment of patients with hepatic metastases from colon [1, 2] and neuroendocrine cancer [3]. Although the level of evidence is not robust, there is ample evidence on the benefit of radioembolization in the salvage setting of these diseases [4-6]. There is growing evidence on the role of radioembolization for the treatment of patients with hepatic metastases from breast cancer [7, 8]. There are limited reports of radioembolization being employed for many other cancer types.

Unlike patients with primary liver cancer, those with metastatic disease to the liver often have extra-hepatic disease, have had prior therapies, and often have treatment options other than loco-regional therapies. Their clinical presentation is often negatively impacted by prior treatments. In general, patients do best when they have normal liver function, no cancer-related symptoms, liver-only disease, and limited hepatic tumor burden [9].

Appropriate timing of radioembolization in relation to other therapies, such as systemic therapies, must be realized for ensuring safety. The future of loco-regional therapies, including radioembolization, likely involves a combination of these treatments. This has the potential of allowing radioembolization during an early stage in the disease course of patients, and there are probably unrealized benefits of radiosensitizing cancer cells.

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903.3

Radioembolisation: implications in management of advanced HCC

D. Sze

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Learning Objectives

1. To understand the rationale, indications and contra-indications for RE
2. To learn about the results according to disease stage and therapy timelines
3. To understand how RE can fit into smart individualised therapy regimens

Even with the availability of direct-acting antivirals for hepatitis C, the worldwide incidence of hepatocellular carcinoma (HCC) continues to increase. New cases continue to occur in chronically infected patients, and the global epidemic of obesity and metabolic syndrome is now accelerating to become a major etiology of chronic liver disease in the form of non-alcoholic fatty-liver disease and steatohepatitis. Despite increased awareness and screening, most cases of HCC are diagnosed in later stages where resection or transplantation is no longer an option. Treatment options for late-stage HCC are very limited, and the role of radioembolization remains controversial.

Radioembolization with glass yttrium-90 microspheres was approved by the United States FDA in 1999 as a Humanitarian Device Exemption (HDE). The HDE process is an approval set at a lower threshold of evidence based on projections of fewer than 8,000 patients eligible per year, similar to the "orphan drug" approval process. The approved indication was for unresectable HCC, including those involving portal vein tumor invasions not affecting the main portal vein. Although not specifically approved for HCC in the US, resin microspheres are also commonly used for HCC and have shown roughly equivalent results. The CE mark indications (and approvals

in Australia and most South American and Asian countries) for both glass and resin microspheres include all unresectable hepatic neoplasms, both primary and metastatic.

Despite these approvals and increasing utilization, radioembolization is only mentioned as an option within the NCCN guidelines (competing with chemoembolization, bland embolization, hepatic arterial infusion, ablation, sorafenib, systemic chemotherapy, external beam radiotherapy, clinical trials, and best supportive care) and is not included in the BCLC and HKLC algorithms. The optimal application of this effective but expensive technology has yet to be defined. Specifically, no head-to-head study has shown superiority over chemoembolization or bland embolization. In addition, the cost effectiveness of any salvage treatment, whether transarterial or systemic, in patients with advanced HCC with limited life expectancy has been put into question.

Nevertheless, many experienced centers are now favoring radioembolization for the treatment of more advanced disease (TNM stage III and IV, BCLC-C, and HKLC stage 3b and 4a) because of a perception of greater initial tumoricidal effect, less need for repeated treatment, and less severe toxicity including fewer ischemia-related adverse events, such as fever, emesis, abscesses, and infarctions. Radioembolization has been shown to be effective as a bridge to transplantation and as a downstaging strategy for patients initially presenting with excessive disease burden precluding transplantation. According to the BCLC and HKLC algorithms, only patients with BCLC-B and HKLC-3a and 3b disease are eligible for transarterial therapy, namely chemoembolization. In practice, though, many patients with later stage disease also receive radioembolization and appear to benefit from it.

However, to justify the modification of treatment algorithms, in the current era of evidence-based medicine, escalating costs, and tighter financial management of medical resources, more and higher quality data will be necessary to establish the optimal utilization of radioembolization. Comparison trials pitting radioembolization against other options may be difficult to complete or quickly become obsolete because technological developments in chemoembolization and bland embolization materials and improvements in imaging guidance, systemic targeted therapies, and immunotherapies are also raising the standards of the comparators. Population-based studies using "big data" tools, such as deep learning and artificial intelligence, may provide some answers when randomized controlled trials are not feasible or affordable. Unfortunately, the continued increase in the incidence of HCC will require better solutions than what we offer now.

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903.4

New radioembolisation agents: Holmium-166

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Learning Objectives

1. To understand the physical properties of Ho-166 particles in comparison to Y-90
2. To learn about the specific dosimetry, delivery, and visualisation of Ho-166 particles
3. To learn about potential indications and first results

Background

Radioembolisation of liver malignancies with yttrium-90 microspheres is increasingly performed worldwide. Recently, ¹⁶⁶Ho microspheres have been developed and the intra-arterial use of these microspheres has been shown to be safe in a phase 1

dose-escalation study. Additionally, a phase 2 clinical trial has been performed to investigate the efficacy of ^{166}Ho radioembolisation.

Methods

In this prospective cohort study, a total of 56 patients were enrolled; all patients were non-surgical candidates with liver metastases refractory to chemotherapy. Radioembolisation was performed with an intended average absorbed dose of 60 Gy to the liver. The primary outcome was tumour response of two target lesions measured at 3-monthly follow-up intervals post-treatment using RECIST 1.1 criteria.

Results

Between May 2012 and March 2015, a total of 38 eligible patients were treated. In 27 (73%) patients, the target lesions showed disease control at 3 months (95% confidence interval 57%–85%). Disease control in the liver was achieved in 18 (49%) patients (95% CI 33%–64%). The median overall survival was 14.5 months (95% CI 8.6–22.8 months). No serious grade 3 or 4 toxic events occurred. Abdominal pain was reported in 18% patients.

Conclusion

Radioembolisation with ^{166}Ho microspheres is safe and resulted in disease control in 49% of the patients with liver metastases undergoing salvage.

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Special Session Treatment options of bone tumours

904.1

Mechanical stabilisation

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Learning Objectives

1. To learn how to recognise patients contra-indicated for mechanical stabilisation
2. To learn how to choose best indicated patients
3. To learn how to apply different stabilisation techniques in different settings

Fractures may occur because of an underlying bony tumour or bone insufficiency. Another issue in cancer patients is the management of impending fractures, especially when the patient is asymptomatic. The management of bone lesions is multidisciplinary, and the interventional radiologist has a key role to play. Several percutaneous techniques have been developed over the past years to treat and prevent fractures. They offer an alternative when surgery is

not indicated. The interventional radiologist may encounter different clinical situations and should be able to choose the most appropriate treatment considering not only the location of the lesion but also the symptoms and general status of the patient. He should also be aware of the existing surgical possibilities because interventional radiology is not appropriate for all situations. We will review the indications and evidence in the literature for each location.

Compressive stress: spine

Vertebroplasty is indicated to consolidate malignant compression fractures of the vertebral body in the cervical, thoracic and lumbar spine. Vertebroplasty reduces the pain related to pathological fractures and provides bone stabilisation, thus avoiding further vertebral collapse. Reports on the use of cementoplasty to consolidate pathological fractures of the vertebral body, with a high level of evidence, have been published for more than 25 years. Several reports have highlighted the safety and efficacy of other vertebral augmentation techniques (such as kyphoplasty, vertebral body stenting and kiva implantation), but the benefit of these devices over conventional vertebroplasty in the management of malignant fractures is unclear. The decision of prophylactic consolidation of asymptomatic lytic lesions should be based on imaging features. The risk of vertebral body collapse increases with increase in the percentage of bone destruction and becomes significant if the tumour infiltrates more than 50%–60% of the vertebral body in the thoracic spine and more than 35%–40% of the vertebral body in the lumbar spine. These rates decrease if there is an associated destruction of the posterior elements of the vertebra. The scores of spinal instability exist and may be used to decide whether vertebroplasty or surgery is the most appropriate.

When cementoplasty is not enough: long bones of the limbs

In the literature, Mirel's score has been widely reported to evaluate the risk of fracture of bone metastases in the limbs. In case of fracture or a score of >8, surgical fixation should be considered. Intramedullary nailing appears to be the most effective technique and offers an immediate consolidation with a minimally invasive approach. Alternatives to surgery, such as cement-filled catheters of flexible nails, have been proposed, but there are only few evidences in the literature. Cementoplasty alone has also been reported and appears effective in elevating the pain and improving the mechanical function of the limb, especially for lesions measuring <3 cm and located in the upper limb, but is associated with the risk of secondary fractures (up to 10% in the literature). However, fracture in a cemented long bone does not preclude secondary surgery. Fractures or impending fractures of the proximal extremity of the femur requires surgery whenever possible. In non-surgical patients presenting with an impending fracture, the combination of cementoplasty and screw fixation of the femoral neck may be proposed.

Complexity of the pelvis

The pelvis is a very frequent location of bone metastases. Cementoplasty has been widely used to treat lytic lesions of the acetabular roof with favourable results. Care should be taken in case of cortical disruption because intra-articular cement leakage may have disastrous functional consequences, often leading to surgical hip replacement.

The fixation of pathological fractures of the iliac wing with open surgery is effective and is usually performed in patients with a long life expectancy. In many cases, end-stage patients cannot benefit from a surgical treatment because it is associated with a high morbidity. Cementoplasty may be used, but mechanical properties of the cement do not adapt to stress forces applied to the iliac wing. Therefore, the secondary fracture of a cemented zone is likely to occur. Recently, percutaneous screw fixation has been proposed to treat these fractures. Several studies have already reported the feasibility and safety of CT-guided screw fixation in the pelvis of trauma patients. Associated cementoplasty may help to fix the screws in the bone to avoid secondary dislodgement.

In conclusion, interventional radiology may help to treat non-surgical patients. The level of evidence on percutaneous techniques other than vertebroplasty is still low; further studies are needed for more evidence on these techniques.

904.2

Combined therapy: when and how

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Learning Objectives

1. To learn how to recognise patients contra-indicated for combined therapies
2. To learn how to choose best indicated patients
3. To learn how to apply different combinations in different settings

Interventional radiology plays a key role in the management of malignant and benign bone tumors.

Consolidation, ablation, and embolization are available but have specific indications and limitations.

Combined therapies aim to increase the efficacy of interventional radiology procedures, thereby maintaining complication rates as low as possible.

Combination therapy can be performed with all previously cited treatment options as well as with non-IR modalities, such as radiotherapy and surgery.

The most common indication of pre-ablation embolization is for hypervascular tumors, typically renal cell carcinomas, HCC, or endocrine metastases. For malignant pathologies, the goal is mostly palliative (pain management) but can be curative in patients with oligometastasis and/or malignancies with a low tumor growth rate.

Another rare but classic indication is embolization (percutaneous) prior to cementoplasty to treat aggressive vertebral hemangiomas. Ablation (cryotherapy, RFA, and MWA) can be combined with other modalities. Notably, ongoing protocols evaluating the cryoablation of painful metastases allow and even encourage radiation therapy prior to the IR procedure.

Lastly, consolidation (cementoplasty, osteosynthesis, or screwplasty) must be performed in addition to all ablative treatments of weight-bearing bones.

904.3

HIFU: when and how

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Learning Objectives

1. To learn how to recognise patients contra-indicated for HIFU
2. To learn how to use HIFU in therapeutic and palliative settings
3. To learn how to use data to improve safety and efficacy

Thermal ablation of bone tumors is usually performed with a needle whose tip is heated by energy. High focused ultrasound (HIFU) works without placing a needle and uses an acoustic lens to concentrate multiple intersecting beams of ultrasound on a target. Each individual beam passes through tissue with little effect but at the focal point where the beams converge, the energy can have useful thermal or mechanical effects. HIFU is typically performed with real-time imaging via ultrasound or MRI to enable treatment targeting and monitoring including thermal tracking with MRI.

MR guided high focused ultrasound (MRgFUS) was the first system to obtain FDA market approval in the United States. Currently, there are HIFU systems approved to treat uterine fibroids, the prostate and essential tremor, Parkinsonian tremor and neuropathic pain. Regarding bone pathology CE labeling was achieved to treat

pain from bone metastases, pain from facet joint osteoarthritis and benign bone tumors, for example osteoidosteoma.

Indication, technical considerations and results of bone treatments by MRgFUS will be presented. MRgFUS lacks of invasiveness and is well tolerated by the patients. Bone treatments need analgesia and in many cases ITN as the patients need to lay still to be treated safely. The treatments are safe for the patients as MRI allows thermal feed-back during the ablation. The results with respect to symptom control = pain relief are striking.

Take home points:

- Indications/contraindications to treat bone disorders by MRgFUS
- Technique and infrastructure to treat successfully
- Results of MRgFUS (bone metastases, osteoidosteoma, facet joint osteoarthritis)
- Patient management pre- and post-ablation

904.4

Medical management of benign bone tumours

K.S. Rankin

Northern Institute for Cancer Research, Newcastle University, Newcastle Upon Tyne, United Kingdom

Learning Objectives

1. To learn how to recognise patients contra-indicated for medical management
2. To learn how to apply evidence-based medicine
3. To learn how to apply medical management safely

No abstract available.

Special Session

Therapy of diabetic foot (BTK interventions)

1001.1

Pedal access and co.: how to make them easier

M. Palena

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Learning Objectives

1. To learn the vascular anatomy of the foot
2. To learn the different techniques for pedal access
3. To learn about complications

No abstract available.

1001.2

Treat as much as you can at the initial sitting

P.E. Huppert

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Learning Objectives

1. To learn about limb salvage techniques
2. To learn about direct and non-direct flow
3. To learn about complications

No abstract available.

1001.3

"Go around" technique

M.G. Manzi

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Learning Objectives

1. To learn how to perform a recanalisation using collateral pathways
2. To learn how to avoid possible complications
3. To learn about indications

No abstract available.

1001.4

Drug-eluting stents to improve limb salvage?

H. van Overhagen

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Learning Objectives

1. To learn about the drug-eluting stent technology
2. To learn about the indications
3. To learn about the data available

Critical limb ischemia (CLI) is the end stage of peripheral artery disease (PAD) and represents a substantial burden for patients and healthcare due to its poor prognosis for both limbs and life.

The incidence of CLI is estimated to be 500–1000 new cases per million inhabitants per year in the western world, and important risk factors are diabetes, advanced age, and smoking.

Recanalization of the occluded vessels in the leg remains the most important therapy because medical treatment is not very effective and new cell therapies have been disappointing up to now. In the previous decade, endovascular therapy has become the recommended recanalization strategy replacing vascular surgery even for lesions below the knee (BTK), with percutaneous transluminal angioplasty and bail-out bare metal stenting (PTA±BMS) as the standard endovascular treatment.

Although the initial technical success rate of PTA and bail-out BMS is reported to be relatively high, long-term results are negatively affected by restenosis due to intimal hyperplasia.

Drug-eluting technologies have been used BTK in order to reduce restenosis rates after endovascular treatment. After an initial optimistic report, the results of drug-eluting balloons BTK have been disappointing. Results of drug-eluting stenting (DES) BTK have been more encouraging morphologically regarding restenosis rates, but until recently, clinical results were lacking. This may at least partially have been caused by the fact that many DES BTK studies included patients with intermittent claudication who were unlikely to reach difficult clinical endpoints such as amputation or death and a limited number of patients.

In the percutaneous transluminal angioplasty and DES for infrapopliteal lesions in critical limb ischemia (PADI) trial, patients with CLI (Rutherford category ≥ 4) were randomized to receive PTA±BMS or DES with paclitaxel. Primary endpoint was 6 months, and primary binary patency of treated lesions was defined as $\leq 50\%$ stenosis on CTA. Stenosis $> 50\%$, re-treatment, major amputation, and CLI-related death were regarded as treatment failure. Severity of failure was assessed with an ordinal score ranging from vessel stenosis through occlusion to clinical failure.

Six-month patency rates were 48% for DES and 35.1% for PTA±BMS ($P=0.096$) in the modified intention-to-treat and 51.9% and 35.1% ($P=0.037$), respectively, in the per-protocol analysis. The ordinal score showed significantly worse treatment failure for PTA±BMS versus DES ($P=0.041$). The observed major amputation rate remained

lower in the DES group until 2 years post-treatment with a trend toward significance ($P=0.066$). Less minor amputations occurred after DES until 6 months post-treatment ($P=0.03$).

Long-term follow-up of the PADI trial consisted of annual assessments up to 5 years post-treatment or until a clinical endpoint was reached. Preserved primary patency ($\leq 50\%$ restenosis) of treated lesions was an additional morphological endpoint assessed by duplex sonography. The estimated 5-year major amputation rate was lower in the DES arm (DES 19.3% vs. PTA±BMS 34%; $P=0.091$). The 5-year amputation-free survival and event-free survival (survival free from major amputation and re-intervention) rates were significantly higher in the DES arm (DES 31.8%, PTA±BMS 20.4%; $P=0.043$ and DES 26.2%, PTA±BMS 15.3%; $P=0.041$, respectively). The limited available morphologic results showed higher preserved patency rates after DES than those after PTA±BMS at 1, 3, and 4-year follow-ups.

Data from the PADI trial were combined with those from the rejuvenating endothelial progenitor cells via transcatheter intra-arterial supplementation (JUVENTAS) trial in order to determine implications of diabetes in a population of patients with CLI and infrapopliteal lesions and to study the prognostic value of the ankle-brachial index (ABI).

Diabetes was present in 49.1% of patients in the combined population. The major amputation rate at 5 years of follow-up was higher in patients with diabetes than that in patients without diabetes (34.1% vs. 20.4%, $P=0.015$). The major event and death rates did not differ. The unadjusted hazard ratio (HR) of diabetes for the major amputation risk was 1.87 (95% CI 1.12–3.12). Model factors with significant HRs in the multivariate analysis were baseline Rutherford category (HR 1.95; 95% CI 1.24–3.06) and ABI > 1.4 (HR 2.78; 95% CI 1.37–5.64).

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Fundamental Course Ablative therapies of renal cancer

1003.1

Partial nephrectomy: news from the urologist

A. Volpe

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Learning Objectives

1. To learn the indications of partial nephrectomy - including open versus laparoscopic surgery
2. To learn the long-term survival after partial nephrectomy
3. To learn the complications and contra-indications of partial nephrectomy

No abstract available.

1003.2

Thermal ablative therapies are as efficient as surgery

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Learning Objectives

1. To learn when thermal ablative techniques are indicated
2. To learn the different thermal ablative techniques available
3. To learn the advantages and disadvantages of one ablative technique vs. another

No abstract available.

1003.3

When to use cryoablation

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Learning Objectives

1. To learn about technical and anatomical difficulties of cryoablation
2. To learn about incomplete ablation and recurrence rates after cryoablation
3. To learn survival rates after cryoablation

Smaller volume renal cell cancer (RCC) is a curable disease, and renal tumour ablation must set out to achieve definitive results in oncological equipoise with surgical resection. There must be precision in the procedure, with a negligible primary subtotal treatment (<5%) and late local recurrence (<5%), besides minimal complications and relative sparing of the background renal function. This author believes that cryoablation is currently best set to provide such a treatment when compared with other available ablation modalities. It is likely that identical results can be achieved for relatively exophytic, sub- 3cm tumours using radiofrequency or microwave ablation, but as tumours move above this size or become more central or even peri-pelvic, cryoablation becomes the ablation modality of choice.

Case series and wider clinical experience have indicated that cryoablation is the modality of choice for RCCs that are >30mm in diameter [1], are >50% intra-cortical, are present at a deeper location adjacent to the pelvicalyceal (PC) system (cryoablation has been shown to be less injurious to the collagenous PC system [2]) and require tighter treatment precision adjacent to thermally sensitive structures such as the bowel.

It is difficult to pull out these technical benefits of cryoablation from the mixed published experience and coarse meta-analyses in the literature [3], but the ready visualisation of the therapeutic ice ball under imaging suggests that in many RCC case scenarios, cryoablation is the ablation modality of choice.

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1003.4

Update on clinical guidelines

A. Veltri

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Learning Objectives

1. To learn about the current status of clinical guidelines
2. To learn if there is consensus among clinical guidelines
3. To learn how clinical guidelines can improve clinical cryoablation practice

No abstract available.

Special Session

Sedation and analgesia performed by IR

1101.1

Basics of different drugs and sedation levels

A. Vari

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Learning Objectives

1. To learn about the most commonly used sedation drugs in IR
 2. To learn about specific precautions of sedation drugs in IR
 3. To learn how to be prepared for emergencies
- Sedation and anesthesia represent different points on a continuum of responses observed in patients receiving a drug (or a combination of drugs) designed to reduce the level of consciousness and responsiveness to external stimuli.

The American Society of Anesthesiology and the Joint Commission on the Accreditation of Healthcare Organizations has identified four levels of sedation as part of a continuum:

Minimal sedation (anxiolysis) is a drug-induced state during which patients respond normally to verbal commands. Although cognitive function and coordination may be impaired, ventilatory and cardiovascular functions are unaffected.

Moderate sedation/analgesia (previously termed "conscious sedation") is a drug-induced depression of consciousness during which patients respond purposefully to verbal commands without stimulation or with light or tactile stimulation. No intervention is required to maintain a patent airway, and spontaneous ventilation is adequate. Cardiovascular function is usually maintained.

Moderate sedation/analgesia, as defined here, specifically excludes the administration of sedative and/or analgesic medications under emergency conditions.

Deep sedation/analgesia is a drug-induced depression of consciousness during which patients cannot be easily aroused but respond purposefully following repeated or painful stimulation. The ability to independently maintain ventilatory function may be impaired. Patients may require assistance in maintaining a patent airway, and spontaneous ventilation may be inadequate. Cardiovascular function is usually maintained.

General anesthesia is a drug-induced loss of consciousness during which patients are not arousable even by painful stimulation. The ability to independently maintain ventilatory function is compromised, thus requiring assistance in preserving a patent airway and positive pressure ventilation. Cardiovascular function may be impaired.

Moderate or deep sedation should be used to minimize patient's discomfort, anxiety, and/or pain during diagnostic and therapeutic procedures in the IR suite. Such sedation is useful to reduce risks and complications that are associated with the use of general anesthesia.

Moderate sedation is typically achieved by administering intravenous drugs. Most frequently used agents are as follows:

1) Opioids: These drugs produce sedation and analgesia and have the propensity to cause respiratory depression.

Opioids that are commonly used for moderate sedation/analgesia include morphine, meperidine, and fentanyl. Naloxone is an opioid antagonist that may be used to rescue a patient from respiratory depression.

2) Benzodiazepines: They are a group of medications that are most commonly used for moderate sedation.

In addition to their sedative properties, most benzodiazepines have amnesic, anxiolytic, anticonvulsant, and hypnotic effects. These drugs have no analgesic property. Benzodiazepines that are commonly used for moderate sedation include diazepam, lorazepam, and midazolam. Flumazenil is an antagonist that rapidly reverses the effect of benzodiazepines.

3) Propofol: An intravenous sedative-hypnotic agent with a rapid onset and short duration of action. These properties make its clinical administration potentially dangerous for those not trained in cardiopulmonary resuscitation and have raised long controversy on its use by non-anesthesiologists.

4) Other agents: Ketamine (N-methyl-D-aspartate receptor antagonist)

Dexmedetomidine (α_2 -adrenergic receptor agonist)

Methohexital (short-acting barbiturate)

Chloral hydrate (oral use in pediatric patients)

As general principles for the clinical use of sedatives, all agents should be administered in proper settings with mandatory monitoring and titrated to their clinical effects, considering that the effects of nearly all drugs used for sedation are maximized when they used in combination (i.e., opioid and benzodiazepines). The sedation provider should also be trained in managing most common side effects of overdosing sedatives, i.e., respiratory depression and hemodynamic alterations.

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1101.2

Pre-assessment and monitoring

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Learning Objectives

1. To learn what to ask a patient before the procedure
2. To learn how to evaluate a patient before sedation
3. To learn how to monitor patients during sedation

Introduction

Considerable progress has occurred in endoscopic and interventional radiology technology in the last few decades, allowing gastroenterologists to perform complicated procedures, such as endoscopic retrograde cholangiopancreatography, and cardiologists to perform pulmonary vein isolation that lasts for hours, percutaneous aortic valve modifications, etc. without using general anaesthesia. However, these modern diagnostic and therapeutic procedures cannot be properly performed without adequate and safe moderate-to-deep sedation (MDS). In the last few years, the increased availability of MDS services have led to a considerable increase in patients with significant co-morbidity, thus emphasising the need for effective pre-sedation assessment of the health condition and cardiopulmonary reserve of eligible patients because MDS is a risky medical procedure.

Pre-assessment

Pre-sedation assessment is a prerogative for safe sedation and can be performed using simple but effective screening tools, such as health enquiry forms, which can be filled by patients at home. Health enquiry forms can be prepared to contain data that alert the endoscopist, cardiologist, radiologist, or consulting anaesthetist to perform additional tests to provide the required information in case of relevant co-morbidities.

The following information is required to assess the physical condition of the patient: general health, earlier and actual medical points of interest, actual drug consumption, unusual side effects of drugs, earlier surgical procedures, inadvertent effects of earlier anaesthetics and sedations, patient experiences and physical examination of the airways, heart and lungs.

Additional tests and consultations are required based on the data from the history of the patient, drug use and complexity of the intended procedure as these may affect the sedation procedure. All these data should be included in the medical file of the patient. Moreover, the patient should be informed about the nil per os policy, the medications that should be continued and the drugs that should be interrupted.

The patient should be informed about the expected advantages and disadvantages of the proposed sedation technique, about the side effects that may be expected and about postoperative care. Lastly, the patient's informed consent is legally required.

Prerequisites for safe MDS

Because MDS is recognised to be a risky medical procedure, strict safety policies are warranted to achieve acceptable patient safety (1). MDS is an independent medical procedure characterised by indications, contraindications and development of an individual plan and requires informed consent from the patient. To provide high-quality care and maximum comfort to both the patient and the treating physician, a number of requirements need to be met.

Training of sedation practitioners

As the execution of MDS is associated with considerable risks to the patient, the sedation practitioners need to be instructed and trained to be able to safely execute the sedation procedure. They also should be able to deal with the common adverse effects of MDS, which mainly affect the level of consciousness and the ventilatory and cardiovascular systems. In many countries, MDS techniques are not formal components of the medical specialist training

in anaesthesiology. In such cases, anaesthetists who have had additional training in these techniques perform MDS procedures. In some countries where there is a shortage of anaesthetists, anaesthesia assistants or nurses have successfully been introduced as sedation practitioners following an additional training course with examinations. The training programme comprises a basic theoretical training and practical training with 50–100 MDS procedures under direct supervision. According to the European Curriculum for sedation training in gastrointestinal endoscopy, the course integrates theory with practice and covers the following areas (2):

- Relevant anatomy and physiology of the heart and respiratory tract, including definitions of hypoxaemia, hypocapnia and hypercapnia, and their relationship with the risk profile of the individual patient
- Basic pharmacology, pharmacokinetics, indications and contraindications of drugs commonly used for endoscopy sedation and pain control (i.e. benzodiazepines and opioids as well as their antagonists, propofol, entonox and oxygen)
- Different sedation concepts, including possibilities and limitations, possible side effects and prevention and management of complications
- Selection of suitable patients using health care questionnaires for the administration of sedation by non-anaesthetists
- Equipment and staff requirements necessary to ensure patient safety before, during and after endoscopic interventions
- The use of different scores to assess patient risk status [e.g. American Society of Anesthesiology (ASA) classification and risk score to predict difficult mask ventilation] and the relationship between patient risk status and anticipated difficulty in the endoscopic procedure under sedation
- Patient preparation and surveillance, including safe positioning, intravenous access, monitoring and oxygen administration
- Stages of sedation (3)
- Management of sedation complications
- Documentation on sedation
- Discharge criteria and patient instructions following GI endoscopy under sedation
- National laws and guidelines as well as European and departmental guidelines and standards

These educated and trained procedural sedation practitioners, working closely with anaesthetists, have demonstrated the ability to independently provide safe MDS to patients under indirect supervision and under final responsibility of the anaesthesia department (4).

Patient safety

In accordance with general safety practices, all attending personnel should be adequately trained in basic life support. At least one attending personnel should be trained in advanced life support, and a resuscitation team should be available readily at all times.

Equipment and monitoring of vital data

A patient under MDS needs to be supervised continually by a trained practitioner who has no responsibility other than clinical observation of the patient and instrumental monitoring of his/her vital signs. Continuous instrumental monitoring comprises monitoring of arterial oxygen saturation, pulse rate, three-lead electrocardiogram (five-lead electrocardiogram in patients with a relevant cardiac history) and intermittent non-invasive blood pressure.

Although the evidence is scarce and occasionally contradicting, continuous capnometry is valued as the first-choice early-warning method for failing pulmonary ventilation, and capnometer has become a standard monitor in many cases.

Capnometer has been introduced fairly late as an essential monitor because of its limitation in sampling of end-expiratory gases in patients who breathe spontaneously without an airway device, such as a laryngeal mask or an endotracheal tube. The advent of lightweight disposable devices, which allow not only to administer

oxygen but also to retrieve expiratory gases in a semi-quantitative way, has facilitated the use of a capnometer.

Whenever respiration is impaired by an upper airway obstruction or by an insufficient respiratory drive because of the combination of opioids and hypnotics/sedatives or both, capnometry provides the earliest warning sign even when oxygen saturation is still normal. When a capnometer is not available or is not used, a decrease in oxygen saturation is a very late sign indicating that ventilation of the lungs is failing. This situation may rapidly proceed to hypoxaemia and associated vital organ damage.

Oxygen, a defibrillating AED device, rapid support by an experienced resuscitation team and ready access to a step-up care facility are important prerequisites for patient safety.

Registration of data

MDS procedures, being risky medical procedures, need to be registered preferably in a digital sedation report, including data from the vital parameters; relevant events of the procedure, such as briefing, time out, start and ending of sedation; administered drugs; sedation scores, such as the (adapted) Ramsay scores or the OAAS scores (3); proceedings and events of the endoscopic procedure and adverse effects. This serves as the legal obligation to enable an exact replication of the entire event, including sedation, in case of an unwanted outcome or for justification to the patient or to independent investigators in cases of reclamation of the patient.

Recovery

Nowadays, long-acting drugs are no longer recommended for MDS because of unpredictable effects on consciousness and ventilation as well as late complications when the stress of the endoscopic procedures gradually disappears. This does not mean that recovery care is not necessary when using short-acting drugs. Propofol, benzodiazepines, remifentanyl, alfentanil, dexmedetomidine, ketamine and others are relatively short-acting but are also very potent. Moreover, they may strongly interact with other agents, which affects the level of consciousness, and potentially with the medication that the patient is taking.

When a painful endoscopic procedure ends and the administration of sedative/analgesic drugs is discontinued, the patient may wake up early. However, when the patient is kept on bed or is wheeled to the recovery area, sedation may return in the absence of the painful stimulus and respiration may be impaired, causing significant hypoxaemia.

Therefore, it is recommended that patients are again clinically observed by a competent nurse and that the same vital parameters are instrumentally monitored (pulse oxymetry, capnometry, NIBP and ECG). Patients can be discharged from the recovery area based on the standard discharge criteria (5).

Continuous quality improvement programmes require that all data on patient sedation be collected for regular evaluation and quality improvement strategic goals. Regular multidisciplinary meetings to discuss unexpected events during the procedures and during MDS, new developments and the application of quality indicators are very helpful for continuously improving the quality of care.

New developments

Following the increasing availability of well-trained procedural sedation practitioners, the number of patients eligible for MDS has sharply increased in the last 5 years. More importantly, we observed a strong relative increase in the number of ASA class III and IV patients who opted for MDS services. This development increases strain on anaesthesia departments, which are bearing responsibilities for sedation to cope with these changes.

In our department, the total number of patients eligible for MDS increased from 401 in 2010 to 2188 in 2015, a 5.4-fold increase. However, more importantly, the number of ASA III patients increased from 4% to 30% in the same time period. This emphasises the need for vigilance to maintain high-quality standards (6).

A second development includes the wider availability of MDS for increasing number of domains in medicine. Starting from

gastroenterology, MDS has rapidly expanded to cardiology with hours-long procedures, such as pulmonary vein isolation and percutaneous valve replacement procedures, and to specific radiological procedures, such as MRI high intensity focused ultrasound treatment for uterine fibroids. For the latter procedure to be executed successfully, synchronised breathing is required, for which special and specific sedation protocols have been developed in our laboratories (7).

It is clear that the application of MDS procedures is rapidly expanding to new fields of radiology, radiotherapy, gastroenterology, cardiology and other areas, for which new techniques, protocols and procedures need to be developed. Patient safety for these high-risk procedures must be the beginning and the end of all policies.

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1101.3

Special precaution for the elderly patient

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Learning Objectives

1. To learn about paradoxical drug reaction
2. To learn about the fluid management
3. To learn about red flags

Ageing has a variable impact on body physiology, leading to altered pharmacokinetics and pharmacodynamics of most sedative and analgesic drugs used in everyday clinical practice (1-4). The main physiologic alterations associated with advanced age are as follows (1-4):

- Decreased muscle mass, decreased blood volume and increased body fat composition
- Decreased cardiovascular compliance, increased sensitivity to hypovolaemia, increased sympathetic tone and decreased vascular auto-regulation
- Decreased ventilatory response to hypoxia and hypercarbia, increased lung residual volume, decreased muscle strength and reduced cough and airway reflexes (these modifications make the elderly more vulnerable to oxygen desaturation)

- Presence of co-existing diseases (especially cardiovascular, respiratory, renal and hepatic diseases; disorders of the central nervous system, such as dementia and cognitive dysfunction), decreased glomerular filtration rate and urine concentration ability, decreased liver function and decreased albumin concentration affecting pharmacokinetics
- Reduced drug metabolism and elimination; longer duration of some drugs' action
- Systemic drug administration for multiple diseases; careful consideration of drug-to-drug interactions; special attention to anticoagulants, drugs acting on the cardiovascular system and drugs affecting the central nervous system

There is lack of sufficient evidence to recommend a single 'best' sedative plan for the elderly (1-4). The selection of technique and appropriated agents depends on the nature and duration of the procedure, the individual's physiological status and co-existing diseases as well as the facilities of the department. However, the most relevant recommendation for the elderly is to 'start low, go slow', describing the necessity for the administration of low, incremental doses of selected sedative/analgesic drugs to achieve the optimal level of sedation with the minimum side effects (3).

A careful history-taking and preoperative evaluation of the patient is essential, as in every case, focused especially on co-existing diseases and co-administered drugs that may interfere or interact with analgesics or sedatives. The presence of 'red flags' that may complicate sedation and require special care should also be assessed (see below) (1,2,5-11).

Drug selection and titration

Drugs with short half-life and rapid and predictable onset and recovery should be selected for the elderly. Drugs that do not have active metabolites and do not depend on renal or hepatic elimination are also preferable. The cognitive deterioration should always be considered (3,4). The elderly require careful titration of sedative/analgesic drugs. Incremental dosing increases patient comfort and reduces the risk of adverse effects (1,2,12). Sufficient time must elapse between doses to allow the effect of each dose to be assessed before subsequent drug administration. When routes other than intravenous are used (e.g. rectal, intramuscular and transmucosal), drug pharmacokinetics may be altered and unpredictable. Careful consideration of possible drug-to-drug interactions with other co-administered drugs, mostly affecting the central nervous system or the cardiovascular status, should be performed (1,3,4).

Literature suggests that combinations of drugs may be used (most commonly combining a sedative with an opioid) but with extreme care in the elderly because of the increased additive pharmacodynamic sedation effect and the increased risk of adverse effects (1-4). Advanced age may be associated with increased vulnerability to ventilatory depression, hypoxia and haemodynamic deterioration. Ideally, each component should be administered individually and titrated to the desired effect, leaving the required amount of intervals between subsequent doses to allow each drug to reach its maximum effect. Most of the times, reduced dose of each drug is required when used in combinations because of additive pharmacodynamic effects.

Paradoxical drug effect

Benzodiazepines and propofol are widely used for sedation. They exhibit similar modes of action, mainly through the activation of the inhibiting GABA pathway. The rare effect of paradoxical agitation after administering these drugs may complicate an interventional procedure and necessitate more specialised management. The main features of paradoxical reactions include emotional deterioration, agitation, excessive movement and confusion, combined with or without exaggerated autonomic nervous system activation, tachycardia, hypertension and tachypnea. These reactions have mostly been described after the administration of benzodiazepines (1%-2%), but they have also been reported after the use of propofol in some cases. The main risk factors include alcoholism, extremes

of age and psychiatric comorbidities (1,13). The paradoxical reactions should be a diagnosis of exclusion because in critically ill patients, symptoms may overlap with disease-related clinical features, such as hypoxia and hypovolaemia. Aetiology remains unclear but may be related to alterations of the GABAergic pathway and differences in receptor subunit composition. Management comprises discontinuing the offending agent and the addition of a non-GABA sedating medication (i.e. opioids, antipsychotics, dexmedetomidine and ketamine), whereas antagonism of the causal factor by a specific reversal agent (flumazenil in the case of benzodiazepines) has also been suggested (13).

Red flags for sedation

Practitioners who administer procedural sedation/analgesia should be aware that the transition process from complete consciousness to deep sedation does not always include discrete stages, especially in the elderly or patients with comorbidities (1,2,10,11). The margin of safety of drugs varies widely, and the major risks include the loss of consciousness and protective reflexes, which can occur rapidly and unexpectedly. Conditions that must alarm physicians of the possibility of difficulties during sedation or of extreme reactions/adverse effects that may require an advice by a specialist or even anaesthesiological assistance as follows (5-7,10-12):

- History of apnoea or high risk of apnoea (documented by sleep study, strong clinical history or apnoea monitor)
- Respiratory-compromised patients (with recent <8 weeks pneumonia, active bronchitis, asthma exaggeration or respiratory infection)
- Uncontrolled/unpredictable gastroesophageal reflux or vomiting that poses aspiration risk; any case of increased aspiration risk (increased intra-abdominal pressure, full stomach, pregnancy, etc.)
- Craniofacial abnormality and history of difficult airway
- Unstable cardiac disease (cyanotic cardiac disease, abnormal cardiac anatomy, depressed myocardial function, significant stenotic or regurgitation lesions or life-threatening arrhythmia)
- Hypotonia or lack of head control (patient may not be able to maintain his/her airway without assistance)
- Allergies to sedative/analgesic drugs
- Anterior mediastinal mass
- Tremors (unlikely to be ablated by sedation)
- Prior failed sedation
- Painful procedure that may be challenging to provide adequate analgesia without a general anaesthetic
- High-risk procedure that may require the presence of an anesthesiologist for resuscitation
- Procedure that requires absolute immobility
- Procedure being performed in remote location where immediate emergency backup assistance would be impossible
- Inadequately qualified personnel available to provide safe procedural sedation

Fluid management

Intravenous fluid administration should be based on the physiological status of the patient, the degree of hypovolaemia, the cardiovascular and renal reserve, and the nature of the procedure. Interventions that are accompanied by significant blood loss require special care of because of the possibility of coagulation disorders and the necessity of transfusion of blood products. Specialists' consultation should be available in cases in which hypovolaemia or acute haemorrhage is present. Fluid therapy should be 'goal-directed' and appropriately monitored (through standard BP and HR monitoring and urine output) using more sophisticated monitors in complicated cases (invasive BP measurement, CVP measurement, etc.) (1-4). There is no consensus regarding the optimal fluid management in the elderly because it should be individualised based on the nature of the procedure and the co-existing diseases. However, more 'restricted' strategies are commonly preferred over fixed-volume administration, aiming to maintain a stable cardiovascular status and a normal urine output (3,4).

Key points

- Procedural sedation is generally safe in the elderly, although they may be at high risk of oxygen desaturation.
- The elderly usually require lower doses of medications. They tend to be more sensitive, with slower metabolism and less physiological reserve, because of pharmacokinetic and pharmacodynamic alterations.
- Paradoxical reactions to sedative drugs (benzodiazepines and propofol) may occur, requiring special management.
- The risk of complications can increase when multiple agents are used.
- Careful titration and adequate intervals between subsequent doses are required.
- Physicians should take all the usual precautions and consider any comorbidities that can put the patient at more risk of adverse reactions. A thorough preoperative evaluation and the identification of possible red flags for sedation is the safest approach. Appropriate monitoring and precautions are necessary to guarantee the best outcome.
- 'Start low, go slow'

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1101.4

Advantages/role of propofol sedation

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Learning Objectives

1. To learn how to administrate propofol
2. To learn about the advantages of propofol
3. To learn about the experience with propofol in Switzerland

What is propofol?

Propofol is an intravenous sedative agent with a half-life of approximately 1–3 minutes. If spontaneous ventilation is maintained, the major cardiovascular effect is arterial hypotension with some additional change in the heart rate. Respiratory effects tend to occur later and especially in combination with opioid drugs. There is no antidote for propofol.

Use of propofol:

Propofol is widely used during endoscopic procedures. Because of its properties of inducing amnesia and beautiful dreams, patient satisfaction is higher than that by traditional sedation, and therefore, it is increasingly used for interventional procedures as well. For its safe use, certain precautions should be followed. The key question is whether the presence of an anesthesiologist is mandatory.

Guidelines for the administration of propofol for gastrointestinal endoscopy have been published by Dumonceau Jean-Marc et al. NAAP: ESGE-ESGENA Guideline 2015. Endoscopy 2015; 47: 1175–1189.

Its top five recommendations are as follows:

1. Assessment of anesthesia risks beforehand
2. Involvement of anesthesia if ASA status is ≥ 3
3. Consideration of capnography to monitor respiration
4. Preferable propofol monotherapy
5. Administration with infusion/perfusor instead of bolus

Examples of practice:

- Presence of an anesthesia nurse with experience in propofol administration
- Use of a perfusor system for propofol administration: performing titration till hypotension is observed and then decreasing the dose; minimizing the combination with other sedatives, such as midazolam or opioids
- Elaborate patient monitoring with blood pressure, oxymetry and EKG, including thoracic impedance monitoring of respiratory rate
- Equipment for resuscitation, including mask, oxygen and defibrillator in the room
- Collaboration with anesthesiologists for emergency situations

Risks of propofol administration:

Several meta-analyses of randomized controlled trials that reported the safety of propofol versus traditional agents (benzodiazepines plus opioids) for sedation during endoscopy have found no increase in cardiopulmonary complications (Qadeer MA, Vargo JJ, Khandwala F et al. Propofol versus traditional sedative agents for gastrointestinal endoscopy: a meta-analysis. Clin Gastroenterol Hepatol 2005; 3: 1049–1056; McQuaid KR, Laine L. A systematic review and meta-analysis of randomized, controlled trials of moderate sedation for routine endoscopic procedures. Gastrointest Endosc 2008; 67: 910–923; Singh H, Poluha W, Cheung M et al. Propofol for sedation during colonoscopy. Cochrane Database Syst Rev 2008; 4: CD006268 DOI 10.1002/14651858.CD006268.pub2; Wang D, Chen C, Chen J et al. The use of propofol as a sedative agent in gastrointestinal endoscopy: a meta-analysis. PLoS ONE 2013; 8: e53311).

Summary:

Propofol is an attractive drug for IR procedure with a high patient satisfaction. Several randomized trials have demonstrated its safe administration by non-anesthesiologists with no increased risk of hypotension or hypoxemia compared with that by traditional

sedation. Collaboration with an anesthesiologist is helpful, but a permanent presence of an anesthesiologist for every propofol sedation appears unnecessary.

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Honorary Lecture

Andreas Gruentzig Lecture

1301.1

Percutaneous treatment of cystic echinococcosis (hydatid cysts): current concepts

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No abstract available.

Hot Topic Symposium

Hot Topics Symposium – Aorta

1302.1

Do the long-term outcomes of EVAR justify its generalised use?

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In previous years, we have come a long way in improving care for our patients with aortic disease. The evolution of endovascular therapy has changed the way of treatment for abdominal aortic aneurysms (AAAs) in a way that no one could have imagined 20 years ago.

The promising initial results have been confirmed by more recent studies. Moreover, long-term follow-up supported the use of stent-graft (EVAR) for the treatment of AAAs.

What we have also observed is an increase in the inclusion criteria; initially, only those patients who were not good candidates for surgery were considered suitable for EVAR, but with each passing year, endovascular procedure has become the treatment of choice even in more complex situations such as short and angulated necks.

Recently, the 15-year follow-up of the EVAR-1 trial reported an aneurysm-related mortality rate greater for patients who underwent EVAR compared with that for those treated with open repair; however, the authors stated that during the entire follow-up, the aneurysm-related mortality was not significantly different between the two groups.

It is interesting that half the patients treated for infrarenal AAAs were still alive 10 years after aneurysm repair.

The OVER randomized trial with a follow-up of 9 years showed no differences between EVAR and open repair regarding survival, quality of life, costs, and cost effectiveness. After a mean follow-up of 5.2 years, mean life-years were 4.89 in the EVAR and 4.84 in the open repair groups.

Similar results were also reported in the DREAM trial: 12-year after initial randomization, the cumulative overall survival rates were 42.2% after open repair and 38.5% after endovascular repair.

Unlike the EVAR-1 trial, increased aneurysm-related mortality after EVAR over the long term was not found in the DREAM trial.

Both EVAR 1 and DREAM trials showed the highest rate of reintervention to be between 4 and 6 years depending on stentgraft durability.

However, we have to consider that these data are correlated with the use of “first” generation devices and that the increased mortality rate seems to be correlated with a higher incidence of post-EVAR sac rupture. Therefore, reintervention rates might be higher compared with more recent studies investigating newer generation stentgrafts.

This is also confirmed by a recent study comparing long-term outcomes with newer and older stentgrafts that demonstrated similar perioperative and long-term mortalities.

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1302.2

Is standard EVAR justified outside IFU?

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No abstract available.

1302.3

Should individualised follow-up after EVAR be the standard of care?

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The use of EVAR for the treatment of aneurysms of the abdominal aorta has become widespread over the previous decades, and this therapy is being used more and more in patients of younger age and

with a longer life expectancy. The typical follow-up consists of CT angiography or Duplex ultrasound performed at regular intervals. CT-based follow-up, although highly reliable, is hampered by the significant exposure to ionizing radiation and the repetitive administration of iodinated contrast medium that may lead to radiation-induced disease and renal failure. Furthermore, these examinations cause a significant economic burden that may comprise 30%–50% of costs of EVAR follow-up.

Finally, with the development of newer generation stentgrafts, a better knowledge on the behavior of stentgrafts, the importance of endoleaks and mechanisms of stentgraft failure, and better sizing and planning (using 3D tools) the number of complications related to EVAR has been reduced significantly.

All these factors require and allow for a more tailored approach for EVAR follow-up. This presentation will discuss the rationale behind such individualized programs of follow-up and will provide algorithms that allow a reduction of the number and alter the type of follow-up examinations after EVAR.

1302.4

Is it justified to treat old and frail patients with TAAA endovascularly?

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The indication to treat an aneurysm is based on the rupture versus surgical risk. In general, abdominal aortic aneurysms (AAAs) deserve treatment when they reach a diameter of 5.5 cm.¹ Smaller aneurysms, as shown by the CAESAR trial, do not deserve treatment even with endovascular repair because there is no survival benefit overall.² For thoracoabdominal aortic aneurysms (TAAAs), the treatment indication threshold has always been 6 cm, mainly in view of the higher risk of an extensive surgery.

In TAAA repair, the impact and risk of surgery is so high that many patients are refused open repair. According to the literature, a high proportion of these TAAAs will rupture and lead to death.³ The option to treat TAAA by endovascular means has logically opened the way to treat patients who would not be offered open repair.⁴ As always, minimally invasive techniques are then “overused” before learning to respect the anatomical restrictions and other limitations. With regard to patient risk stratification, little is known because most articles on complex endovascular techniques state that they treated “high-risk” patients.

We reviewed the results of our TAAA branched cases in terms of the learning curve with regard to technical success, mortality, and outcomes. Growing experience has undoubtedly led to better planning and better execution, with lower technical failure and the possibility to treat more complex anatomies.

The main question for this presentation is whether there still are limitations with regard to the patient risk status. The risk balance analyses are based on the age and comorbidity of the patient on one side and extent of aneurysm and anatomical limitations on the other. The literature should be appraised critically because there is never a clear definition of “high risk.”

Looking back at the 300 TAAA branched cases, in an attempt to divide the patients into an “old and frail” patient group versus a normal “high-risk” group, mortality was clearly higher in the “old and frail” group with 22.7% versus 6.2% in the normal “high-risk” group ($P < .001$) and survival was lower with an overall mortality of 52.9% versus 18.7% ($P = .006$) at a mean follow-up of 24.2 ± 20 months. It is therefore safe to conclude that indications to treat old and frail patients should be exerted with extra caution, especially in TAAAs with borderline diameters or with a challenging anatomy.

Conclusion: “Primum non nocere” in old and frail patients.

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Special Session Dialysis fistula management beyond PTA

1702.1

Surveillance: clinical or ultrasound

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Learning Objectives

1. To learn what the clinical parameters to assess for fistula surveillance are
2. To learn the pros and cons of different imaging techniques
3. To learn when to treat a failing fistula

Introduction

Chronic kidney disease is becoming a global healthcare problem with worldwide incidence and prevalence. Majority of patients with chronic kidney disease rely on hemodialysis to survive renal failure. Therefore, a viable vascular access, in terms of function and patency, in these patients is vital. Low access flow and loss of patency may impede adequate hemodialysis and even lead to increased morbidity and mortality. Loss of vascular access patency, usually preceded by the development of access stenosis accounts for 15%–20% of hospitalizations among patients on hemodialysis¹⁻³. Therefore, predicting access failure is of great clinical and socioeconomic importance for both patient and society.

Surveillance

The purpose of structural surveillance program is to detect access stenoses in a timely manner, allowing for early treatment to prevent under-dialysis and thrombosis. To forecast access dysfunction, several techniques are available.

Physical examination

Inspection, palpation, and auscultation are the three main components of physical access examination, which can be used to assess vascular access function. The swelling/edema of the extremity, ischemic fingers, aneurysms, and/or collateral veins can be detected

by visual inspection and may be related to access-related complications. Although subjective, assessing the strength of the arterial inflow and venous outflow by palpation and/or auscultation is a useful test. In general, a fistula has a continuous thrill and is soft and compressible. However, in presence of a downstream stenosis or occlusion, the fistula becomes very pulsatile ("water-hammer pulse") with a weak thrill. Conversely, a weak pulse indicates poor arterial inflow and/or a stenosis at the anastomosis level. In addition, the location of stenosis can be palpated by experienced hands. In grafts, the direction of flow can be easily detected using a simple compression maneuver. A local intensification of bruit over the graft or the venous anastomosis may indicate a stenosis⁴. Although proven to be cost-effective, regular physical examination has not become very popular among nurses and/or doctors in the hemodialysis departments. This is probably due to the high workload in the dialysis departments and also due to the lack of specific training, which plays an important role.

Indirect flow measurement

The ultrasound dilution technique is a well-established method for indirectly measuring access blood flow during hemodialysis. Using ultrasonic sensors, changes in protein concentration can be measured while infusing saline distally in the vascular access, which allows the calculation of the access blood flow. Although the accuracy of this technique is influenced by many (hemodynamic) parameters that potentially under- or overestimate the flow, it is the most validated and broadly accepted technique⁵.

Venous dialysis pressure

Although measurements of pressure from the hemodialysis circuit were not originally designed to assess access (dys)function, it is currently one of the surveillance tools. Pressures can be measured through the arterial and venous needles and have to be compared with each other as well as to the mean arterial pressure to assess the location of the possible stenosis. When the intra-access pressure increases to >50% of the mean arterial pressure, graft flow is likely decreased to the thrombosis-prone range and the presence of stenosis is likely. Because of the variability of the hemodynamic parameters, there is little correlation between a single measurement of flow and pressure. Serial measurements of pressure in each patient are more valuable than isolated measurements⁶.

Duplex ultrasound

Duplex ultrasound allows for direct flow measurement by assessing the blood flow velocity in relation to the cross-sectional area of the access. The accuracy of the measurement strongly depends on a correct Doppler angle and on a proper estimation of the cross sectional area, which makes the technique error-sensitive and operator-dependent. Furthermore, duplex ultrasound is not very sensitive in the region of the central veins⁷. However, in experienced hands, it is a valuable tool not only to assess the access flow but also to locate the underlying stenosis, which is particularly helpful in planning the subsequent (percutaneous) intervention. In addition, several studies have suggested that duplex-guided balloon angioplasty of failing or non-maturing AVFs is feasible and safe even when it is performed as an office-based procedure⁸.

Magnetic resonance angiography

Magnetic resonance angiography (MRA) is an attractive modality for evaluating both hemodialysis access anatomy as well as function. Using phase-contrast and time-of-flight techniques, it is possible to assess the vascular access flow without the need to administer contrast media. However, the wide range of flow rates complicates interpretation: high flow rates may produce signal voids, suggesting severe stenoses at only mild narrowings and/or sharp-angled anastomoses. Contrast-enhanced MRA has been shown to be a reliable tool for detecting stenoses and occlusion not only in the upper extremity veins but also in the arteries. However, apart from issues regarding the costs and availability of this technique, all interest in the MRA imaging of dialysis accesses has virtually evaporated due to concerns regarding the use of gadolinium in patients with renal

failure⁹. The recent development of other more modern and safe gadolinium-based contrast agents will perhaps revive the research into the MRA imaging of hemodialysis accesses.

Multi-slice computed tomographic angiography

Multi-slice computed tomographic angiography (CTA) is a relatively new minimal invasive technique for stenosis detection in hemodialysis access. Multi-slice CTA has been shown to be clinically feasible for evaluating the complete vascular tree¹⁰. Moreover, the modern dual-source CT systems can provide hemodynamic details over the access. However, concerns regarding radiation exposure and the use of contrast agents hamper the widespread application of CTA for access imaging.

The rationale for surveillance is based on the assumption that progressive stenoses are accurately detected before thrombosis and that the patency of the vascular access can be maintained with subsequent open or percutaneous intervention. However, to date, randomized controlled trials have not consistently shown that surveillance programs improve outcomes in grafts, which might be explained by the number of clinical and hemodynamic parameters, variation in definitions, and differences in the risk of thrombosis. Thus, surveillance aimed at a high sensitivity in predicting thrombosis has a high false-positive rate that likely yields many unnecessary intervention procedures. Furthermore, balloon angioplasty by definition induces a mechanical trauma, accompanying neointimal hyperplasia and thereby the risk of stenosis and impaired access survival. Given the poor reproducibility of the measurements, it seems plausible that the surveillance will improve if measurements are taken more frequently. Regular, consecutive measurements would allow the calculation of average values that may neutralize hemodynamic variation. Embarking on this strategy will have consequences for staff resources, will require significant patient time, and will cause inconvenience.

Despite the controversial data, surveillance continues to be widely supported as a routine part of access maintenance. The KDOQI guidelines recommend an intervention when graft flow is <600 ml/min or when the flow has decreased by >25% and falls below 1000 ml/min. Fistula referral is not recommended until the flow is <400–500 ml/min because fistulae may remain patent at a flows lower than graft flows.

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1702.2

DCB to improve patency

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Learning Objectives

- To learn what the current status of DCB is
- To learn when DCBs should be used
- To learn about current trials

No abstract available.

1702.3

The role of stent grafts

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Learning Objectives

- To learn what the current status of stent grafts is
- To learn when stent grafts should be used
- To learn about current trials

Stent grafts are becoming more widely used in the treatment of dysfunctional dialysis accesses. Industry-sponsored randomized trials have suggested that stent grafts may have a higher primary unassisted patency over angioplasty alone; it should be recognized that the inclusion and exclusion criteria of such trials are selective and may not reflect many real-world situations. Although evidence continues to accumulate for stent graft placement over angioplasty, the incremental benefit in patency following stent graft placement as a first-line approach has not been proven a more cost-effective strategy to maintaining access patency. Several clinical scenarios exist in which there is a clear clinical benefit of stent grafts, and other scenarios exist in which stent grafts should be used sparingly until more data justify their application.

Clear benefits of stent grafts:

Angioplasty-induced venous rupture

Most small venous tears following angioplasty within dialysis fistulae can be treated with balloon tamponade (Trerotola). This is an especially effective strategy when the angioplasty location is within or adjacent to needle cannulation zones. Larger tears and ruptures, which do not respond to balloon tamponade maneuvers can benefit from stent graft placement as it can reduce resultant peri-access hematoma formation and blood loss as well as avoid catheter utilization from hematoma-induced arm swelling.

Recurrent venous stenosis

Two well-described anatomic locations that appear to benefit from recurrent restenosis following angioplasty are the terminal cephalic arch and the transition between in-situ and transposed basilic vein fistulae. The cephalic arch is a challenging location for stent graft placement as the extension of the device into the axillary-subclavian junction can produce upper-extremity deep-vein thrombosis, intractable arm swelling, or both. Moreover, the altered fluid dynamics and wall shear stress at this site induced by the placement of a stent graft (with a resultant jet of blood against the opposing venous wall in the axillary vein) may accelerate intimal hyperplasia and restenosis; more data is needed for routine use in these settings.

Settings where stent grafts should be used sparingly or not at all:

1. Critical venous junctions

Stent grafts can impede venous drainage from the arm or lower extremity when placed with the covered segment spanning the confluence of dialysis access outflow and the venous drainage of the extremity. Examples of this include the cephalic arch in brachiocephalic fistulae, radiocephalic fistulae with dominant venous outflow into the basilic and brachial veins, and thigh fistulae when the greater saphenous vein is used as venous outflow. Superficial and/or common femoral veins may be compromised.

2. Preservation of collaterals when treating arterial inflow disease

Patients with symptomatic peripheral arterial disease contributing to vascular steal symptoms will often benefit from endovascular treatment of hemodynamically significant inflow stenosis. These arterial lesions may be subject to in-stent stenosis, and stent graft placement may cover critical collateral vessels.

3. Cannulation zone of access

Although every attempt should be made to avoid placing any stent within a cannulation zone of an access, there are scenarios in which failure of angioplasty/thrombectomy may require stent placement within a cannulation segment to prevent certain access failure. Repetitive needle cannulation through the interstices of a bare metal stent can produce stent fracture; however, bare metal stents appear less susceptible to cannulation-induced damage and infection compared with stent graft counterparts.

4. Preservation of the interval jugular vein during treatment of central venous lesions

It is usually possible to place a tunneled catheter through the interstices of a bare stent using a directional catheter and guidewire to cross the interstices and then to perform serial dilation to enable the placement of a peel-away sheath. This may be difficult or impossible when the internal jugular vein is covered by a stent graft.

5. Across the elbow in treating outflow stenosis in forearm fistulae

Repetitive flexion and extension in the movement of the elbow appears to produce early stent graft thrombosis.

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1702.4

Percutaneous creation of an AV fistula

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Learning Objectives

1. To learn what the purpose of creating percutaneous fistulas is
2. To learn about the current alternative methods
3. To learn if there is already enough evidence

Introduction

The arteriovenous fistula (AVF) is well accepted as the primary access option to facilitate dialysis treatment for patients with end-stage renal disease. AVFs have better overall long-term durability than the current next best option, i.e., arteriovenous grafts [1]. However, AVFs still exhibit high rates of primary failure (15%–46%), early thrombosis (10%–23%), and interventions (1-2 per patient-year) despite the many procedural advances in surgical creation over the years in Europe [2-7]. The result is high patient costs (~€80 000 per patient-year) and dissatisfaction that leads to the refusal of treatment in favor of central venous catheters [8].

The percutaneous creation of an AVF may provide some benefits that can address the challenges faced by surgery. The Achilles heel of the surgical AVF appears to be early juxta-anastomotic stenosis that likely results from the trauma of surgically dissecting, mobilizing, and suturing of the vein to the artery [9-11]. Additional challenges arise from the surgical inconsistency in technique from center to center and surgeon to surgeon that results in a wide range of reported outcomes [9-13]. Lastly, avoiding open surgery helps to minimize the risk of infection and morbidity in patients due to the AVF.

Recent advances in catheter-based technology provide an opportunity for interventional radiologists to create an AVF in a minimally invasive, consistent procedure. The endovascular procedure may reduce the incidence of primary failure, early thrombosis, and re-interventions by avoiding the need to dissect, mobilize, and suture the vein. The consistency and reproducibility of a catheter-based approach may also serve to normalize outcomes across vascular centers.

Here, a summary of the clinical outcomes from prospective studies and real-world experience will be reviewed. The outcomes will demonstrate that percutaneous AVF creation has a high technical success rate with low rates of early thrombosis and requirement of few interventions to achieve a high rate of maturation and usability. These outcomes were consistent across the prospective clinical studies and real-world experience.

The endovascular AVF procedure

The first endovascular AVF (endoAVF) creation called the everlinQ™ endoAVF System for hemodialysis device was introduced in Europe in 2015 by TVA Medical, Inc. The system comprises a venous and an arterial catheter that align at the target AVF creation site via magnets. The endoAVF is created between the artery and adjacent vein (venae comitantes) in the ulnar artery/ulnar vein or the radial artery/radial vein distal to the perforating vein in the upper forearm. Access is gained in the brachial artery (antegrade) and brachial vein (retrograde) of the upper arm. Once the catheters are in place, an electrode housed in the venous catheter delivers radiofrequency energy for less than 2 s to create a channel between the artery and the vein. The close proximity of the artery and venae comitantes (<2 mm from the inner lumen to the inner lumen) and the dense surrounding tissue of the pedicle facilitates the shunting of blood from the artery to the vein without extravasation. The cephalic and basilic veins receive immediate arterialized flow from the endoAVF via the perforating vein. One of the two brachial vein comitantes is intraprocedurally embolized in a location proximal to the endoAVF to divert more flow to the superficial system.

Maturation typically occurs within 60 days post creation. The endoAVF forms an endothelium along the channel within 30 days post procedure creating a native vessel lacking intraluminal scarring or stenosis. The cephalic and basilic/medial cubital vein segments are available for cannulation starting in the forearm, which is unique to this type of AVF. The cephalic vein is the primary choice for cannulation, but adequate length of the basilic/medial cubital vein segment is available for cannulation without elevation as well.

Clinical outcomes

Outcomes using the everlinQ system in patients with end-stage renal disease who required dialysis have been reported in two prospective clinical studies: FLEX and NEAT. Each study followed similar exclusion/inclusion criteria: target vein and artery diameters of ≥ 2.0 mm, life expectancy of >1 year, absence of central or ipsilateral upper extremity venous stenosis, or ineligibility for a distal forearm fistula. Key outcomes included technical success (creation of a patent connection between the artery and the concomitant vein, with brisk flow demonstrated by angiography and absence of appreciable extravasation), maturation (brachial artery flow > 500 ml/min and vein diameter > 4 mm), initiation of dialysis via two-needle cannulation, and early thrombosis (thrombotic occlusion within 3 months of creation). In additional, intervention rates and subsequent cost analysis in NEAT were compared with those of a propensity-score matched surgical AVF cohort from the Medicare database. FLEX was a prospective first-in-man study to assess the feasibility of percutaneous AVF creation, and it evaluated the utility of the endoAVF to provide dialysis access [14]. The study enrolled 33 patients from August 2012 to September 2013 and reported outcomes during a 6-month follow-up period. Technical success was achieved in 97% (32/33) of patients. One patient was lost to follow-up, and four patients died during the follow-up period from causes unrelated to the procedure. Maturation was achieved in 96% (27/28) of the remaining patients with 96% (25/26) initiated dialysis via their endoAVF by 6 months. Two additional patients had usable access but remained pre-dialysis patients. The mean time to pAVF maturation was 58 days (range, 37–168 days). One serious procedure-related adverse event (pseudoaneurysm that resolved with thrombin injection) and five minor procedure-related adverse events were reported. No access related infections were observed.

NEAT was a prospective, multi-center study across Canada, Australia, and New Zealand that was designed to assess the safety and efficacy of the endoAVF [15]. The study enrolled 60 patients in the evaluable cohort plus an additional 20 roll-in patients. EndoAVF was created in 98% (59/60) of patients, with 91% (52/57) achieving physiological maturation and only 1.8% (1/57) experiencing early thrombosis. Five patients (8.3%, 5/60) experienced serious procedure-related adverse events, with only one categorized as having device-related adverse event (1.7%, 1/60). No access related infection was observed. Compared with a propensity-score matched surgical AVF control group from the Medicare database, the endoAVF required fewer post-creation procedures (0.59 vs. 3.43 per patient-year, $p < 0.0001$), with fewer event rates for angioplasties, thrombectomies, catheter placements, AVG creations, new surgical AVF creations, and vascular access-related infections. The reduction in interventions has a reported cost savings of ~\$11,240 USD for the first year for each patient with AVF [16].

In additional, the real-world experience in Germany at the Universitätsklinikum Carl Gustav Carus Dresden was reported previously at CIRSE 2016 by Radosa et al on the first eight patients [17]. Technical success was achieved in 100% of patients with no serious peri-interventional complications. Cannulation was initiated in 100% (7/7) of patients, of whom one patient was lost to follow-up and another required an elevation procedure. The median time to endoAVF maturation was 63 days (range: 26–137 d) with the elevation patient being cannulated at day 137 post creation. No interventions to restore patency, incidence of early thrombosis, or access infections occurred during this data release.

Discussion

The observed clinical outcomes were comparable with those expected from surgical AVF creation, except potentially lower rates of interventions and thrombosis. A critical metric of successful AVF creation is the initiation of sustained two-needle cannulation for the delivery of adequate dialysis. Once two-needle cannulation begins, the patient's central venous catheter, if they have one, can be removed, which is a primary goal of providing high-quality dialysis care. The experience so far demonstrated that two-needle cannulation was initiated in 67%–96% of patients, which is similar to 54%–85% of surgical patients reported in European patient cohorts [2–5]. However, the delivery of dialysis via the endoAVF was achieved with less than one intervention per patient-year, whereas surgical AVFs have been reported to require one to two interventions per patient-year in European cohorts [5–7]. In addition, the early thrombosis as a failure mode tended to be low in the endoAVF clinical studies, and no early thrombosis occurred in the Dresden patient cohort. In contrast, early thrombosis of surgical AVF has been reported in 10%–23% of patients in European cohorts [5–7]. As with any new technique, a learning curve with the endoAVF procedure was observed and attributed to endoAVF intervention or abandonment in a few patients. These procedural complications are expected to be alleviated with training and experience.

In conclusion, the endoAVF appears to be a safe and effective option to provide patients with a functioning AVF. EndoAVF creation has demonstrated high technical success rate with low rates of early thrombosis and requirement of few interventions to achieve a high rate of maturation and usability across multiple clinical settings. The clinical study results have been consistent across multiple studies. The results from the real-world experience in Germany have been similar to the results reported in the prospective clinical studies. A prospective, multi-center European study is currently ongoing to further evaluate the benefits of the endoAVF for dialysis patients.

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Fundamental Course

Therapy of painful bone metastases

1703.1

Combination of radiotherapy and IR

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Learning Objectives

1. To learn how to use radiation therapy in painful bone metastases
2. To learn how to combine radiation therapy to IR techniques
3. To learn how to evaluate current results reported in the literature

Bone metastases have been observed in a high percentage of patients with cancer, showing a variety of symptoms and affecting the quality of life and survival of patients. A multidisciplinary approach from different healthcare providers, including radiation oncologists, international radiologists, medical oncologists, and surgeons, is required for treatment. The role of radiotherapy in the management of bone metastases has long been established through multiple randomized trials. Several equivalent schedules of radiotherapy have been reported, such as 5x400cGy, 10x300cGy, and 1x850cGy. The estimation of response to the therapy is subjective and is based on the palliation of the symptoms in terms of quality of life and pain scores. Objective measurements have also been analyzed mainly in terms of the bone density. The combination of IR and radiotherapy is currently a promising tool for the management of bone metastases, increasing the therapeutic effect of both methods in terms of pain relief and improvement in the bone density in

affected areas (mainly lytic). The sequel of either irradiation or IR is currently under investigation with prospective trials.

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1703.2

Bone augmentation

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Learning Objectives

1. To learn how to use different bone augmentation techniques
2. To learn how to avoid limitations of standard cementoplasty
3. To learn how to evaluate current results reported in the literature

No abstract available.

1703.3

Ablation for therapeutic and palliative treatment

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Learning Objectives

1. To learn how to use ablation in painful bone metastases for therapeutic purposes
2. To learn how to use ablation in painful bone metastases for palliative purposes
3. To learn how to evaluate current results reported in the literature

In the modern era of interventional radiology focused on oncological patients, the ablation techniques are not any more limited to the usual targets such as HCCs and primary lung tumors and are finding new targets, particularly in MSK tumors of both benign and malignant nature. In the literature, the most encountered benign tumors treated via ablation are osteoid osteoma, although the application of ablation in osteoblastoma, chondroblastoma, and osteochondroma has been reported to show good results. In turn, malignancies of the bones are rare, with spinal metastases (originating from carcinomas of the breast, lung, prostate, kidney, and uterus) likely being the most common one. It should be emphasized that in most cases, palliative measures are related to malignant cancer and the patient's quality of life and mortality are the priority. Recently, the indication of tumor control with the intent of increase in the overall life expectancy has been emphasized, particularly in patients with an oligometastatic disease, a good performance status, and a life expectancy of more than 6 months. The treatment of spinal lesions could be challenging considering the risk of severe neurologic dysfunction with dramatic consequences pertaining to the quality of life. For these reasons, some precautions must be taken in order to prevent such risks. For the same reason, among the ablation techniques, cryotherapy is gaining interest of the IR community due to its powerful pain management feature and the possibility of an instant check of the ice ball, preserving nervous tissues, particularly in case of vertebral metastases. Nevertheless, ablation may be applied both for curative and palliative strategies when combined with cement injection, allowing a precise patient selection. New heroes of oncologic interventions and probably future trend are MR-guided HIFU (also known as FUS) and irreversible electroporation despite requiring a higher cost. Improved research in the field is strongly needed to assess a proper cost-effective analysis and the limits of these approaches.

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1703.4

Transarterial embolisation of skeletal and spinal metastases

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Learning Objectives

1. To learn how to apply indications for embolisation in skeletal and spine metastases
2. To learn how to use tips and tricks to increase success and limit complications
3. To learn how to evaluate current results reported in the literature

Introduction

Osseous metastases may result in intractable pain, instability/fracture and neurologic compromise. Embolisation alone or in combination with other techniques should be a part of the treatment algorithm^{1–3}. The goal is tumour devascularisation without non-target compromise, resulting in reduced tumour turgor and periosteal pain fibre stimulation. Additional potential benefits include reduced recurrence rate and prolonged survival; chemoembolisation is under active investigation.

Indications

Pre-operative embolisation limits intra-operative blood loss^{4–16}, ensuring optimal visualisation and adequate resection⁴ and reducing operative duration and mortality. Without embolisation, resections are occasionally abandoned due to uncontrolled haemorrhage^{17,18}. Embolisation has an important role in the palliative setting, frequently in combination with other modalities^{2,3}.

Patient selection

Predictors of a positive outcome post-embolisation are purely lytic tumours, pathologic fractures, rapid increases in size and progressive destruction⁹. Embolisation is not precluded by the presence of prior instrumentation and may be repeated. If embolisation and radiotherapy are both planned, the latter should be performed first because its efficacy depends on the target oxygenation¹⁹.

Angiographic Anatomy

A thorough knowledge of the locoregional arterial anatomy, variants, anastomoses and variations in flow patterns that may occur during embolisation is critical for avoiding complications.

Embolisation

Once stable access proximal to the tumour circulation is secured, angiography demonstrates the arteries supplying the tumour and those supplying the potential at-risk structures. Road mapping and super-selective microcatheters are routinely employed.

Calibrated particles are the preferred agents given their predictable distribution, reduced tendency to clump and less microcatheter occlusion. No clinical advantage was identified when polyvinyl alcohol or trisacryl microspheres were compared²⁰.

If an adequate collateral circulation is present, prophylactic coiling distal to the tumour circulation may be appropriate to protect non-target tissues²¹.

Most frequently, 300–500-micron particles are used. Extra caution is required when using 100–300-micron particles given the increased risk of non-target embolisation through intra-lesional arteriovenous anastomoses. Particles less than 100 microns should be avoided because of potential passage into the systemic venous circulation.

Alcohol is discouraged in the spinal setting given its propensity to pass into the radiculomedullary branches with resultant spinal cord infarction¹⁰.

Proximal embolisation of feeding vessels (with coils or gelfoam) is doomed to failure because rapid collateralisation may occur within hours; however, these agents have a role in the setting of life-threatening haemorrhage. The more complete the devascularisation is and the sooner a surgery follows the embolisation, the greater is the reduction in perioperative blood loss^{22–24}.

Complications

In experienced hands, the risk of neurologic complications is less than the quoted 2%.

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Special Session

Advanced biliary therapies

1704.1

Gallstone retrievals

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Learning Objectives

1. To learn about proper patient selection
2. To learn about the several PTC retrieval techniques
3. To learn how to make the procedural management and to avoid complications

Percutaneous cholecystostomy (PC) is an established lifesaving drainage procedure for the management of high-risk patients with acute cholecystitis. Acute cholecystitis might be the result of calculous disease. After PC, transcatheter cholangiography is performed to assess the patency of cystic duct, presence of gallstones and catheter position. After the end of inflammation, if patients are still considered as inoperable, percutaneous treatment with gallbladder stone retrieval can be attempted.

In the last 20 years, interventional radiologic techniques for the treatment of gallstone disease have become more widely available. In the past, percutaneous chemical ablation of the gallbladder was a relative popular method offering a potential solution to the problem of gallstone recurrence. So, in the late 90s, contact dissolution of stones with methyl tert-butyl-ether and percutaneous extraction of calculi was treatment options in such patients. In patients with cholesterol-rich gallbladder stones and a patent cystic duct, complete stone clearance rates of 65-90% have been reported using oral bile acids (OBAs) alone or with adjuvant lithotripsy (extracorporeal shock-wave lithotripsy; ESWL).

With increasing use of intra-corporeal gallstone lithotripsy techniques, combined fluoroscopic with or without direct cholangioscopic visualization during percutaneous procedures become more

important. Limitations or relative contraindications to percutaneous cholecysto-lithotomy (PCCL) were a small, shrunken, thick-walled gallbladder or an intrahepatic gallbladder.

First, tract dilation had to be performed until a quite wide and mature channel was formed. After that, peel-away sheaths was introduced through which further interventions were operated. A safety guide wire had to be placed outside the sheath in order to get new access in case something went wrong. Endoscopes, stone-baskets, extraction balloons and other instruments were inserted through the sheath for a less traumatic procedure. Complete stone clearance can be achieved using multiple sessions over several months. Gallstones complete clearance of over 80% is reported in the literature. Complete symptom relief can be obtained in more than 95 percent of these patients.

Patients with Mirizzi syndrome involving a common bile duct stone are rare cases. Trans-cholecystic treatment using lithotripsy via a cholangio-fiberscope can be performed in such patients.

Complications associated with PC usually occur immediately or within days and including haemorrhage, vagal reactions, sepsis, bile peritonitis, pneumothorax, perforation of the intestinal loop, secondary infection or colonization of the gallbladder and catheter dislodgment. Regarding stone extraction, biliary fistulas and major bile leakages may be encountered.

In experienced hands, PCCL can be a safe, effective procedure for clearing the gallbladder of calculi regardless of their size, composition, or number. It preserves the gallbladder, enables possible restoration of contractility, and can be performed without general anesthesia. The purpose of this presentation is to illustrate the techniques and to discuss the indications, complications, and technical difficulties of this alternative percutaneous treatment option.

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1704.2

Biliary lithotripsy

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Learning Objectives

1. To learn about the indications of biliary lithotripsy
2. To learn which devices can be used for this technique
3. To learn about the success rates and clinical outcome

It is noteworthy that bile duct stones are related to the development of further diseases such as recurrent cholangitis, biliary cirrhosis and cholangiocarcinoma.

At present, endoscopic retrograde cholangiopancreatography (ERCP) associated with endoscopic sphincterotomy (EST) represents the first-line approach for the removal of bile duct stones. However, some stones may be refractory or not suitable for endoscopic removal, thereby requiring additional or other therapeutic options. Those stones are called 'difficult bile duct stones' and may be associated with one or more of the following features: perampullary diverticula, previous surgery, large stones (≥ 20 mm), presence of multiple stones, stones above a stricture, intrahepatic stones, impacted stones and patient's clinical conditions that actually represent main indications for percutaneous cholangioscopy (PTCS) and lithotripsy.

Surgery was mainly indicated in relatively young patients with good clinical condition/fair liver function with unilobar hepatolithiasis, particularly left-sided, atrophy, fibrosis and multiple abscesses secondary to cholangitis and/or suspicion of concomitant operable intrahepatic cholangiocarcinoma.

In patients not suitable for surgery or endoscopy, 'difficult bile duct stones' may be treated with a combination of PTCS and interventional radiology (IR) techniques or IR techniques alone according to the extent of the disease. The correct choice can be made according to the Tsunoda classification (from class I to IV) and stone size (i.e. greater or smaller than 25 mm). To classify and select patients appropriately, magnetic resonance cholangiopancreatography (MRCP) or post-contrast CT should be performed beforehand.

In case of stones less than 20 mm and mainly located in the common bile duct (CBD) at imaging, the endoscopic approach (ERCP) should be attempted first.

If this fails or in the presence of larger stones (>20 mm), intrahepatic or impacted stones or stones associated with narrowed CBD, a percutaneous approach should be considered as the preferred method. If a percutaneous approach is decided, a US-guided puncture or double puncture technique should be chosen according to the Tsunoda class, location of the target stones and bile duct anatomy (any anatomic variant should be promptly recognised as it may impact the technical success).

IR techniques, such as PTC which are associated with the use of large PTA balloons (used to dilate strictures) and basket-type catheters, were mainly indicated in Tsunoda class I patients with a few stones less than 25 mm in diameter. In more complex cases, the use of a cholangioscope (CS) was recommended under general anaesthesia. Large-bore or small calibre CS with electrohydraulic lithotripsy (EHL) or laser probes may be used according to the extent of the disease and patient's characteristics. Recent studies reported the use of small calibre CS with EHL or YAG laser (approximately 3 mm in calibre) obtaining complete stone clearance in more than 80% cases. Also, large-bore endoscopes have been used (16 or 18 Fr calibre)

with a low complication rate. Generally, large CS should be used mainly in complex Tsunoda class III and IV patients.

In our and other recent studies, the technical success (complete stone clearance) was above 83% with combined techniques. If only IR techniques were used, intrahepatic stone clearance may drop down to 61% as reported by Ozcan et al. In our series, most complex patients needed at least three sessions for complete stone clearance.

The recurrence rate may vary according to the complexity and type of techniques used, ranging between 15% and 56% of patients treated. Usually, recurrent cases are successfully treated with similar techniques.

Major complications from PTCS with EHL/Laser may be major bleeding that requires embolisation ($<2\%$), cholangitis/infection (10%) and perforation/bile leakage ($<1\%$).

In conclusion, the combined radiological-endoscopic approach for 'difficult bile duct stones' represents a reliable option in cases not suitable for endoscopy or surgery. Despite the lack of randomised controlled trials or large prospective studies, large retrospective studies reported good clinical outcomes, with a low recurrence and complication rate.

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1704.3

Brachytherapy

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Learning Objectives

1. To learn about the proper indications of biliary brachytherapy
2. To learn about the treatment protocol and the medical devices to perform the procedure
3. To learn about the clinical outcome and the clinical trials available on this technique

Biliary cancer remains a complex medical problem. The typical hilar location, infiltration, and longitudinal spread along the bile ducts as well as the occlusion of vascular bundles frequently make R0 resection difficult or even impossible to achieve. Chemotherapy and its combination with radiotherapy can prolong survival, but their results are still far from satisfactory.

Despite adenocarcinomas of the bile ducts being regarded as tumors with low radiosensitivity, data in the literature support the

use of radiotherapy as palliative care for tumors in this location. Lethal radiation doses for adenocarcinomas are high (up to 60 Gy), and increasing doses heighten the risk of damage to surrounding healthy tissues. Perihilar location of tumors is risky because of radiation sensitivity of the liver, whereas distal tumors affecting the bile ducts can only be irradiated while considering the vicinity of the duodenum and the small intestine with caution.

Intraluminal brachytherapy of the bile ducts is a minimally invasive method that can overcome disadvantages of high-dose external-beam radiation therapy. It has the possibility of administering higher radiation doses in a shorter time than with external radiation. In brachytherapy, percutaneous access is used to reach the bile ducts or it can be endoscopically applied through an implanted drainage catheter. Fletcher et al. were among the first to use intraluminal brachytherapy with iridium as a radiation source (iridium-192) in the late 1970s.

When using intraluminal radiation therapy with an iridium radiation source, iridium is shaped into cylindrical, granular, or filiform particles that emit gamma and beta radiation within the affected area. Afterloading systems are currently used for administering brachytherapy. These automatically place the radiation source into an applicator positioned in a pre-established location. High-dose rate (HDR) techniques with an application of >12 Gy/hour or low-dose rate (LDR) techniques with an application of <2 Gy/hour are used. Advantages of HDR brachytherapy are shorter hospitalization time and according to the literature, lower rates of cholangitis due to drain occlusion. Brachytherapy and external beam radiotherapy techniques can be safely combined; the objectives being not only to limit the effect of radiation therapy to the bile ducts but also to irradiate lymphatic drainage. There are local differences depending on the radiation dose applied in brachytherapy. When combining external radiation therapy and brachytherapy, the usual dose is in the range of 7–30 Gy, prescribed at a distance of 0.5–1.0 cm from the center of the source in 1–6 fractions. Each fraction typically consists of 5.0–7.5 Gy and takes several minutes in one HDR brachytherapy session. In the case of standalone brachytherapy, 20–42 Gy is applied.

During the administration of brachytherapy, cholangitis and liver abscess may develop because of cholestasis. It is necessary to anticipate acute and late radiation toxicity, particularly when HDR brachytherapy is combined with external radiotherapy. Thirty-day patient mortality is reported on rare occasions, and biliary and gastrointestinal bleeding have been occasionally reported in other studies. Symptoms of gastrointestinal toxicity appear in up to 30% of patients, most frequently as very moderate vomiting and nausea, while gastrointestinal ulceration and erosion may occur in later stages.

It is frequently recommended to concurrently administer chemotherapy with radiation therapy when treating tumors of the extrahepatic bile ducts. One of the negative aspects of concomitant radiation and chemotherapy can be disproportionately increased toxicity of such treatment to healthy tissues. Indication for this combination therapy must be carefully and individually considered with respect to the overall state and intercurrent diseases of a particular patient.

The effectiveness of brachytherapy has been observed in both prospective and retrospective studies. In the case of distal extrahepatic carcinoma, it has contributed to prolonging median survival to the range of 10–14 months. The largest study was published in 2010 by Shinohara et al., analyzing 193 patients with cholangiocarcinomas treated with brachytherapy. The overall median survival was up to 11 months, while it reached to only 4 months in a large control group without radiotherapy (6,859 patients).

Brachytherapy, while prolonging stent patency, can provide longer patient survival times and improve the quality of life. Brachytherapy can be used as a solitary source of radiation therapy to prevent reocclusion. In a prospective study, Chen et al. applied HDR brachytherapy after insertion of self-expandable metal stents. A significantly

longer stent patency duration was achieved in patients undergoing brachytherapy (12.6 vs. 8.3 months). Long-term patency of metal stents was also achieved by Park et al. on administering external radiotherapy only at a dose of 45–50 Gy.

Another option enabling HRD delivery is the use of iodine-125 seeds (radioactive half-life of 60 days), which could be permanently implanted in tissues with an effective radiation radius of 20 mm. Stranded seeds in a 4-F tube retained by a metal stent or seeds attached directly to the stent structure could be employed. Rather smaller randomized study groups showed prolonged patency rate of metal stents and survival of patients with malignant biliary obstruction.

Despite positive results of brachytherapy with respect to prolonging patient survival and symptom palliation, this technique remains in question because of the organization of care and markedly extended hospitalization times.

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1704.4

Biliary RFA

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Learning Objectives

1. To learn about the main indications of biliary RFA
2. To learn about the procedural setup and treatment protocol
3. To understand success and potential complication rates

Introduction

Biliary obstruction is a common problem in various HPB malignancies. Significant number of such patients turn to be unsuitable for radical surgery and thus, need palliation for jaundice. Endoscopic retrograde cholangiopancreatography (ERCP) or percutaneous transhepatic biliary drainage (PTBD) with stent placement has been documented to be an effective palliation for malignant biliary obstruction. However, occlusion of the stent is frequently observed because of tumor in-growth, epithelial hyperplasia, and sludge deposits. To

increase the duration of stent patency and exert local tumor destruction local ablative therapy, radiofrequency ablation (RFA) might be used. RFA has been widely accepted as an effective and safe treatment option in oncology practice, but traditional RF devices cannot be used to treat the biliary tree tumours, perihilar obstructing proximal bile duct tumours, or distal duct obstructing tumors. Therefore, Habib™ percutaneous HPB (EMcision Ltd, London, UK) endoluminal device that can be introduced into the bile duct lumen over the wire was developed.

Here we present the overview of the existing experience in endoluminal RFA application in bile ducts. We will outline physical aspects of the endoluminal RF device; rationale of its application in the bile duct; endobiliary RFA technique, including device delivery methods to the biliary tree target area and power; and time of RF processing. Main indications and outcome, including possible complications, will be discussed.

Technical characteristics of the endoluminal RF device: Habib™ HPB is a single use, disposable, bipolar 8-F catheter with a different working length (90 cm or 180 cm) depending on the method of device introduction into the “target” area: the percutaneous or endoscopic approach. The device is positioned in the bile duct obstructed segment for coagulation and ablation of the tissue. A radiofrequency power is applied to the electrodes at the tip of the catheter so that heat is applied to the tissue surrounding the catheter. The device comprises a catheter with 2 contact electrodes that create a cylindrical coagulation/ablation in the radius of up to 10 mm around the electrodes of the inserted device at a length of approximately 2.5 cm, causing coagulation necrosis of the bile duct obstructing tumor. The RFA device is connected to a compatible radiofrequency generator. The logic of this approach is that intraductal RFA may prolong stent patency, achieve local tumor control, destroy small tumor volume, and palliate large tumors in conjunction with chemotherapy. The important point is that the RF-mediated antitumor immune response, generated by the wide spectrum tumor antigen released on RFA processing, causes massive death of the tumor cells by coagulation necrosis. Indications for biliary RFA are quite similar to those defined for inoperable patients when biliary stenting is used for palliation. Malignant biliary strictures might be caused by a variety of malignant problems, such as cholangiocarcinoma; different types of primary liver tumors; metastasis; and gallbladder, pancreatic, and papilla of Vater carcinoma. If the biliary stricture is caused by malignancy, which is not removable surgically, endobiliary RF processing acts as an important adjunct for widely accepted stent positioning alone, enabling partial destruction of the bile duct obstructing tumor by coagulation necrosis and at the same time, having a potential to “switch on” the antitumor immune response. Biliary RFA might also be used to recanalize stents obstructed by tumor ingrowth into the stent lumen.

Procedural setup and treatment protocol

General considerations

The biliary RFA procedure might be performed using endoscopic or percutaneous approaches under deep venous sedation. The initial steps repeat the technique of an ordinary stent placement, including conduction of the wire through the strictured bile duct segment; as the 0.035-inch-diameter wire is successfully conducted, an 8-Fr-diameter bipolar RF device is advanced over the wire under real-time fluoroscopy guidance and positioned in the strictured duct segment; the stiff wire is helpful in cases where the stricture is very tight. The RF processing with a power of 10–15 watts for 2 minutes is applied to cause coagulation necrosis of the bile duct obstructing tumor. Number of ablation sessions depends on the stricture length; usually, 1 or 2 sessions are used as the biliary RFA device processing length is approximately 2 cm. The procedure is completed with the placement of a metal stent of an appropriate diameter (usually 8–10 mm) over the wire. If self-expanding stents (SEMS) are used, stricture pre-dilation is recommended to exclude the problem of the stent opening on its release, when stent radial force is not enough to

overcome tight stenosis. If the stent does not open completely, balloon post-dilation might be easily performed.

Details of the endoscopic approach: the endoscopic procedure is a straightforward, one-step intervention; the procedure success is documented by visual observation of bile passage from the recanalized bile duct and/or by opacification of the biliary tree by contrast injection.

Details of the percutaneous approach: the percutaneous procedure might be performed as a one- or two-step intervention. In the one-step intervention, PTBD and biliary RFA with subsequent stenting are completed in one session. In the two-step intervention, the first step is PTBD and biliary recanalization by RFA and stenting is performed 1 or 2 weeks later. The percutaneous biliary RFA procedure is terminated by repositioning the transhepatic catheter “above” the positioned stent; the catheter is left closed to have access to the biliary tree in case patency is not restored completely. The catheter is removed a few days later following recheck cholangiography.

Results and complications

Patients were followed up every 2 weeks for 1 month and as per the oncology follow-up protocol thereafter; they underwent clinical examination, liver function tests, and ultrasound scans to rule out cholangitis or biliary obstruction. The key point for achieving technical success in the biliary RFA procedure is conduction of the wire across the stricture; therefore, the technical success rate is actually identical to that with ordinary biliary recanalization by stent placement. To understand the clinical success of the procedure, we need to emphasize the importance of coagulation necrosis of the bile duct obstructing tumor resulting in improved patient survival, as reported by few published papers. Biliary RFA is quite safe and feasible procedure; the only possible significant complication is the perforation of the bile duct with bile leakage because of damage in the extrahepatic bile duct intact segment during RF processing, a possibility that cannot be excluded and can be easily documented on the procedure itself by contrast injection. Usually, normal biliary patency restoration by stent placement is sufficient and addition of antibiotics practically excludes the need of surgery in the management of this complication. Hemorrhage is extremely rare as vessel wall thermal injury is practically excluded by the heat-sinking effect (cooling by blood flow). Subsequently, patients are referred to the oncologists for further management.

Discussion

RFA has been used to achieve localized tumor necrosis in solid neoplasms for many years. It delivers a high amount of thermal energy to the target tissue with curative or palliative intent, but thus far, the intraductal application of RFA has not been considered because of the expected complication of thermal biliary damage, such as bile leakage or biliary stricture. The thermal effect on bile duct has been regarded as the cause of post-RFA biliary stricture. This is the case whenever the energy is delivered to the “outside” of the bile ducts. Here, in contrast, the energy was delivered “inside” the biliary system where the Habib™ Percutaneous HPB takes advantage of the radiofrequency thermal effect as a means to locally destroy the malignant biliary stricture by delivering low radiofrequency energy from 2 electrodes to ensure that the energy is evenly spread around the endoluminal device before the metal stent is positioned. Local coagulation necrosis caused by RFA has the potential to delay tumor growth which might be partially due to RF induced immune response and may prolong the duration of stent patency, finally improving the overall survival.

The endoscopic or percutaneous approach can cover all cases when biliary RFA is needed; each approach has advantages and the more suitable one should be chosen in every case. The advantage of the endoscopic approach is relative low invasiveness (no puncture required). Advantages of the percutaneous approach is the possibility of two-step performance (particularly important in cases with long-standing jaundice and cholangitis), lesser physical distance to the area of interest which enables easier and more effective

manipulation with wires and catheters, and the possibility of maintaining an immediate and easier access to the processed area after the completion of the procedure which enables easy repetition of the procedure, if needed.

Biliary tract RFA in patients with unresectable, malignant biliary obstruction is a feasible and effective treatment option. Further randomized studies to determine the efficacy of intraductal RFA therapy on long-term biliary stent patency and patient survival are warranted.

Special Session

Central venous access for IRs

1802.1

PICC

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Learning Objectives

1. To learn about the advantages of PICC compared to other access devices
2. To learn tricks for successful placement
3. To learn about interdisciplinary patient care for long term success

Peripherally inserted central venous catheter (PICC) is an interesting short-to-mid-term type of central venous catheter that can be implanted by physicians and specially trained nurses. New techniques, such as integrated magnetic tip tracking and ECG-controlled tip placement, offer new options for catheter placement by nurses and physicians in dedicated patients. Because PICC placement uses a peripheral, relatively superficial and small vein for implantation, PICC placement can be safely performed in patients with haemorrhagic disorders.

Ultrasound-guided venipuncture and a modified Seldinger technique with a peel-away sheath are standards in PICC implantation. Creating a short subcutaneous tunnel to reduce infectious complications is a recent development in PICC placement.

1802.2

Tunnelled catheters

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Learning Objectives

1. To learn about the advantages of tunnelled catheters compared to other access devices
2. To learn tricks for successful placement
3. To learn tricks for successful management

Tunneled devices are characterized by the fact that their insertion site on the skin and site of ultimate venipuncture are physically separated. Long-term venous catheters became available in 1968, and the design was improved by Dr. John W. Broviac in 1973.¹ Hickman et al. further modified the principles in 1979 with subcutaneous tunneling and a Dacron cuff that formed an infection barrier and promoted fibrous ingrowth to prevent catheter migration.²

Tunneled cuffed catheters (TCCs) provide reliable and instant long-term intravenous access for a large variety of therapeutic purposes, including chemotherapy, parenteral nutrition, and apheresis. The most frequent application is as an access device for hemodialysis (HD) in patients with renal failure.³ Even though native arteriovenous fistulas (AVFs) are considered the best vascular access option for HD,⁴ TCCs are the initial access for approximately 80% of patients

in the USA and 30% of patients in Europe who are starting HD.⁵⁻⁶⁻²⁴ It is mandatory to focus on the use of TCCs for HD considering that dialysis catheters represent the most commonly placed tunneled central venous catheters. However the main principles and techniques of TCC placement for HD are applicable to devices, such as the Hickman, Broviac, Groshong, or tunneled peripherally inserted central catheters, that are used for different purpose.⁷ Familiarity with basic concepts of the devices and procedural techniques are crucial for achieving successful long-term venous access.

The National Kidney Foundation-Kidney Disease Outcome Quality Initiative (NKF-KDOQI) clinical practice guidelines were first published in 1997 and provide extensive clinical practice guidelines for vascular access including tunneled central venous catheter for dialysis.⁸ This document has provided guidelines named "clinical practice recommendations (CPRs)" that are evidence- and opinion-based statements. According to the NKF-KDOQI guidelines, tunneled cuffed venous catheters are indicated for temporary venous access that is expected to be required for longer than 3 weeks. In the HD setting, tunneled catheters should serve as bridging devices during the maturation of newly placed arterio-venous fistulas, especially for patients with end-stage renal disease who are admitted with an urgent need for dialysis or as the final option in patients in whom fistulas and grafts are contraindicated or have failed. However, functioning permanent access at the initiation of HD confers lower mortality than that in patients temporized with a tunneled cuffed venous catheter while awaiting the maturation of permanent access.⁵

The preferred insertion site for tunneled cuffed venous dialysis catheters or port catheter systems is the right internal jugular vein.⁸ Other options include the right external jugular vein,⁹ left internal and external jugular veins, subclavian veins, femoral veins, and translumbar and transhepatic access to the IVC. Subclavian access should be used only when no other upper-extremity or chest-wall options are available. If possible, TCCs should not be placed on the same side as a maturing AV access.

Tunneled cuffed venous catheters should be placed preferentially in the right internal jugular vein because this site offers a more direct route to the caval-atrial junction than the left-sided great veins. Catheter insertion and maintenance in the right internal jugular vein are associated with a lower risk of complications than those at other potential catheter insertion sites.¹⁰ Catheter placement in the left internal jugular vein potentially puts the left arm's vasculature in jeopardy. Catheter placement in the left internal jugular vein is associated with poor blood flow rates and high rates of stenosis and thrombosis. Catheter placement in the femoral and translumbar veins is associated with higher infection rates than placement at other sites.¹¹

Ultrasound should be used in catheter placement. The NKF-KDOQI guidelines state that fluoroscopy is mandatory for the insertion of all cuffed dialysis catheters. The position of the tip of any central catheter should be radiologically verified. Ultrasound insertion has been shown to limit insertion complications. Evidence is sufficient to recommend the use of ultrasound guidance for all insertions because it minimizes inadvertent arterial cannulation.¹²⁻¹³ Fluoroscopy allows ideal catheter tip placement to maximize blood flow.¹⁴ In recent literature reviews and the most current iteration of KDOQI guidelines, the recommended catheter tip position was in the "mid-atrium with arterial lumen facing the mediastinum."¹⁵⁻¹⁶ However, even these recommendations are marred by inaccuracy because they make no distinction between the different tip designs of the currently available dialysis catheters and dynamic interplay between catheter function, side hole design, and resulting complications. Considering the functional tip as the part of the catheter from the most proximal side hole to the catheter tip, the entire functional length should be placed in the right atrium, but not too deep, to avoid touching the floor of the right atrium. There is currently no proven advantage

of one cuffed catheter design over another. Catheters capable of a rapid blood flow rate are preferred. Catheter choice should be based on local experience, goals for use, and cost.

Systemic sepsis is an absolute contraindication for central venous access via TCCs because it can lead to line infection. In septic patients who require a long-term tunneled line for a reason other than intravenous antibiotic administration, new permanent access should not be placed until culture results have been negative. Relative contraindications include local cellulitis and abnormal coagulation results, including prothrombin time INR of >1.5 and markedly decreased platelet count ($<60,000/\text{mm}^3$). However, in select cases, there is a need to deviate from these general guidelines if clinically warranted.

Even with care, fewer than half the catheters placed as “long-term access” are in use a year after their placement,¹⁷ and approximately a third are removed because they fail to deliver adequate blood flow. The definition of adequate blood flow varies inversely with the “efficiency” of HD. High-efficiency dialysis, as that practiced in the United States, requires dialyzer-delivered BFRs $> 300 \text{ mL/min}$ to achieve the target single-pool Kt/V of 1.2 (see the KDOQI HD Adequacy Guidelines). Conversely, in Europe, BFRs $< 300 \text{ mL/min}$ are frequently used because dialysis treatment durations are longer.¹⁸ The adequacy of dialysis is also influenced by the site of placement and degree of recirculation.¹⁹ Recirculation is significantly greater in femoral catheters than in internal jugular catheters (13.1% versus 0.4%; $P < 0.001$). In addition, femoral catheters $<20 \text{ cm}$ have significantly greater recirculation (26.3%) than those $>20 \text{ cm}$ (8.3%; $P = 0.007$). This length dependency may result from the ultimate tip position of longer catheters in the IVC as opposed to the common iliac vein with shorter catheters. The high blood flow available to the catheter at the IVC site reduces recirculation. Recirculation may increase when the “lines are reversed” (inversion of inlet and outlet lumens), even in “well-functioning” non-split catheters (from 2%–3% to $>10\%$).

All catheters are “locked” with some anticoagulant. The purpose of the lock is to prevent thrombosis. The loss of anticoagulant by diffusive transport would be expected. The lost locking solution is replaced by blood. Therefore, it is not surprising that thrombosis is common in catheters because blood is likely to be in the lumen of the catheter for prolonged interdialytic times. The loss of anticoagulant permits the entry of clotting factors into the catheter lumen. The presence of these processes is manifested by a change in flow long before occlusion occurs. After assessment precludes mechanical dysfunction, such as a kink or dislodgement, thrombotic occlusion, partial (poor flow on aspiration) or total (unable to aspirate or push), is the most common cause of catheter dysfunction and/or occlusion.

Catheter dysfunction can be attributed to many causes, and the progression of dysfunction to non-function varies accordingly. The most common complications are thrombosis and infection.^{20–21} The need to use a Trendelenburg position to achieve adequate blood flow from a catheter placed in great veins leading to the right atrium always implies that the catheter is improperly placed. If the problem is not obvious and not easily correctable, the patient should be referred to an interventional center for diagnosing the cause. Although mechanical problems can develop acutely in catheters previously exhibiting good performance, access dysfunction occurring after 2 weeks is more likely because of progressive occlusion of the catheter tip by fibrin or thrombus.

The location of obstruction may be as follows:

- Intraluminal thrombus; within lumen of catheter, partial or complete occlusion may occur.
- Catheter tip; in catheters with side holes at the tip of arterial limb, thrombus may occlude or act like “ball valve.”
- Fibrin sheath (fibrin sleeve); fibrin adheres to the external surface of catheter, with thrombus trapped between sheath and catheter tip.

- Fibrin tail (fibrin flap); fibrin adheres to CVC end, leading to “ball valve” effect.

Although endoluminal brushes have been used to clear thrombi from dialysis catheters,²² there are no convincing data their efficacy. Such brushes were originally developed to obtain biofilm specimens from catheters. Currently, the Work Group recommends the change of catheter with the disruption of the sheath using a balloon. Fibrin sheath stripping is rarely used because of high cost and increased patient morbidity.

Although thrombotic occlusions leading to flow delivery problems are more common than infection, catheter-related infection has emerged as the primary barrier to long-term catheter use. The greater infection rate in catheters than in grafts and fistulae is its major limitation. Infection is the leading cause of catheter removal and morbidity in dialysis patients.²³ The rate of septicemia in HD patients and hospital admissions for vascular access infection is still a matter of concern.²⁴ Catheter-related bacteremia (CRB) is the major reason for catheter loss and has been associated with substantial morbidity, including metastatic infection. It is a life-threatening condition requiring initial hospitalization and parenteral antibiotic therapy if the patient is clinically septic. The observation in a large trial of patients with CRB in whom systemic antibiotics alone could salvage $<25\%$ of catheters²⁵ led to the commonly used “salvage of site rather than salvage of catheter” approach.²⁶ Conversely, in studies using catheter guide wire exchange in stable patients without tunnel involvement, using antibiotics alone salvaged 80%–88% of sites without apparent ill effects.²⁷ In such a setting, there is no advantage in delaying the replacement of the catheter by several days.²⁶

Bacteremia with tunnel-tract involvement should prompt catheter removal. Unstable patients require catheter removal for rapid response to therapy. The KDOQI Work Group believes that a minimum of 3 weeks of systemic antibiotic therapy is needed to treat CRB and that new permanent access should not be placed until culture results have been negative for at least 48 hours after the cessation of antibiotic therapy.⁸

Preventing CRB can be difficult despite the use of rigorous infection control techniques. Gentamicin/citrate solution and a tauro-lidine solution used as interdialytic antibiotic locks are effective.²⁸ The overall risk of TCCs infection can be reduced by adopting cost-effective, evidence-based interventions, such as proper education and specific training of the staff, an adequate hand-washing policy, proper choices of the type of device and the site of insertion, use of maximal barrier protection during insertion, use of chlorhexidine as an antiseptic prior to insertion and for disinfecting the exit site thereafter, appropriate policies for the dressing of the exit site, routine changes of administration sets, and removal of central lines as soon as they are no longer necessary.²⁹ To prevent infection, stringent cleaning of the catheter insertion site is advised. Chlorhexidine appears to be twice as effective as povidone-iodine solution. Although there is a wealth of literature focused on placement, infection prevention, and maintenance of catheter patency, circumstances and indications for TCCs removal are less well understood. Catheters in the inpatient setting were commonly removed for proven or clinically suspected infections. The timely removal of these catheters is an important management decision, with the length of TDC duration representing the largest cumulative risk factor for catheter-associated blood stream infections.³⁰ The prevention and early treatment of complications should greatly reduce associated morbidity and mortality.

Tunneled cuffed venous catheters are essential tools for providing urgent and, in some cases, long-term vascular access. High-quality vascular access should be a hallmark of interventional radiology.

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1802.3

Ports

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Learning Objectives

1. To learn about the advantages of ports compared to other access devices
2. To learn tricks for successful placement
3. To learn about removal of ports

No abstract available.

1802.4

Revision and salvage of central venous access

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Learning Objectives

1. To learn about diagnostic imaging of central venous access malfunction
2. To learn about different salvage techniques for different access devices and for central venous obstruction
3. To learn about complications and their avoidance during revision procedures

The use of central venous catheters (CVC) is part of everyday clinical practice offering long-term access for the administration of intravenous drugs, such as antibiotics, as well as that of parenteral nutrition and chemotherapy [1]. Forssmann introduced this concept in 1929 [2], but the first silicone-based access catheters were developed in the early 70s.

CVC dysfunction is not infrequent and may occur in 3%–30% of patients [3–5]. The most common causes of catheter dysfunction include occlusion from medication or clot, fibrin sheath formation at the catheter tip and adherence to the vessel wall. Other causes include catheter migration and central venous obstruction.

Occlusion from medication occurs due to inappropriate concentrations or incompatible mixtures of infusions that cause medications to precipitate within the catheter lumen; for example, if calcium and phosphorus are co-administered, calcium phosphate crystals form and precipitate in the catheter lumen. The presence of alkaline or acidic pH further influences crystal formation and precipitation. Adherence to the vessel wall occurs mainly due to continuous trauma to the venous wall from the catheter tip that leads to localized thrombosis around it. However, even if the catheter is not abutting the vessel wall, thrombus develops in the catheter tip due to intravascular protein and cell deposition. This process begins almost immediately after catheter placement because of the deposition of albumin, lipoprotein, and fibrinogen around the catheter tip that creates a protein sleeve [6]. The well-known fibrin cap or fibrin sheath at the catheter tip is formed after platelets and coagulation factors are recruited in the area.

In cases of central venous access dysfunction, mechanical obstruction needs to be first excluded by imaging. Plain X-ray imaging is usually recommended prior to contrast injection to exclude any severe kinking or migration of the catheter tip. If the catheter is in position, a linogram study under aseptic technique is suggested to assess viability. In such cases, contrast is injected through the catheter lumen and a digital subtraction angiography is performed. In case of the presence of a fibrin sheath, a typical pseudoenlargement sign presents at the catheter tip because of the refluxes of contrast within the fibrin sheath or a pouch at the catheter tip may be formed instead.

If the catheter is blocked or is adherent to the vessel wall, several methods can be used to restore functionality. In case of parenteral nutrition, several agents may be injected in the catheter lumen to unblock it. If the blockage is due to precipitants of low-pH medication, 0.1% hydrochloric acid may be injected, although the catheter wall may get damaged [7]. If high-pH medications are likely to have caused the obstruction, sodium bicarbonate or sodium hydroxide may be applied. In case of lipid precipitants, 70% ethanol solution may be used, which provides reasonable results [8, 9].

If there is no blockage from precipitants and the linogram has revealed the presence of intraluminal clot or fibrin sheath, a small amount of a thrombolytic drug (i.e., 2 mg of alteplase) may be applied or endovascular removal of the fibrin sheath may be performed. This latter maneuver involves obtaining access from a brachial or femoral vein and advancing a snare around the catheter that is then closed with moderate tension to clean the fibrin sheath from the catheter. The technique has been described with a high success rate in various reports [10–12]. Another technique that has been described for the salvage of failing CVCs due to adhesion in the venous wall is mechanical adhesiolysis that involves the use of a pig-tail catheter that is twisted multiple times around the stuck catheter to break the adhesion to the vessel wall [10]. In some cases, a more radical approach, such as the use of biopsy forceps, might also help to mobilize the catheter. In case of migration of the central catheter tip, a snare can also be used to reposition the tip. In such cases, although the underlying cause, which is usually the short length of the catheter, probably leads to further migration, the solution provided is only for short term. Nevertheless, endovascular techniques tend to increase the overall patency time of the central lines, without the need of a complete revision. In case of an underlying venous obstruction, venoplasty may be performed. It needs to be considered that recoil might occur after balloon angioplasty and that stent deployment may also be required in selected cases.

The complications of the endovascular revision of CVCs are very limited and mainly involve catheter tip dislodgement during stripping or venous laceration and catheter kinking during adhesiolysis. Pulmonary embolism may also be considered as a potential complication after extensive catheter manipulation [13]. Overall, endovascular techniques appear to offer a valid solution of revision and salvage and to prolong the patency of failing CVCs.

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Controversy Special Session

Controversies in interventional oncology

1803.1

Ablation is superior to SBRT for oligometastatic lung disease: PRO

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Learning Objectives

1. To learn about the physical effectivity of ablation
2. To understand the indications, contra-indications, and limitations
3. To understand the clinical scenarios where ablation is superior to SBRT

No abstract available.

1803.2

Ablation is superior to SBRT for oligometastatic lung disease: CON

P. Iyengar

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Learning Objectives

1. To learn about the physical effectivity of SBRT
2. To understand the indications, contra-indications, and limitations
3. To understand the clinical scenarios where SBRT is superior to ablation

Despite improved imaging and newer technologies, most patients with non-small cell lung cancer (NSCLC) are diagnosed with advanced, metastatic disease. Patients with stage IV NSCLC have had overall survival (OS) in the range of only 1 year in the modern era of cytotoxic chemotherapy. With the utilization of targeted therapies and immunotherapy in the induction/first- and second-line settings, OS has improved for subsets of patients. However, targeted therapy and immunotherapy have varying degrees of success depending on tumor expression of various molecules, including mutant EGFR and fusion ALK and PD-L1. Furthermore, survival outcomes for NSCLC tend to lag behind those for other major primary cancers. Ultimately, for a significant proportion of patients with stage IV NSCLC, systemic agents offer limited potential for durable control of disease.

Advanced by Weichselbaum and Hellman, the concept of oligometastatic disease has gained increasing attention. Oligometastatic disease represents a state of malignancy with limited metastases (traditionally 3 or fewer) between local and widely disseminated disease. Historically, with limited metastatic colorectal cancer and sarcomas, the use of local therapies including surgery or/and radiation with cytotoxic agents have become a part of the standard of care as a means of drastically improving OS along with local control. It, therefore, poses a question, as we try to identify more and more subsets of patients with advanced NSCLC with favorable biology, if there is a group of patients with limited metastatic NSCLC who could benefit from local treatments in addition to their systemic therapy regimens. If so, what would be the optimal treatments, when should they be delivered, and what type of benefit is realistic. This concept of combining local therapy with systemic therapy becomes more relevant with data showing original sites of gross disease as first sites of failure following systemic agents for advanced NSCLC.

Major arguments for aggressive local treatment of metastatic disease in the modern setting include the general lack of ability of systemic therapy to "cure" solid tumors, failures most commonly presenting in the original sites of gross disease; the heterogeneity in response to systemic therapy secondary to disease biology; and the reduced effectiveness of subsequent lines of systemic agents. All of these points collectively support an argument where a local therapy might enhance overall tumor control because local therapies are more effective at reducing tumor bulk, are less likely to be rendered ineffective by multidrug resistance mutations, and may reduce further metastases by successful gross tumor control.

Over the last several years, a number of groups and institutions have begun to be more aggressive with treatments for oligometastatic/limited metastatic NSCLC by combining local therapies with chemotherapies, targeted agents, and immunotherapies. Local therapy could include surgery, radiation, and radiofrequency ablation. In the ascending order, local control improves when comparing radiofrequency ablation, microwave ablation, cryoablation, stereotactic body radiation therapy (SBRT), and surgical lobectomy; however, despite enhanced local control, the rate of distant disease remains highly variable between studies and between therapies.

Because of its significant capacity for local control over other ablative modalities in a non-invasive and safe/minimal toxicity approach, SBRT has been adopted as the local therapy of choice in a large number of institutions for treating oligometastatic disease in consolidation or salvage for oligoprogression. Data from multiple types of experiences (retrospective analyses, meta-analyses, and institutional experiences) had until recently supplied the rationale to support potential progression-free survival (PFS) and OS and control benefits in patients with limited metastatic NSCLC compared with historical outcomes. In non-randomized prospective approaches, there is always a question of whether oligometastatic disease represents a biological entity with a more indolent disease course, i.e., fewer sites of progression or metastasis, resulting in improved survival independent of treatment management. However, prospective single-arm trials and now smaller randomized phase II trials are starting to validate and solidify a possible PFS benefit of local therapy added to systemic agents in oligometastatic lung cancer. The question will be if this PFS benefit will translate into an OS advantage. NRG LU002, a phase II/III clinical trial, has recently been activated in North America and will randomize 300 patients with limited metastatic NSCLC who have stable disease/response after first-line cytotoxic chemotherapy to either maintenance chemotherapy alone or SBRT to all sites of limited metastases (and SBRT or hypofractionated radiation to the primary) followed by maintenance chemotherapy. The primary endpoint of the study will be OS. As approved for first-line or maintenance regimens, immunotherapies will be permitted for NRG LU002 as systemic approaches, with the same question of the radiation's role in consolidation being asked. Ultimately, NRG LU002 should provide the answer to how important local therapy is to oligometastatic disease.

This talk at the CIRSE conference will provide an overview of the benefits of using SBRT in oligometastatic NSCLC. We will review the current data to date supporting SBRT use and offer prognostications as to the direction it will be used in the future for this patient population. There will certainly be an effort to distinguish its benefits over the use of radiofrequency or other ablative techniques.

1803.3

IRE is the technique of choice to treat central liver lesions: PRO

M.R. Meijerink

Radiology and Nuclear Medicine, VUMC, Amsterdam, Netherlands

Learning Objectives

1. To understand the physical properties of IRE in comparison to other ablative techniques
2. To learn about the beneficial efficacy of IRE
3. To understand the clinical scenarios where IRE is superior to ablation

No abstract available.

1803.4

IRE is the technique of choice to treat central liver lesions: CON

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Learning Objectives

1. To understand the physical properties of ablative techniques in comparison to IRE
2. To learn about the beneficial efficacy of ablative techniques
3. To understand the clinical scenarios where ablation is superior to IRE

No abstract available.

1803.5

Presurgical TARE is better than PVE: PRO

R. Salem

Radiology, Northwestern University, Chicago, IL, United States of America

Learning Objectives

1. To understand the efficacy of TARE in inducing hepatic hypertrophy
2. To learn about the beneficial effects of TARE over PVE
3. To understand the clinical scenarios where TARE is superior to PVE

No abstract available.

1803.6

Presurgical TARE is better than PVE: CON

A. Denys

Radiology and Interventional Radiology, CHUV, Lausanne, Switzerland

Learning Objectives

1. To understand the efficacy of PVE in inducing hepatic hypertrophy
2. To learn about the beneficial effects of PVE over TARE
3. To understand the clinical scenarios where PVE is superior to TARE

Portal vein embolization (PVE) is performed in order to induce contralateral hypertrophy before extended hepatectomy. PVE has existed for nearly 25 years and is performed worldwide with various techniques and embolic products. Safety issues have been raised pertaining to performing PVE from the contralateral side, as previously described. These issues are more theoretical because very few complications have been reported in the future remnant liver after contralateral PVE. Compared with TARE, PVE is more rapid in inducing hypertrophy and has a very low failure rate both in cirrhotic and

metastatic patients. In a candidate for extended resection, there is no data supporting the test of time of waiting for 3 months for hypertrophy being a safe strategy after TARE. Patients developing new liver tumors during this waiting period might benefit from a faster surgery, while others argue that these patients probably are poor surgical candidates. Recent technical developments seem to improve the results of PVE, such as hepatic vein embolization simultaneously performed during PVE and PVE associated with percutaneous ALLPS by radio frequency ablation of the surgical dissection plane. These early results need to be confirmed in the future. Of course, unlike TARE, PVE is not a therapeutic procedure for tumors located in the future remnant liver; this is probably the main difference between the 2 methods. Although it seems logical to use TARE when tumor downstaging is recommended before considering resection (e.g., HCC with portal vein segmental invasion and a small future remnant liver), there is no definite reason to defend TARE against PVE in other situations; TARE is much more expensive and delays surgery.

Fundamental Course

IR management of pancreatitis

1804.1

The clinical problem and imaging

T.L. Bollen

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Learning Objectives

1. To learn about clinical findings and dilemmas in pancreatitis
2. To learn about optimal imaging strategies in pancreatitis
3. To learn about important imaging findings in pancreatitis and how to report and communicate them

No abstract available.

1804.2

IR management of pancreatitis: update on trials and recent developments

K.P. van Lienden

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Learning Objectives

1. To learn about clinical management strategies of pancreatitis
2. To learn about recent trial results influencing the management of pancreatitis
3. To learn about ongoing trials and future perspectives in the management of pancreatitis

No abstract available.

1804.3

IR management of pancreatitis: optimal drainage strategies

P.G. Nardis

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Learning Objectives

1. To learn about the role of IR in percutaneous treatment of pancreatitis
2. To learn about the optimal approach and drainage techniques in pancreatitis
3. To learn how percutaneous drainage can facilitate minimally invasive surgery for pancreatitis

Acute pancreatitis is a severe condition due to inflammation of the pancreatic gland that is self-limiting in 80% of cases, while in the remaining cases, it is called complicated acute pancreatitis and can lead to tissue necrosis and abscess or pseudocyst formation.

In complicated cases, the optimal treatment strategy depends on the lesions and clinical conditions and symptoms and ranges from medical therapy to surgical drainage or pancreatic necrosectomy.

Endoscopy has a primary role in the management of complicated acute pancreatitis. It allows treating the underlying causes of the disease, such as pancreatobiliary calculosis, stenosis, and malformation; moreover, thanks to the introduction of echo-endoscopy, it permits fluid collection or pseudocyst drainage through the visceral wall.

Nevertheless, surgery that theoretically is the optimal strategy because it allows the removal of all the necrotic tissue and collections with different techniques can lead to severe complications, especially in sick patients.

Image-guided percutaneous management is a valid option that in the majority of cases, allows results similar to surgery, without opening the peritoneal cavity.

There are different image-guided approaches for complicated acute pancreatitis depending on the type of lesion.

Image-guided catheter placement is generally the basic approach for fluid collection secondary to acute pancreatitis and can be performed using computed tomography (CT), Dyna-CT, or ultrasound guidance.

Peripancreatic simple fluid collection can be easily drained using a single catheter, but in most cases, multiple catheters have to be placed in order to aspirate all the fluid and to allow continue flushing of the cavity with saline solution.

Percutaneous necrosectomy is another option that can be used in case of a large amount of tissue necrosis using different type of catheters and devices.

Pancreatic pseudocyst is a long-term outcome of acute pancreatitis and is defined as a collection of pancreatic juice limited by a fibrotic wall due to disruption of the pancreatic duct. The treatment of this condition is based on symptoms that are fortunately rare and are generally mass related, such as dysphagia due to compression of the stomach or the duodenum. This lesion cannot be drained through standard fluid collection because of the continuous pancreatic juice secretion in the cyst forcing long-term percutaneous catheter placement.

Being inspired by the endoscopic procedure of pseudocyst gastrostomy and by surgery, a long-term intentional fistula between the pseudocyst and the stomach can be created with a percutaneous approach in order to maintain drainage of the cyst into the viscera.

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1804.4

Vascular complications of pancreatitis

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Learning Objectives

1. To learn which vascular complications can result from pancreatitis
2. To learn imaging strategies for detecting vascular complications of pancreatitis
3. To learn how to treat vascular complications of pancreatitis

Pancreatitis can range from between a mild and self-limited to a severe and life-threatening disease, and it is estimated that around one quarter of patients may develop some sort of vascular complication, although an accurate incidence is not known.

Venous thrombosis involving the splenic, mesenteric, or portal veins is the most frequent vascular complication.

Pseudoaneurysm formation is the second most frequent vascular complication of pancreatitis, resulting from vessel erosion, usually caused by pseudocyst and walled-off necrosis. The most commonly involved vessels are the splenic, gastroduodenal, and pancreaticoduodenal arteries. Pseudoaneurysms are not an early complication because they take time to develop; however, they are associated with high mortality rates due to the risk of rupture, ranging from around 12% if treated to >90% if untreated.

Hemorrhage is as a life-threatening complication of pancreatitis, which may occur with or without the prior formation of a pseudoaneurysm after surgical intervention or as a consequence of the formation of varices and may occur in the peritoneal cavity, extraperitoneum, or gastrointestinal tract or directly in the Wirsung duct.

Both multiphase contrast-enhanced CT or MRI are suitable techniques in the diagnosis of vascular complications of pancreatitis, including image acquisition in the arterial and portal venous phases. CT remains particularly useful for suspected hemorrhagic complications because it is faster and more accessible in the urgent or emergent setting. Angiography is the gold-standard imaging strategy, although it is not usually used initially, and allows the localization and treatment of the bleeding site. In some cases, angiography may be unable to detect the source of bleeding due to venous bleeding, intermittent arterial bleeding, or bleeding from a large surface area. Interventional radiologists play a crucial role in the treatment of vascular complications of pancreatitis. Surgery is indicated in the presence of hemodynamic instability. Embolization is the most frequent first-line treatment in patients with acute hemorrhage or peri-pancreatic pseudoaneurysms using a variety of embolic agents, such as coils and glue. "Back-door" and "front-door" embolizations are usually required to ensure isolation of the bleeding site due to the abundant peri-pancreatic collateral circulation. Occasionally, it may not be possible to catheterize the small and tortuous culprit vessels, although technical advances with microcatheters and guidewires have largely surpassed this limitation.

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Special Session

Anaesthesia and interventional radiology: time to team up!

1901.1

Patient selection: which type of anaesthesia for which procedure

A. Vari

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Learning Objectives

1. To learn about the different methods of anaesthesia
2. To learn about indications
3. To learn about complications

Safe peri-procedural care in interventional radiology (IR) is based on a thorough assessment of the patient and an appropriate choice of the anesthetic technique. The purpose of the pre-procedural assessment is to determine the level of sedation that the patient needs and whether it can be safely administered.

The "classic" assessment flowchart is as follows:

1. relevant history and physical evaluation → 2. medications currently taken and previous adverse reactions to anesthesia and/or sedation → 3. airway assessment, including examination and recognition of high risk airways → 4. NPO → 5. patient's eligibility for sedation using the American Society of Anesthesiologist classification; in IR, it is particularly important to elaborate a proper procedure plan with the choice of technique (moderate or deep sedation, general anesthesia, or locoregional techniques) and the medications to be utilized.

The intrinsic heterogeneity of IR as a specialty hampers the standardization of peri-procedural care. The following factors need to be considered: setting, equipment, resources, type of procedure, expected length of and pain due to the procedure, and hospitalization vs outpatient regimen. Other factors related to the procedure and the individual interventionalist's preferences also play a pivotal role (patient immobility, control of respiratory movements, position on the table, etc.).

Lastly, the patients' individual factors, conditions, and preferences add more elements to the already complex process of planning optimal patient care.

The availability of anesthesia providers vs the provision of sedation/analgesia by the interventionalist has been recently shown to represent a key factor in technique selection.

Analgesia and pain management also represent crucial issues. Many interventional oncology patients present with chronic pain syndromes that can be challenging for the anesthesia provider. A deep knowledge of the pharmacology of pain medications (in addition to sedation and cardiopulmonary resuscitation skills) is essential when sedoanalgesia is administered by a non-anesthesiologist.

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1901.2

Advantages of high frequency jet ventilation

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Learning Objectives

1. To learn about the principles of jet ventilation
2. To learn about indications
3. To learn about complications

Percutaneous ablative techniques, such as radiofrequency ablation (RFA), microwave ablation, or cryoablation, are increasingly used as curative options for patients with solid tumors. During these minimally invasive procedures, from one to several probes are placed in the target lesion under imaging (computed tomography or ultrasound) guidance. The energy is then directly deposited by the ablation needle(s) into the target lesion to yield tumor cell death. The success of this treatment modality is directly related to the ability to induce both destruction of the tumor and potential microsatellites around it. Thus, not only the lesion itself but also the circumferential rim of the normal-appearing parenchyma around the tumor need to be ablated. To accomplish this, precise positioning of probes is critical. Some of the many parameters that may influence lesion targeting precision are lesion depth/localization, patient's corpulence, quality and reliability of the imaging guidance, radiologist's experience, and motion of the lesion-bearing organs.

A usual ablative procedure, such as RFA, is performed under general anesthesia. To obtain immobility of tumor lesions for better targeting, intermittent apnea can be requested to the anesthesiologist. However, intermittent apnea proved to be impractical and may complicate needle positioning. General anesthesia with high-frequency jet ventilation (HFJV) has been recently introduced and has revolutionized the field of tumor ablation. HFJV is a mechanical ventilation method where high-flow, short-duration pulses of pressurized gas are delivered to the trachea through a small caliber catheter. Gas exchange is assured by high-velocity gas flow washing the alveoli. Because HFJV is made of short and small pulses of air, it induces very small amplitude respiratory movements. The diaphragmatic excursions are thus greatly reduced allowing for virtually no abdominal organ motion. This not only greatly helps in precise lesion targeting but also helps in per-procedure evaluation of treatment efficacy [e.g., by comparing same level CT (due to HFJV) obtained before and immediately after the ablation]. Moreover, the use of HFJV is particularly appealing for needle positioning using stereotactic navigation systems which are increasingly used in tumor ablation. As any technique, HFJV has its own limitations and contraindications, such as severe chronic obstructive pulmonary disease, obesity, recent pneumothorax, or pulmonary surgery. These contraindications are not absolute and the risk of the anesthesia could be outweighed by the potential benefit of the procedure. According to our experience, HFJV can be used in majority patients. It is, therefore, crucial to establish a close collaboration with the anesthesiologists to perform HFJV in adequately selected patients to improve tumor targeting and treatment efficacy.

1901.3

Nerve and epidural blocks

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Learning Objectives

1. To learn how to perform nerve and epidural blocks
2. To learn about indications
3. To learn about complications

Regional anaesthesia (RA) is a method of delivering anaesthesia for surgery and analgesia intra- and post-operatively. There are more

advantages than disadvantages in using RA techniques: lower pain scores, reduced side effects (nausea and vomiting, pruritus, drowsiness and sedation) associated with opioid use and successful management of challenging clinical cases.¹

Between 1884, the year when Carl Koller performed the first regional block for eye surgery in Vienna, and the late 1970s, the main developments were pertaining to new local anaesthetic drugs and the introduction of anatomical/landmark methods for nerve identification. Unfortunately, anatomy is not exactly predictable, and the natural variability of human anatomy led to poor success rates for many peripheral nerve blocks (PNB). Much of the antipathy pertaining to regional anaesthesia has its origins in the arguably 'hit and miss' times. Part of this may also be associated with a lack of understanding of the anatomy. During these times, RA was appreciated more as an art than a science; anaesthesiologists would extrapolate the location of a target nerve/plexus uniquely based on the identification of relevant surface landmarks. General application was imperfect due to limited training, lack of understanding of the anatomy, bad patient positioning or other inconsistencies even after the advent of electrical stimulation for nerve localisation.² On the other hand, peripheral nerve stimulation is neither precise nor perfect; it is possible to elicit paraesthesia or be intraneural with the needle without producing any motor response.³

Ultrasound-assisted (USA) and ultrasound-guided (USG) RA techniques were introduced in the late 70s when La Grange et al. used a Doppler ultrasound blood flow detector to localise the third division of the subclavian artery, making the supraclavicular approach to the brachial plexus safer and highly successful.⁴ Two decades later, Kapral et al. described the USG supraclavicular approach for RA of the brachial plexus.⁵ In the following 10 years, the ultrasound technology advanced in parallel with the understanding of its practice and the development of block techniques, which suited its use. The increased interest and investment in ultrasound led manufacturers to design machines specifically for RA and software to facilitate PNB. Better quality images should produce better quality blocks.⁶ The interest and popularity of USG RA for both adult and paediatric patients and special patients (e.g. obese and obstetric) has increased over the last 20 years.^{2,7,8}

There are several advantages³ with respect to the use of USG for performing RA. There is no risk of radiation, and nerves as well as the point of division of the nerve can be easily identified. The surrounding anatomy, such as blood vessels (e.g. femoral artery), can be easily identified, which in turn can help in the identification of the nerves. Using an in plane approach, needles can be visualised as a hyperechoic line and guided towards the target nerve or structure. Real-time needle guidance can avoid inadvertent needle entry into the blood vessels, pleura or structures such as the spinal canal. Local anaesthetic spread can be appreciated under US vision; thus, if inadequate, it can be corrected or an additional injection could be made. Partial nerve blocks can be prevented by ensuring circumferential spread of the local anaesthetic. Peripheral nerve catheters can be placed under direct vision. USG nerve blocks can be a relatively painless procedure when muscle contraction is avoided, without nerve stimulation. It has been demonstrated that the success rate is higher, dose of the local anaesthetic required is lower, sensory onset time is shorter and duration of blocks is longer using USG. Block quality is significantly improved. Less incidence of diaphragmatic paralysis as less volume can be used for interscalene block.

Patient groups where USG RA is particularly useful include children⁸ because blocks are performed under general anaesthesia and echogenicity of tissues in children is very clear, patients with peripheral neuropathy because it is difficult to elicit nerve stimulus (e.g. diabetic neuropathy) and obese patients in whom the use of Doppler has been described or in whom the vascular landmarks cannot be easily identified.

USG nerve block has been described for upper limb and lower limb blocks, trunk blocks and neuraxial techniques (spinal and epidural). Disadvantages of USG nerve blocks are as follows: it is still an operator-dependent technique and the potential for post-operative nerve symptoms (PONS) remains the same as that with nerve stimulation techniques. The ultrasound machines are still expensive, although the cost is coming down. The skills and knowledge of anatomy remain the corner stones of successfully performing USG RA.

Can USG be effective and reliable, improving block performance, quality and durability and reducing complications and RA side effects? USG RA has conquered a top, evidence-based place in modern anaesthesiology practice.

USG regional anaesthesia and children. In a recent review,⁸ there was a high quality of evidence that USG increased the success rate and block duration (peripheral and neuraxial blocks) in children. An inverse correlation between the success rate and block duration and age was also found, implying that the younger the child, the more likely she/he is to benefit from USG. In very young children, neuraxial US allows the real-time observation of needle and catheter placement and local anaesthetic spread.⁹

Upper limb blocks. The blocks included are interscalene, supraclavicular, infraclavicular and axillary plexus blocks. The American Society of Regional Anaesthesia supports that USG modestly improves surrogates for block quality and performance, including faster sensory block onset, fewer vascular punctures, faster performance time, and fewer needle passes (level Ib evidence and grade A recommendations).⁹

Lower limb blocks. These mainly include sciatic, femoral, obturator, fascia iliaca and saphenous nerve blocks. The evidence supporting USG for lower limb blocks is stronger than that for upper limb blocks and USG is recommended (grade A, level of evidence Ib), with better results in the onset time, performance time, and rate of complete sensory blockade as compared with nerve stimulation techniques.⁹

Truncal blocks. Truncal blocks include thoracic paravertebral, intercostal, transversus abdominis plane (TAP), rectus sheath, ilioinguinal/iliohypogastric (II/IH), PECS, quadratus lumborum and fascia transversalis blocks.⁹ The use of USG with thoracic paravertebral blocks based on level Ib evidence has a grade B recommendation. Considering TAP blocks, meta-analyses published are somewhat difficult to interpret because they commingle landmark-based and USG TAP blocks. When taken together, it is suggested as a grade A (level Ia evidence) recommendation that the benefits of TAP blocks are relatively limited (reduced nausea and vomiting without consistent improvement in analgesia) as compared with those of other types of analgesia. USG II/IH is a grade A (level Ib evidence) recommendation in children compared with landmark techniques. There is limited evidence to support a US-based improvement in the rectus sheath block safety. Considering the other truncal blocks, there is insufficient evidence, particularly in terms of clinically relevant comparison to standard alternatives such as thoracic epidural analgesia or surgeon infiltration.

Neuraxial blocks. USG accuracy for determining the correct lumbar interspace varies between 68% and 76% compared with radiologic imaging accuracy. Level IIa evidence supports a grade B recommendation that neuraxial US aids in the identification of interspace level more accurately than palpation but not as accurately as radiologic imaging. Actual needle insertion-to-target depths were mostly within 3 mm or less of the preliminary US measurement (level Ia evidence).⁹ Grade A (level Ia evidence) recommendations support that neuraxial US has a role in improving the efficiency of lumbar neuraxial anaesthesia and in accurately predicting the depth to target. Level III evidence based on small subject numbers supports a role for neuraxial USG in reducing surrogate markers of potential neurologic injury, but evidence is inadequate to assess its effect on safety outcomes.

Patient safety. USG RA does not reduce the incidence of PONS compared with other nerve localisation techniques. USG RA reduces but does not eliminate the incidence and intensity of hemidiaphragmatic paresis in an unpredictable manner. The frequency of pneumothorax has decreased with USG supraclavicular blocks. There is strong evidence regarding a significant reduction in the incidence of LAST.⁹

Take home points¹:

- 1) Ultrasound allows for the real-time evaluation of neural anatomy, needle position, and spread of local anaesthesia.
- 2) Challenging patients can be successfully approached with regional anaesthesia, specially using USG.
- 3) USG blocks are more accurate, reliable and effective.
- 4) Globally, safety is improved using USG, although PONS remains the same as that with other localisation techniques.

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1901.4

Postprocedural analgesia

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Learning Objectives

1. To learn about the different techniques of analgesia
2. To learn when to use analgesia
3. To learn about complications

Minimum invasion, reduced discomfort, and shorter hospital stay are the essential elements of interventional radiology. Newer inventions have expanded its utility in all clinical specialities.

During interventional procedures, pain management often relies on local anesthetics and intravenous (IV) conscious sedation using opioids and benzodiazepines (1-8). Intra-arterial lidocaine may be used in tumor embolizations (9). Neuroaxial blockade or regional celiac ganglionic blockade may be used in procedures associated with greater pain anticipation (10).

Pain assessment:

In post-procedural period, visceral pain from the intervened structures can be more discomforting than local pain at the entry site. Pain assessment is necessary to optimize the analgesic therapy. Self-reporting scales (SRS) (12-21) are considered the single most reliable descriptor of pain experience (1,11), and these scales (12-21) have shown similar statistical power, efficacy, and response problems (17). Of the SRS, the visual numeric scale is particularly easy to administer, correlates well with other scales, sensitive to change, and has demonstrated success in elderly adults as well; however, it may be cumbersome in immobilized patients (12). A purely verbal 0-10 linear numerical scale, with 0 indicating no pain at all and 10 indicating worst pain imaginable, has been validated and can be used as an alternative (21,22).

Adequate post-procedural analgesia is necessary for the patient's comfort and to combat the deleterious stress response. Local anesthetic field and nerve blocks (23), NSAIDs, and opioids supplemented by sedatives and antiemetics remain the mainstay of pharmacological treatment of acute pain.

Non-opioid analgesics:

The World Health Organization recommends stepwise pattern, beginning with NSAIDs, progressing to weak opiates, and subsequently to strong opiates. The addition of NSAIDs can significantly improve the efficacy of opiate analgesics, reduce opiate dose, and reduce side effects. Non-opioid analgesics may be used alone or in combination with opioids and local anesthetics. Commonly used non-opioids include acetaminophen and NSAIDs. An overview is provided below.

Commonly used non-opioid analgesics:

Acetaminophen:

Onset (min): 30
Duration (h): 2-4
Maximal dose (mg/24 h): 3000-4000

Aspirin:

Onset (min): 30-60
Duration (h): 2-4
Maximal dose (mg/24 h): 3600

Naproxen:

Onset (min): 60
Duration (h): 4-7
Maximal dose (mg/24 h): 1500

Fenoprofen:

Onset (min): 60
Duration (h): 4-6
Maximal dose (mg/24 h): 3200

Ibuprofen:

Onset (min): 30
Duration (h): 4-6
Maximal dose (mg/24 h): 3200

Ketorolac:

Onset (min): 30-60
Duration (h): 4-6
Maximal dose (mg/24 h): 120

However, the risk/benefit ratio should be reconsidered when NSAIDs are used in patients with asthma who have a history of sensitivity, those with a history of peptic ulcer disease, and those on anticoagulant therapy. NSAIDs may produce or exacerbate renal insufficiency; due to this concern of addition to the deleterious effect of contrast medium on kidneys, NSAIDs should be used with caution especially in patients with pre-existing impaired renal function. It is best to limit the use of NSAIDs to typically 24-48 h postoperatively.

Local anesthetics:

Local anesthetics can be used as local infiltration around catheter and puncture sites and for regional nerve blocks. The injection of intra-arterial lidocaine during tumor embolizations can be an effective intraoperative measure in postoperative pain management (9). When a local anesthetic is intentionally administered intravascularly, maximum allowed serum concentration should not be surpassed. The below lists summarize the onset, duration of action and maximal recommended doses of the injectable local anesthetics (35). The more widely used local anesthetics are lidocaine, mepivacaine, and bupivacaine (36,37).

Commonly Used Local Anesthetic Agents:

Lidocaine (Xylocaine):

Most dilute commercial formulation: 0.5% (5 mg/mL)

Onset of action (min) (infiltration): 4–10

Duration of action (min) (infiltration): 60–120

Bupivacaine (Marcaine, Sensorcaine):

Most dilute commercial formulation: 0.25% (2.5 mg/mL)

Onset of action (min) (infiltration): 8–12

Duration of action (min) (infiltration): 120–240

Mepivacaine (Carbocaine, Polocaine):

Most dilute commercial formulation: 1% (10 mg/mL)

Onset of action (min) (infiltration): 6–10

Duration of action (min) (infiltration): 90–180

Levobupivacaine (Chirocaine):

Most dilute commercial formulation: 0.25% (2.5 mg/mL)

Onset of action (min) (infiltration): 8–12

Duration of action (min) (infiltration): 120–240

Ropivacaine (Naropin):

Most dilute commercial formulation: 0.2% (2 mg/mL)

Onset of action (min) (infiltration): 8–12

Duration of action (min) (infiltration): 120–240

Maximum doses of Local anaesthetic agents:

Lidocaine (Xylocaine):

Most dilute commercial formulation: 0.5% (5 mg/mL)

Maximal dose (mg/70 kg) (with vasoconstrictor): 300 mg (500 mg)

Maximal dose (mL/70 kg) (of dilute formulation with vasoconstrictor): 60 mL (100 mL)

Bupivacaine (Marcaine, Sensorcaine):

Most dilute commercial formulation: 0.25% (2.5 mg/mL)

Maximal dose (mg/70 kg) (with vasoconstrictor): 175 mg (225 mg)

Maximal dose (mL/70 kg) (of dilute formulation with vasoconstrictor): 70 mL (90 mL)

Mepivacaine (Carbocaine, Polocaine):

Most dilute commercial formulation: 1% (10 mg/mL)

Maximal dose (mg/70 kg) (with vasoconstrictor): 400 mg (500 mg)

Maximal dose (mL/70 kg) (of dilute formulation with vasoconstrictor): 40 mL (50 mL)

Levobupivacaine (Chirocaine):

Most dilute commercial formulation: 0.25% (2.5 mg/mL)

Maximal dose (mg/70 kg) (with vasoconstrictor): 150 mg (NR)

Maximal dose (mL/70 kg) (of dilute formulation with vasoconstrictor): 60 mL

Ropivacaine (Naropin):

Most dilute commercial formulation: 0.2% (2 mg/mL)

Maximal dose (mg/70 kg) (with vasoconstrictor): 175 mg (NR)

Maximal dose (mL/70 kg) (of dilute formulation with vasoconstrictor): 87.5 mL

(Maximal doses are given for use without a vasoconstrictor. Always calculate the maximal single dose taking into consideration the patient's weight and the actual concentration of the local anesthetic preparation used; hence, for a 70-kg patient, the maximal dose of 1% lidocaine without epinephrine is 30 mL. Always note whether a vasoconstrictor is added in the preparation because this alters the maximal recommended dose. For example, the maximal dose of lidocaine with epinephrine would be 500 mg/70 kg (50 mL of 1% solution of lidocaine with epinephrine).

Local anesthetic toxicity

Local anesthetics in higher concentrations can block sodium channels in the heart and brain leading to loss of consciousness and, seizures, heart block, malignant re-entrant rhythms with ventricular fibrillation that may be resistant to electrical defibrillation until the level of local anesthetic falls. Patients with cardiac toxicity may require prolonged cardiopulmonary resuscitation or even cardiopulmonary bypass until local anesthetic levels fall sufficiently for a normal rhythm to be restored.

Bupivacaine

Intravascular injection (i.e. intravenous regional anesthesia or for intra-arterial injection) and overdose should be avoided when bupivacaine is used, as, compared with lidocaine, bupivacaine has a much lower therapeutic index i.e. cardiac arrest may occur at the same serum concentration that produces loss of consciousness or seizures.

Lidocaine and Bupivacaine when injected in a well-perfused tissue, a peak serum level may occur within 30 and 40 minutes respectively. As reinjection within this time can lead to toxicity, it is safer to wait at least 20 minutes for lidocaine and 40 minutes for bupivacaine.

Overdose management

When signs and symptoms of local anesthetic toxicity are apparent, the local anesthetic injection should be stopped immediately and the patient's vital signs continuously monitored.

In mild toxicity i.e. perioral paraesthesia and dysphoria, management should initiate with reassurance to the patient, followed by advise to take deep breaths (which makes alkalotic shift in brain tissue pH, facilitating passage of local anesthetic molecules out of nerve cell membranes), supplementing oxygen, providing bag mask positive pressure ventilation and eventually intubation if the patient loses mental alertness. In severe central nervous system toxicity, benzodiazepine, may be necessary to treat seizures. In cardiac arrest, resuscitation should be initiated until the patient recovers or until sufficient time has elapsed for the serum level to fall below toxic levels (several hours). Rapid access to cardiopulmonary bypass may effectively maintain perfusion and should be considered part of the treatment of severe toxicity, especially for the more cardiotoxic local anesthetics such as bupivacaine.

The limited duration of action and narrow therapeutic level of local anaesthetics makes opioids as favoured choice in pain management. Enteral route of administration carries uncertainty of absorption and slow and unpredictable action. This makes IV administration, a preferred route.

If given as needed by medical personnel, patients are at risk of receiving inadequate analgesia because providers may underestimate the pain level, overestimate the opioid effect and duration, or fear opioid abuse and side effects (25). In comparison with intermittent intramuscular or IV bolus, patient controlled analgesia (PCA) offers superior overall analgesia, especially with newer advanced PCA pumps, as it is more likely to keep stable plasma concentrations of drug within the therapeutic window, with fewer peaks and valleys of drug effect. At the same time, patients tend to use less drug and have fewer side effects.

In PCA, physician has control over the choice of drug, the size of a bolus, the lockout period (time between bolus doses), and the continuous rate (if one is used). The most common potent opioids used for PCA are morphine and fentanyl (24,33). Being efficacious, longer acting, and generally the most familiar to staff, morphine is a sensible drug to start with. Although Fentanyl has the lowest incidence of nausea, it carries shortest duration of action.

PCA is thought to enhance comfort while providing patients with a means of control (29,30), and patients have reported that PCA improves their recovery (31). This sense of control and reduced anxiety by not having to rely on another person for administration of pain relief have been shown to have psychological benefits on patients (32).

An overview of bolus doses, lockout intervals, and infusion rates is shown below:

Opioids commonly used in PCA with examples of doses and lockout times:

Morphine:

Loading dose to treat intense pain before starting PCA: 2–4 mg, repeat up to 30 mg/70 kg

PCA dose: 1–5 mg

Lockout time (min): 5–10 min

Fentanyl:

Loading dose to treat intense pain before starting PCA: 25–50 µg, repeat up to 300 µg/70 kg

PCA dose: 10–50 µg

Lockout time (min): 3–6 min

Hydromorphone:

Loading dose to treat intense pain before starting PCA: 0.4–0.8 mg, repeat up to 6 mg/70 kg

PCA dose: 0.2–1 mg

Lockout time (min): 5–10 min

Continuous infusions are useful for procedures that are expected to result in a high degree of pain and for patients who chronically take opioids and have developed tolerance.

PCA has been proven to be favourable option not only in middle-aged but also in elderly subjects (Duggleby and Lander) (29) however, careful patient selection and patient and staff education in use of PCA is important for its success. In certain situations, such as the mentally impaired or demented and those who cannot physically operate the system, PCA cannot be reliably used.

In these situations, per oral or parenteral opioids may be preferred. Epidural or intrathecal administration of opiate is available for patients expected to have very high post procedure pain levels or for patients who cannot tolerate enteral or parenteral opiate administration. This modality may be particularly helpful in treating intense post embolization pain, such as in preoperative renal embolization. Placement and removal of epidural catheters in anticoagulated patients are discouraged because of an increased risk of epidural hematoma. In situations in which this cannot be avoided, ongoing neurologic monitoring is suggested.

Precautions with Opioid use.

Caution should be exercised when prescribing opioids for patients who may be more sensitive to the respiratory depressive effects, such as elderly patients (26,27), and those with obstructive sleep apnea and in patients with decreased renal clearance where high or repeat doses may lead to higher systemic opioid concentration for prolonged duration (26).

Adverse Effects with Opioid Use.

Adverse effects, relevant to post-operative period like respiratory depression and nausea are generally dose related and resolve quickly when opioid serum levels fall.

Respiratory Depression

Opioids act on m-receptors in the brain stem causing inhibition of ventilatory drive in response to increasing levels of carbon dioxide resulting in decreased respiratory rate, irregular and periodic breathing, desaturation, and hypercarbia which augment opioid sedation in a dangerous positive feedback loop leading to apnea. However serious respiratory depression has been reported at an incidence of 0.5% (34).

Antidote: Naloxone, naltrexone, and nalbuphine all reverse the m-opioid respiratory depressant effect. Low dose of these antagonists significantly improves ventilatory response, however high doses may be dangerous as it may unmask m opioid receptor analgesia leading to sudden emergence of high levels of pain and subsequently a massive sympathetic discharge which may result in adverse cardiac events. Similarly, duration of action of m-antagonist is less than that of a m agonist, therefore the patient should be monitored for a longer period until it is unlikely that respiratory depression will recur.

Nausea

Narcotics directly stimulates central chemoreceptor trigger zone in the medulla and may lead to nausea and vomiting, particularly when the dose exceeds that required for analgesia in a given patient. This effect varies with opioids f.ex. morphine produce more nausea and vomiting than fentanyl. However, it should also be kept in mind that untreated pain can also stimulate the chemoreceptor trigger zone and result in nausea (28).

Conclusion:

Visual analogue scale is preferred method of pain assessment and reliable analgesia is predominantly oriented around opioids, preferably through PCA. Intravenous injection of local anaesthetics especially bupivacaine should be avoided. NSAIDs are not recommended at least first two days.

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Hot Topic Symposium Radiation protection: burning issue

2102.1

Radiation protection: are you prepared for the new legislation in 2018?

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The new European Directive 2013/59/Euratom on basic safety standards for protection against the dangers arising from exposure to ionising radiation is expected to have a relevant impact on the European diagnostic and interventional radiology. The directive was adopted by the Council of the European Union (EU) on 5 December 2013. Member States of the EU shall complete the transposition of the directive into national legislation by 6 February 2018. After the transposition, the implementation of the new requirements will be a challenge for the interventional practices in Europe, but it is expected to substantially improve the radiation safety for patients and professionals.

The most relevant changes in the new directive (with impact on interventional practices) may be summarized as follows: 1. use and regular review of diagnostic reference levels (DRLs), including interventional procedures; 2. education and training in radiation protection; 3. responsibilities (involvement of several professionals in optimisation); 4. role of medical physics experts (MPEs); 5. new requirements for equipment; 6. procedures (optimisation process); and 7. registry and analysis of accidental or unintended exposures. The most relevant change in occupational exposures is the new annual limit for the lens of the eyes.

The use and regular review of DRLs is a new requirement. Appropriate local reviews are needed whenever DRLs are consistently exceeded and require corresponding corrective action without undue delay. The impact of complexity factors when setting DRLs in interventional procedures will be a challenge.

Member states shall ensure that practitioners and the individuals involved in the practical aspects of medical radiological procedures have relevant competence in radiation protection. Continual education and training (including radiation protection) after qualification need to be provided, especially when new techniques are introduced.

With regards to responsibilities, it is stressed that any medical exposure takes place under the clinical responsibility of a practitioner. The MPE and those entitled to carry out practical aspects of the procedures shall be involved in the optimisation process.

The directive contains new requirements for equipment: any equipment used for interventional radiology shall have a device or a feature informing on the quantity of radiation produced by the equipment during the procedure and shall have the capacity to transfer the dosimetric information to the record of the examination (equipment installed prior to 6 February 2018 may be exempted from this requirement). Member states shall ensure that information relating to patient exposure forms part of the report of the medical radiological procedure.

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2102.2

Is there a real radiation hazard for young female doctors entering interventional radiology?

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Fewer than 10% of the interventional radiology and interventional cardiology trainees are females, comprising one of the lowest percentages of women among medical specialties. Suggested reasons for this include a challenging work-life balance, lack of female role models and concerns regarding exposure to ionising radiation. Young female doctors considering a career in interventional radiology should be cognizant of the radiation risks, particularly related to pregnancy. Lack of knowledge or misinformation provided by the medical community often leads to undue apprehension and may deter potential trainees.

Although there is no absolutely 'safe' threshold dose of radiation and it is known that the developing foetus is highly sensitive to radiation, particularly during the first trimester, the scale of exposure from medical imaging is in orders of magnitude below known thresholds for individual or foetal injuries. The risks of radiation need to be considered in this context. The average annual background radiation dose in most countries is 2–3mSv. Once a pregnancy has been declared, ICRP recommends that the additional dose to the foetus should not exceed 1mSv during the remainder of the pregnancy. The threshold dose for foetal injury is 100mSv. The average dose received by a working pregnant interventionist over the entire gestation is 0.3mSv and to the foetus is approximately 0.09mSv. The risks from occupational radiation exposure during pregnancy are very small indeed compared with other risks that may affect a pregnancy, i.e. a spontaneous abortion rate of 15% and an incidence of major malformation of 2%–4%. Pregnancy outcomes after exposure to radiation levels encountered in the angiography suite are indistinguishable from outcomes among the unexposed population (those exposed to natural background radiation).

Once a medical radiation worker has declared a pregnancy, there are three options that are often considered. First, there may be no change in working duties. Second, work may be changed to another area with a lower radiation exposure, and third, it may be changed to an area with no radiation exposure. The latter is often requested because despite knowing that the risks are small, the pregnant worker does not wish to accept any risk. This may be logistically difficult if other employees are needed to fill the vacated position.

If a pregnant interventionist continues working, it is important to keep the dose to a minimum by wearing appropriate personal protective shielding and practising careful fluoroscopic techniques.

The simple answer to the posed question is that there is no real radiation hazard for young female doctors entering interventional radiology.

2102.3

Paediatric intervention: how to keep radiation exposure low?

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Paediatric image-guided minimally invasive interventions are expanding and gradually replacing surgical interventions. A child should not be considered a 'small adult' but a standalone entity by means of procedure safety in general and radiation safety in particular. Children are more sensitive to radiation than adults. Radiological procedures carry higher risk per unit of radiation dose on an average for the development of cancer in infants and children compared with that in adults owing to known reasons such as longer life expectancy in children and that developing organs and tissues are more sensitive to the harmful effects of radiation. Clearly,

the average risk is higher in infants and young children compared with older children. Interventional procedures in children should be absolutely justified, and radiation exposure in young children must be lower than that in adults.

Good and well-controlled sedation or general anesthesia should be a routine for pain and anxiety and as a consequence dose management. A well-controlled relaxed child requires a lesser fluoroscopic intervention and less retakes during DSA runs.

Exposure parameters on X-ray machines are often not adjusted for paediatric patients, and there is a clear need for appropriate selection of technical parameters such as focal spot size, pulse width, pulse rate, field size, air-gap magnification, filter thickness and position and anti-scatter grid systems.

IR has to limit fluoroscopy time and the number of images obtained in angiographic and radiographic acquisitions, appropriate use of last image hold and storage of dynamic fluoroscopy, flexible automated detection systems, radiation-free patient positioning and collimation and post-processing magnification. No correlation is found between fluoroscopy time and measured entrance dose, but a strong correlation is observed between cumulative skin dose and patient weight.

Diagnostic reference levels (DRLs) have a high importance in paediatric population. For interventional procedures, complexity of the procedure may be considered in setting DRLs. Data from all interventional procedures performed (not just from a limited sample) should be collated to derive local and national DRLs. This requires adjustment for the varying sizes of children.

Because the use of IR procedures in children is likely to expand and procedures are likely to become more complex and time consuming, they should always be individually justified and accurately planned. A clinically justified balance between the risk and the benefit is necessary. It is important to have a history of previous procedures. We have to verify that the procedure is necessary based on the natural history of the disease and the risks and benefits of other available therapeutic options.

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2102.4

How to select the most appropriate personal protection?

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In general, medical staff should never be exposed to the primary X-ray beam during interventional procedures. However, Compton scattered radiation from the patient can be significant. Personal protection strategies to reduce such exposure rely on three basic principles: time, distance, and shielding. Dose-reduction equipment include fixed barriers or shields close to the source of scatter (the patient) as well as personal protective equipment worn by interventional radiologists and technicians. Radiation at energies that are observed in fluoroscopy-guided interventions primarily interact through the photoelectric effect. The photoelectric attenuation coefficient depends on the atomic number (Z) of the absorbing material, which is why protective garments traditionally use lead (Pb, $Z > 80$) as the material usually in thicknesses of 0.25, 0.35, or 0.5 mm. The main disadvantage of Pb as the attenuation material is its

heavy weight, which can cause discomfort, especially during long and repeated procedures. Various manufacturers provide garments made of alternative light-weight absorbers, sometimes in combination with Pb. The attenuation characteristics of such Pb composites or non-Pb protective garments are expressed in terms of Pb equivalence, assuming that they will attenuate the same as Pb. A 0.25-mm Pb-equivalent garment should attenuate about 97% of the X-Ray at 70 KVp. With an increasing KVp, the protective value of the shielding material declines; at 100 KVp, the attenuation will only be about 90%. Recent studies show a substantial variability in the protective value among Pb-equivalent aprons. A verification of the effectiveness of protective garments at a broad beam geometry needs to be warranted. In this lecture, various types of personal protection and their appropriateness for dose reduction will be explained and discussed.

Special Session Knee osteoarthritis

2502.1

Demographics and surgical options

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Learning Objectives

1. To learn how to use pre-treatment imaging in knee osteoarthritis
2. To learn how to use different surgical options in knee osteoarthritis
3. To learn how to use other medical treatments currently available for knee osteoarthritis

No abstract available.

2502.2

Intra-articular injections

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Learning Objectives

1. To learn how to select patients for intra-articular injections in the knee
2. To learn how to use different injectates
3. To learn how to evaluate current results reported in the literature

For knee osteoarthritis (OA), several conservative treatments are recommended by clinical guidelines. The non-pharmacological therapies include patient education and self-management, exercises, weight reduction, walking supports (crutches), bracing, shoe and insoles modification, local cooling/heating, acupuncture, and electromagnetic therapy.

Self-management, education and provision of information on OA, and treatment are widely promulgated as core recommendations for treating hip and knee OA in recent guidelines from National Institute of Health and Clinical Excellence and the American Academy of Orthopaedic Surgeons as well as in the OARSi guidelines and in many previously published guidelines. Pharmacological therapies mainly include paracetamol, non-steroidal anti-inflammatory drugs, opioids, and slow-acting drugs (glucosamine and chondroitin sulfate).

When orally administered drugs are ineffective in reducing symptomatology, intra-articular (IA) injection [corticosteroids (CSs),

viscosupplements, and blood-derived products] is the non-operative modality that can be preferred. The major contraindication for IA injections is septic arthritis because in the presence of overlying soft-tissue infection, there is risk of iatrogenic spread to the joint. The ideal conservative management of knee OA requires a combination of pharmacological and non-pharmacological treatment modalities customized to individual patient needs; the goals of conservative therapy are to reduce pain, improve function and quality of life, and reduce disease evolution. Patient characteristics, symptoms, and clinical findings may indicate a practical approach for IA injections. CSs are generally indicated for acute and persistent synovitis in patients who cannot be operated; in addition, when the correlation of chondrolysis with OA flare is considered, the IA injection of CS for the short-term treatment of disease flares is recommended. Hyaluronic acid (HA) can be indicated for obese patients who are older than 60 years and for patients with extremity disease. The American College of Rheumatology subcommittee on OA has no recommendations regarding the use of IA hyaluronates. However, The American Society of Orthopedic Surgeons does not recommend using IA HA for patients with symptomatic knee OA. Work group of the American Society of Orthopedic Surgeons has interpreted that the quality of the supporting evidence is high, and their recommendation against the use of IA HA is strong in their guideline. The supposed long-term effect of HA is attractive for such patients who are not willing to be operated. Platelet-rich plasma (PRP) is generally used for patients younger than 60 years, with mild OA and body mass index < 30, and for patients that do not have any extremity malalignment. If the patients are older than 60 years, their body mass index is >30, or they have moderate OA, an application of PRP is indicated, followed by a supplementary single dose of HA injection 2–4 weeks after PRP injection.

Five injectable CSs have a current Food and Drug Administration (FDA) label for IA injections: methylprednisolone acetate, triamcinolone acetate, betamethasone acetate and betamethasone sodium phosphate, triamcinolone hexacetonide, and dexamethasone.

A few trials comparing functional outcomes after different IA CS injections have been published. However, the results are inconclusive. Although further research is needed, it seems that any agent provided with correct indication, dosage, timing, and application has similar potency.

CSs have both anti-inflammatory and immunosuppressive effect, but their mechanism of action is complex.

FDA-approved injectable hyaluronan products are sodium hyaluronate, hylan G-F 20, and high-molecular weight hyaluronan.

HA is a glycosaminoglycan and a component of SF and cartilage matrix. Synovial cells, fibroblasts, and chondrocytes synthesize HA and secrete it into the joint. HA enhances the viscosity and elastic nature of SF. SF with normal HA concentration acts as a viscous lubricant during slow joint movements and as an elastic shock absorber during rapid joint movements.

In the osteoarthritic joint, synovial inflammation leads to increased permeability of the synovial membrane for HA. In addition, the elevated levels of free radicals, inflammatory cytokines, and proteolytic enzymes in the SF of osteoarthritic knees impair HA function and contribute to OA progression. Therefore, in OA, both the molecular weight and the HA concentration decrease.

The IA injection of HA is thought to restore normal viscoelastic properties of the pathologically altered SF, which explains the term of the approach: "viscosupplementation."

PRP is prepared from autologous blood by centrifugation to obtain a highly concentrated sample of platelets, which is four to five times higher than that of normal blood.

The platelet concentrate is activated by adding calcium chloride, which results in the formation of platelet gel and the release of growth factors and bioactive molecules. Consequently, platelets actively participate in healing processes by delivering a broad spectrum of GFs and other factors that together contribute to

comprehensive roles of PRP, including those in chondrogenesis, bone remodeling, proliferation, angiogenesis, anti-inflammation, coagulation, and cell differentiation. If the patients are older than 60 years, their body mass index is >30 , or they have moderate OA, an application of PRP is indicated, followed by a supplementary single dose of HA injection 2–4 weeks after PRP injection. Salem et al in 2014 conducted a study on 20 adult rats, which were inducted of cartilaginous defect in both knee joints. During the second time, they injected a mesenchymal stem cell culture suspended in HA solution in the right knee of each rat, whereas the left knee served as a control. After 6 weeks, they showed that in 73% of the rats, the tissue was typical of fibrohyaline cartilage and appeared more cellular than fibrous. In 27% of the rats, the repaired tissue appeared more fibrous than hyaline. In the control knees, the newly formed tissue was an undifferentiated connective tissue and the cells were covered with a thin layer of fibrous tissue. This shows how promising the use of mesenchymal stem cells for autologous cartilage repair is, but further studies are needed to confirm this hypothesis.

Six major portals of approach to the knee joint for injection have been described: the lateral mid-patellar (LMP), medial mid-patellar (MMP), and patellofemoral; the superolateral and superomedial; and the anterolateral and anteromedial (inferolateral and inferomedial) approaches.

The traditional approach to knee injection accesses the patellofemoral joint. This technique is performed with the knee in extension; the patella is pulled medially or laterally, and a needle is advanced under the patella.

The LMP approach is the most commonly used. Via the LMP and MMP approaches the patellofemoral joint can then be used for joint aspiration and/or injection. When performing a procedure via the LMP approach, the needle is directed at a 45° angle toward the middle of the medial aspect of the joint. Injection via the MMP approach is performed with the needle entering the medial aspect of the knee joint under the middle of the patella and is directed toward the lateral patellar mid-pole 3).

Although the usual site of entry to the knee joint is via an LMP approach or an MMP approach, an approach lateral and superior to the patella can be used, especially if there is a large effusion in the suprapatellar bursa 14). This technique is performed with the patient in supine position and the knee extended.

This technique aims for the suprapatellar pouch and allows the needle to pass underneath the articular surface of the patella.

The anterior (or infrapatellar) approaches are an alternative to the classic patellofemoral approaches and are less often used for knee joint injection and aspiration.

The inaccurate placement of injecting needles can result in damage to IA structures secondary to soft tissue infiltration by CS. Clinical experience has shown that the IA injection of the knee joint is more painful when the tip of the needle is in Hoffa's fat pad. This is also the most common ectopic injection site for missed IA injection. Chavez-Chang et al. have suggested that the length of the needle used for IA injection influences the accuracy of IA injection as the standard 3.8-cm needle may be too short to reach the synovial space overlying the medial femoral condyle.

A review by Berkoff et al. has shown that the accuracy of IA injection may be improved using ultrasound guidance, with an accuracy of 95.8% (versus 77.8% using anatomical guidance). Park et al. have reported an accuracy ranging from 95% (medial midpatellar approach) to 100% (superolateral approach) using ultrasound guidance with a long-axis in-plane technique. Maricar et al. 30) have stated that injection under ultrasound guidance may improve the likelihood of response to IA CS injection, and Sibbitt et al. have reported that ultrasound-guided aspiration and injection of the knee results in improved aspiration success, greater synovial fluid yield, more complete joint decompression, and improved clinical outcomes.

Based on randomized controlled trials in OA patients, it is proven that IA CSs are effective, but their benefit over placebo may be relatively short-lived up to 4 weeks.

In a Cochrane review, the short-term efficacy of CSs in knee OA has been confirmed, and recently, the short-term effect has been shown in a systematic review by Hepper et al and in a meta-analysis by Bannuru et al. The efficacy of HA is a matter of debate, with markedly discordant interpretations of the data. Among the published meta-analyses, two have concluded an overall beneficial effect for HA injections, four have reported a small benefit, and two have found no evidence to support HA injection therapy for knee OA.

Rutjes et al have found no important overall benefit on pain intensity or the frequency of OA flares in 89 trials involving 12667 patients. Bannuru et al have reported that HA asserts modest positive effect up to 24 weeks in certain clinical situations, but its cost-effectiveness is advised to be re-evaluated. In conclusion, studies have indicated that PRP is promising for relieving pain and improving knee function and quality of life. However, no data indicate that PRP cause osteophytes to regress or cartilage and meniscus to regenerate in patients with substantial and irreversible bone and cartilage damage. More promising results have been shown in younger patients and in patients with mild OA.

The clinical use of PRP in OA is not supported by high-quality evidence on a real clinical improvement 6). However, its low cost, simple preparation technique, safety, and biologically active content have led to high acceptance by both patients and physicians.

In the Cochrane reviews of trials comparing IA HA injections with IA CSs, no significant differences were observed 4 weeks after injection, but IA HA was more effective 5–13 weeks post injection. This is further supported by a meta-analysis of seven randomized controlled trials involving patients with knee OA in which IA HA was compared directly with IA CS.

In the first 2 weeks, CSs were more effective in relieving pain, but at 4 weeks, both CSs and HA were equally effective, and from 8 weeks to the last assessment during 26 weeks, HA was more effective. The analyses of the results for other outcomes, such as reduction in stiffness and improvement in function following IA HA, were similar. In a recent study, Kon et al evaluated PRP versus HA injections in 150 patients and found that PRP injections provided better results than HA injections in terms of reducing pain and symptoms and recovering articular function up to 6 months. In this study, PRP showed a better performance than HA in younger patients affected by cartilage lesions or early OA.

However, PRP and HA treatments offered similar results in patient aged over 50 years and in advanced OA. In addition, Spakova et al compared 120 patients receiving IA injection of HA or PRP and reported significantly better scores after 3 and 6 months of follow-up in the group of patients who received PRP injections. Say et al compared IA HA and PRP injections in their prospective study and concluded that the application of a single PRP dose to be a safe, effective, and low-cost method for treating OA. Lastly, in very recent three level 1 studies, two randomized HA controlled clinical trials and one placebo-controlled trial, PRP decreased pain and improved function better than HA or placebo.

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2502.3

Neurolysis and intra-articular RF application

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Learning Objectives

1. To learn how to select patients for neurolysis in the knee
 2. To learn how to evaluate current results reported in the literature
 3. To learn how to use tips and tricks for successful neurolysis
- Knee osteoarthritis is a degenerative ("wear and tear") type of arthritis; the prevalence of this type of arthritis increases with age. When the knee joint is involved, osteoarthritis ranks as the 11th leading cause of years lived with disability and as the 3rd greatest contributor to loss of health-related quality of life. The list of risk factors for knee osteoarthritis includes aging, obesity, and mechanical stress. The diagnosis and grading/staging of knee osteoarthritis is performed according to radiographic findings (using the Kellgren-Lawrence scale) or according to clinical symptoms and signs (as defined by the proposal of the American College of Rheumatology). Symptoms of knee osteoarthritis include pain, stiffness, swelling, joint instability, reduced mobility, and muscle weakness. The therapeutic armamentarium includes physical and occupational therapy; weight loss; stretching exercises; analgesics and anti-inflammatory drugs; intra-articular injections of corticosteroids, plasma-rich proteins, stem cells, or hyaluronate solution into the knee; extra-articular neurolysis of the genicular nerves; intra-articular application of pulsed radiofrequency (RF); and surgical options.
- Since the 70s, RF is used for chronic pain therapy in cases unresponsive to conservative treatment; neurolysis applies high temperatures (60°C–80°C) using continuous RF to destroy the target nerve while neuromodulation alters the transmission threshold without damaging the nerve itself. Currently, generators have the ability to simultaneously create multiple or quadrupolar RF lesions or to additionally work with the pulsed RF mode. During this latter case, the generator produces RF pulses each of which is followed by a silent phase, thereby keeping the temperature below 41°C.
- Compared with continuous RF, the pulsed mode has much less (if any) neurodestructive characteristics; the long silent phases (480 milliseconds) between the short bursts of application of energy (10–20 milliseconds) maintain the tissue temperature below 41°C and no nerve tissue damage occurs. Up until now, in vivo and in vitro

studies support that there is no evidence of long-lasting structural effects caused by the application of pulsed RF. Histological studies focusing on the biological effects of the application of pulsed RF on the nerve tissue report architectural impairment of the axonal myelin sheath bundles, interstitial edema (which is temporary and persists for a few weeks post the session) as well as ultra-structural changes in the C and A delta nociceptive fibers.

RF treatments in knee osteoarthritis aim for pain reduction; these kind of therapies for symptomatic patients suffering from pain due to knee osteoarthritis can be performed by extra-articular application of continuous RF at the level of the genicular nerves or by intra-articular application of pulsed RF. Pulsed RF applied inside the knee joint targets the pericapsular nerve endings responsible for pain; the technique suppresses the excitatory C fiber response and the synaptic transmission resulting in immediate pain relief. Additionally, with the application of pulsed RF inside the knee joint, an immune response is created interrupting the production of pro-inflammatory cytokines, such as interleukin-1b and interleukin-6.

Comparative studies between continuous application of RF at the genicular nerves and a placebo therapy report significantly lower pain scores in the RF group during follow-up. On the other hand, studies on intra-articular application of pulsed RF (using a blind technique) report significant decrease in pain (>50%) over a 6-month follow-up. A pioneer study by Masala et al concludes that post intra-articular application of pulsed RF, significant decrease in pain and improved autonomy in daily life lasts for more than 12 months. In everyday clinical practice it is noted that toward 12 months post the therapeutic session, there is a tendency for increase in pain although the self-reported pain scores are significantly lower than those at the baseline. At this time point, a new therapeutic session could provide further symptom improvement.

Application of RF (continuous at the level of the genicular nerves or intra-articular pulsed RF) does not cause regression of osteophytes or regeneration of cartilage and meniscus in patients with substantial bone and cartilage damage and therefore, addition of hyaluronate solution inside the joint seems to be necessary.

Percutaneous application of RF energy either for neurolysis or for neuromodulation seems to be an effective and safe technique for palliative management of chronic pain in patients with knee osteoarthritis. The results seem to be reproducible and last longer than those after intra-articular injection of hyaluronate only. There seems to be a need of repeating the session at 1 year. Further evaluation of the technique against a sham trial and/or an intra-articular injection of hyaluronate ± corticosteroids is warranted.

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2502.4

Transarterial embolisation

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Learning Objectives

1. To learn how to select patients for embolisation in the knee
2. To learn how to evaluate current results reported in the literature
3. To learn how to use tips and tricks for successful embolisation

The hallmark symptom of osteoarthritis (OA) is pain. This is the symptom that drives individuals to seek medical attention and contributes to functional limitation and reduced quality of life (1, 2); the alleviation of pain is the main motivation for treatment that includes non-pharmacological, pharmacological and surgical approaches. Severe and end-stage knee OA is successfully treated with joint replacement surgery, but effective management of mild-to-moderate radiographic knee OA that is refractory to conservative treatment can be difficult. Arthroscopic lavage and debridement have been performed for mild-to-moderate knee OA but their effectiveness has not been proven in a double-blinded, randomised, placebo-controlled trial (3).

Although OA has been viewed as a 'wear and tear' disease for many decades, it is generally accepted to be a low-grade inflammatory disease of the synovial joints and a biomechanical whole-organ disease (4, 5). Of specific interest is the role of neovasculature in supporting the osteoarthritic inflammatory process and catalysing the proliferation of perivascular sensory nerves. Blood vessel penetration across the osteochondral junction may impair the integrity of the cartilage-subchondral bone barrier and can stimulate osteophyte formation (6). Angiogenesis-driven growth of sensory nerve fibres and the innervation of the normally aneural cartilage could be a major source of pain in OA (7). The growth of vascular and neural networks is interdependent on myriad chemokines and other cell signalling molecules (vascular endothelial growth factor, semaphorins, etc.) (8, 9).

We have previously reported on the mid-term clinical outcomes and MRI changes after transcatheter arterial embolisation in 95 knees of 72 patients with mild-to-moderate radiographic knee OA (10).

Our study demonstrates that arterial embolisation improves pain symptoms and knee function up to the 4-year follow-up. No serious adverse event was noted. Minor complications such as moderate subcutaneous haemorrhage at the puncture site and transient cutaneous colour change on the treated knee occurred; all of which resolved without treatment. This study primarily used a non-permanent embolic material imipenem/silastatin sodium (n=88 knees). Embosphere spheres (75 µm) were used for patients who had contraindications to imipenem (n=7 knees). There was no significant difference in clinical success between these two groups. MRI evaluation at 2 years after TAE showed a significant improvement in synovitis, a slight progression in osteophytes and no osteonecrosis or other evidence of ischaemic complications.

In this study, abnormal neovessels were observed on angiography in all patients; these vessels were mainly located within the periarticular soft tissue (synovium, infrapatellar fat pad, periosteum and joint capsule) and were often observed to be in a location consistent with the sites of tenderness, suggesting that the prevalence of vascular changes in mild-to-moderate radiographic knee OA is quite high and that OA pain and local tenderness could be related to abnormal neoangiogenesis. MRI evaluation at the 2-year follow-up showed improvement in the synovitis score, which bolsters the hypothesis that abnormal neoangiogenesis is an important factor in inflammation (and thus pain) and that arterial embolisation can reduce inflammation by occluding these abnormal vessels.

In this study, patients who had more severe degenerative changes (KL 3) showed a lower frequency of clinical success at 6 months after

TAE than those with mild changes (KL 1-2). A subset of patients in both groups experienced pain recurrence after initial clinical success. Knee OA is an age-related disease with no prospect for spontaneous recovery; it is thus expected that structural changes and associated inflammation will continue to progress and that pain can recur, particularly in patients with severe degenerative changes. Thus, although TAE cannot treat knee OA completely or reverse its natural progression, it seems to be an effective additional option to alleviate pain, decrease the use of pharmacologic painkillers and injection therapies and improve the quality of life. In the present case series, TAE allowed a reduction in the use of oral NSAIDs and oral opioids and a reduction in the frequency of use of injection therapies.

There may be several concerns regarding knee OA embolisation, such as the risk of ischaemic events including osteonecrosis, muscle atrophy, peripheral paresthesia or neuropathic joint disease, such as Charcot joint. Although all patients in the present study were repeatedly asked and encouraged to report symptoms suggestive of these pathologies, none reported any such symptoms. On the MRI evaluation at 2 years after the first TAE, no ischaemic findings consistent with osteonecrosis or peri-articular soft tissue abnormalities were detected. The absence of such adverse events may be related to the embolic technique used in our study, particularly the use of small amounts of embolic material.

Our session is designed to focus on patient selection for knee OA embolisation, evaluation of the results and how to use tips and tricks for successful embolisation.

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Special Session

Therapy of claudication (SFA interventions)

2503.1

How to overcome SFA lesions: toolbox proposal

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Learning Objectives

1. To learn about strategies to overcome SFA lesions
 2. To learn the current role of strategies to overcome SFA lesions
 3. To learn outcomes following strategies to overcome SFA lesions
- Peripheral arterial disease (PAD) of the superficial femoral artery (SFA) is probably the most common condition treated using vascular intervention owing to intermittent claudication (IC). Occlusions and stenoses may be isolated or diffuse and may cause IC, which is observed more frequently at single locations in SFA, or critical limb ischemia (CLI), which is observed more frequently when SFA lesions are combined with lesions involving below-the-knee (BTK) arteries.

Percutaneous angioplasty (PTA) with or without stenting has become a state-of-the-art treatment for SFA lesions.

Generally, the main principle is to pass the lesion and introduce a guidewire in a safe position after having crossed the lesion. Then, PTA and/or stent applications are performed using a variety of specific techniques to treat the lesion and re-establish adequate antegrade blood flow.

Therefore, the first step is to pass the lesion as safely and quickly as possible and place the guidewire after having passed the obstructed or stenotic lesion. A clear anatomic overview is mandatory and should be available prior to the procedure, usually using CT or MR angiography. Antegrade access is suggested to reduce distances to a minimum. Retrograde access using a long crossover sheath might be indicated when iliac lesions must be treated coincidentally. Generally, procedures should be performed as atraumatically as possible; therefore, low-profile devices should be used. For this purpose, sheath profiles should be as small as possible but as large as necessary to avoid unnecessary maneuvers. For passing the lesions, generally, hydrophilic guidewires are used intraluminally as the first-line approach. However, in obstructed and heavily calcified lesions, subintimal techniques, such as those primarily described by Bolia, are nowadays widely used. After having passed the lesion subintimally, re-entry into the true lumen of the vessel is mandatory. If such a re-entry cannot be performed by general guidewire techniques, dedicated tools, i.e., the so-called re-entry devices can be used to gain access to the true vessel lumen again.

If antegrade techniques are insufficient, a retrograde access can be acquired by puncture of popliteal or pedal arteries. Dedicated low-profile puncture sets are available to provide a quick and safe access. Once having passed the lesions, clear strategies must further be considered to treat the lesion as sufficiently as possible.

Generally, the first-line approach is PTA with optional stenting. However, in heavily calcified lesions, primary stenting may be an option. Further, a decision must be taken right away if drug eluting balloons (DEB) need to be used. Given the indication for DEBs, they should be applied as the first-line approach. Similar considerations must be taken into account for the use of other first-line devices or tools, such as "cutting balloons."

Regarding stent techniques, general strategies should be defined for the use of drug-eluting stents (DES). Further, special strategies must be considered when treating lesions at highly flexible anatomic locations, such as the femoropopliteal segment. Dedicated stents and DEBs should be used for the treatment of this highly stressed segment.

Regarding potential complications, the interventional tool box must also contain devices and medication for embolectomy and lysis and dedicated stentgrafts in case of rupture or hemorrhage.

Last but not the least, strategies regarding the use of closure devices must be established and considered for punctures of 5 F and more and outpatient management.

Generally, tool boxes must cover all varieties of techniques and all devices that are potentially included within the general therapeutic strategy of each individual IR unit. They include tools for various puncture techniques and adequate guidewires for use in simple antegrade techniques, subintimal techniques, and total occlusions. Balloons and stents of various sizes and profiles with or without drug-eluting properties must be available in addition to tools for complication management and closure devices.

In conclusion, strategic thinking starts with a clear planning of the procedure on the basis of preinterventional diagnostic evaluations. Antegrade access is the easiest and fastest basis for endovascular treatment of SFA lesions; however, crossover or even retrograde access must be considered if necessary. Access profiles should be as low as possible but as high as necessary. Wire size, surface qualities, and profiles must be considered.

Clear technical and procedural strategies should be defined for the treatment itself. Decisions must be taken on primary stenting versus PTA and optional stenting. Further, the decision regarding using DEBs or DES must be pre-established. Special attention and strategies are necessary for the treatment of the highly flexible femoropopliteal segment. Re-entry devices should be included in every interventional tool box.

Strategic thinking is a key point in any endovascular therapy, particularly, for SFA treatment. Due to the huge variety of techniques and devices and the complexity of procedures, all steps must be clearly defined and each maneuver demands its specific set-up.

Tool boxes will be arranged individually in each IR Unit and established on the basis of each strategic decision. In such a set-up, outcomes and efficacy of the endovascular treatment of SFA lesions will be optimized.

Strategic planning of SFA interventions plays a major role in every interventional center because it is the most frequent procedure used and its standardization will help establish a high procedural success, minimum complications, and fast and safe procedures. Clear strategies are essential to maximize outcomes, quality control, and patient safety.

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2503.2

DCB – when, how and why to use

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Learning Objectives

1. To learn the designs of the drug-eluting balloon trials in the SFA
2. To learn the current role of drug-eluting balloons in the SFA
3. To learn outcomes following DCBs in the SFA including follow-up

Drug-eluting technologies have been introduced in various endovascular treatment strategies for peripheral arterial occlusive disease since the early 2000s. With plain old balloon angioplasty offering only the option of dilating the target lesion and not addressing the desired recovery of the endothelial layer and the problem of neointimal hyperplasia, drug-eluting balloon angioplasty sounds tempting. In general, drug-eluting balloon angioplasty is considered to be an attractive alternative among plain old balloon angioplasty, bare-metal stents, covered stents, and drug-eluting stents because the antiproliferative drug is administered in the critical phase of neointimal hyperplasia while not leaving behind any kind of stent as a permanent implant. As balloon dilation of any kind and stent placement provoke trauma in the endothelial layer, the recovery of this inner single-cell layer is crucial for short- and long-term patency of the target lesion. An intact and functional endothelial layer acts as an anticoagulant surface and prevents smooth muscle cell growth and thus, neointimal hyperplasia. By dilating and coating the inner vessel wall at atherosclerotic lesions with cytostatic or immunosuppressive agents, cellular mechanisms causing atherosclerosis and neointimal hyperplasia are blocked and undesirable events in the follow-up may be prevented. Drugs to be delivered endovascularly into the vessel wall during drug-eluting balloon angioplasty may offer both the support of recovery of the endothelial layer and the prevention

of neointimal hyperplasia. The most frequently used drugs in drug-eluting balloon technology are paclitaxel and its derivatives as cytostatic drugs and sirolimus and its derivatives as immunosuppressive drugs. Since its introduction in endovascular treatment of arterial occlusive disease, there is an ongoing debate on the drug, type of coating, and released dose. Multiple randomized controlled trials have been conducted enrolling patients with peripheral arterial occlusive disease with intermittent claudication and/or critical limb ischemia. Objectives of treating intermittent claudication and critical limb ischemia are very different. The main focus for patients with intermittent claudication is to restore walking capacity and to improve the quality of life, whereas patients with critical limb ischemia are treated to relieve ischemic rest pain, to establish wound healing, and to prevent amputation. With respect to the methodological quality of specific trials, a variety of anatomic and clinical objectives are assessed. For anatomic issues such as patency rate, stenosis grade, binary restenosis, target lesion revascularization, and late lumen loss are examined. For clinical issues such as walking capacity, quality of life, change in Rutherford classification, ankle-brachial-index, amputation, death, major adverse cardiac events, and event-free survival are examined. By including the abovementioned patients with intermittent claudication and critical limb ischemia in the respective trials, heterogeneity and decrease in the quality of evidence of the outcomes and conclusions may be caused in terms of the anatomic and clinical objectives. Most of the randomized controlled trials provide follow-up data for 12 months, few for up to 2 years, and one for 5 years. In meta-analyses, drug-eluting balloon angioplasty shows better results for primary patency rates for up to 2 years, with odds ratio of 1.47 at 6 months, 1.92 at 1 year, and 3.51 at 2 years and for late lumen loss, with a mean difference of -0.64 mm at 6 months and -0.80 mm at 2 years. Drug-eluting balloon angioplasty also performed better than plain old balloon angioplasty for target lesion revascularization, with odds ratio of 0.40 at 1 year, 0.28 at 2 years, and 0.21 at 5 years, and for binary restenosis rate, with odds ratio of 0.38 at 1 year, 0.26 at 2 years, and 0.12 at 5 years. No statistic differences were found for amputation, death, change in Rutherford classification, quality of life, or walking capacity. Thus, there is evidence in literature that compared with plain old balloon angioplasty, drug-eluting balloon angioplasty is of advantage in terms of anatomic objectives, such as primary patency rate, binary restenosis rate, target lesion revascularization, and late lumen loss. In contrast, there is no evidence in literature that drug-eluting balloon angioplasty is superior in terms of clinical objectives, such as amputation, death, change in Rutherford classification, quality of life, or walking capacity. Taking into account these controversial results for statistical significance of anatomic and clinical endpoints, drug-eluting balloon angioplasty does not provide better clinical outcome than plain old balloon angioplasty. Moreover, additional costs for this elaborate technology must be considered, particularly when proposed to the patient as the clinical efficacy has not been proven yet.

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2503.3

DES or BMS: what is the current evidence

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Learning Objectives

1. To learn the designs of DES and BMS trials in the SFA
2. To learn the current role of DES and BMS in the SFA
3. To learn outcomes following DES and BMS in the SFA including follow-up

Endovascular treatment of symptomatic peripheral artery disease has become the primary revascularization method in most centers.^{1,2} However, the optimal endovascular modality for femoropopliteal artery disease has not been determined yet. Standard endovascular treatment options include percutaneous transluminal angioplasty (PTA) and routine stent placement. Placement of bare-metal stents (BES) and drug-eluting stents (DES) have emerged as a more durable alternative by providing permanent scaffolding to prevent recoil and increase patency rates, particularly in longer lesions. However, BES are still associated with a considerable rate of restenosis and repeat revascularization. DES use antiproliferative drugs to reduce neointimal hyperplasia and restenosis. DES are associated with lower rates of restenosis, but the evidence is moderate. DES are also attributed with chronic inflammation and incomplete re-endothelialization. They also bring about neoatherosclerotic changes. At present, only limited long-term data are available.

2503.4

Anything left for SFA treatment – new drugs, new tools?

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Learning Objectives

1. To learn the designs of other treatment trials in the SFA
2. To learn the current role of other treatments in the SFA
3. To learn outcomes following other treatments in the SFA including follow-up

No abstract available.

Fundamental Course Therapy of arterial GI bleeding (embolisation)

2601.1

Patient selection

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Learning Objectives

1. To learn about important clinical factors for selecting patients for embolisation
2. To learn about work-up and imaging strategies for selecting patients for embolisation
3. To learn about optimal CT-technique and imaging findings for selecting patients for embolisation

No abstract available.

2601.2

Optimising angiographic techniques

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Learning Objectives

1. To learn about the proper angiography technique for detecting GI-haemorrhage
2. To learn tricks and tips to increase the yield of angiography for GI-haemorrhage
3. To learn strategies how to deal with negative angiography results

Interventional treatment of gastrointestinal haemorrhage is a standard technique commonly used in acute situations. Usually, angiography is performed after bleeding is detected either on a CT scan or by other techniques such as RBC scans. Even though a bleeding has already been observed non-invasively, it can be challenging to visualise it during angiography. This may be due to many different circumstances such as patient condition, unclear location of the bleeding vessel, challenging collateralisation or poor image quality. Thus, careful evaluation of the patient prior to the intervention is necessary, and knowledge of basic anatomy as well as advanced anatomy, including collateral supply, is important. Especially, anatomical variants should be known to be able to inject CM in all potentially bleeding vessels. For optimal visualisation, number of images acquired per second should carefully be chosen and increased if necessary. Injection should be performed in non-subtracted and subtracted images in order to avoid misregistration. Potentially provocative angiography may be able to help, e.g. using vasodilators. In certain cases, empirical embolisation may also be an option and should be carefully considered together with the referring physician.

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2601.3

Embolisation techniques and materials

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Learning Objectives

1. To learn which embolic agents to use when embolising GI-haemorrhage
2. To learn about the advantages and disadvantages of different embolic agents when embolising GI-haemorrhage
3. To learn which complications can occur using the various embolic agents and how to prevent these

Embolisation is currently proposed as the first step in the treatment of acute, life-threatening GI bleeding when endoscopic approach is not possible or is unsuccessful. Like in most procedures performed in emergency settings, time represents a significant factor influencing outcomes. Modern tools permit identifying and reaching the bleeding site faster than two-dimensional angiography.

The second fundamental aspect regards the embolisation technique.

Embolisation may be performed with gelatin sponges, particles, coils and microcoils and more recently, with glue. There are no guidelines for the choice of embolic materials used, and the final decision is usually made by the operator on the basis of his experience and compliance.

There are two main concerns with GI bleeding embolisation: rebleeding and the risk of secondary bowel ischaemia. The goal is to embolise selectively at the level of the vasa recta, avoiding the marginal artery. The particles are associated with an increased risk of bowel infarction because they cannot be visualised or precisely deposited and may reflux into non-target arteries. Cyanoacrylates are very effective in terms of bleeding control and rebleeding but are not controllable and require high operator expertise otherwise their use is associated with a high risk of non-targeted embolisation and severe intestinal ischaemia. For this purpose, in most centres, detachable coils were introduced, and they seem to be safe even if incomplete embolisation is reported in literature. No data are available for selective embolisation of GI bleeding with microvascular plugs. Ethylene-vinyl alcohol copolymer is a liquid embolisation agent, which does not have adhesive properties for making contact with arterial walls but has properties of "filling" the vascular lumen. The major advantages of this liquid compared with glue are its controlled release, non-adherence, progressive solidification, cohesiveness, high vascular penetration and weak inflammatory effect on the endothelium. The remarkable advantage of acting independently of any underlying coagulopathy or low platelet count is another important characteristic.

Early identification of the leaking vessel, fast reaching of the site of bleeding and use of an embolic agent that reduces risks of non-target embolisation and bowel ischaemia may be considered fundamental for fast and precise GI bleeding embolisation. In this field, nowadays, modern tools permit safer and more effective embolisation even if more data are necessary to affirm the exact technique for different situations.

2601.4

Predictors of success and failure

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Learning Objectives

1. To learn about predictors of success and failure when embolising GI-haemorrhage
2. To learn ways to improve the outcome of embolisation for GI-haemorrhage
3. To learn about optimal patient selection algorithms for embolisation of GI-haemorrhage

The success (or failure) of arterial bleeding in the gastrointestinal (GI) tract is determined by multiple factors, some of which can be influenced by interventional radiologists, adequate periprocedural care, or proper logistics.

The presence of a single focal bleeding vessel or only a few bleeding vessels are predictors of success, whereas that of multiple bleeding vessels or diffuse bleeding lower the chances of a successful embolization. This may also be related to the underlying disease. The presence of an underlying tumor or inflammatory process (e.g., necrotizing pancreatitis) may lower the chance of a durable success of embolization as the process itself is not treated by the embolization procedure but only the hemorrhagic sequelae. Bleeding from angiodysplasia also has a high propensity for recurrence.

The nature of the vascular territory is an important determinant of the chances of rebleeding after an initially successful embolization procedure. In general, upper GI bleeding has a higher chance of recurrence as compared with lower GI bleeding because the upper GI tract has a more abundant arterial supply and higher potential for collateral blood flow as compared with the lower GI tract.

The coagulation status of the patient is also an important determinant of the outcome of embolization, and every effort should be made to optimize the coagulation profile immediately before or during the embolization procedure. Coagulation status is not only influenced by medications taken by patients but also by the depletion of coagulation factors during massive hemorrhage and can be further worsened by hypothermia and acidosis.

It is vital to minimize time loss when there is massive bleeding, and studies have shown a strong correlation between the time interval from onset of severe bleeding and angiographic treatment after failure of conservative or endoscopic treatment. A history of many blood transfusions before referral to angiography has also been shown to predict a poor outcome, and this most likely also reflects poor logistics and time loss before referral to angiography in addition to depletion of coagulation factors.

Knowledge of the abovementioned factors may aid in improving logistics and tailoring embolization procedures (e.g., by choosing the proper embolic agents based on the coagulation status of the patient).

Special Session Update on vertebroplasty

2602.1

Update on current literature

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Learning Objectives

1. To learn how to apply data of recent randomised studies in vertebral augmentation
2. To learn how to evaluate randomised studies found in the literature
3. To learn how to use data to improve safety and efficacy

Vertebroplasty has been one of the most controversial interventional radiology procedures over the last 10 years. The controversy was generated by two placebo-controlled trials on vertebroplasty published in 2009 showing no benefit of vertebroplasty over placebo. The clinical use of vertebroplasty reduced after these trials were published, although vertebral augmentation was still performed in significant numbers with 81,000 vertebral augmentation procedures (kyphoplasty or vertebroplasty) performed in the USA in 2013¹.

Randomised controlled trial (RCT) evidence of vertebroplasty can be separated into open-label trials and blinded (placebo-controlled) trials. Several, but not all, open RCTs² have shown better improvement in pain and function with vertebroplasty than with conservative care. At the time of writing this abstract, three blinded RCTs comparing vertebroplasty with a placebo have been published with different outcomes.

Blinded trials are considered to have less risk of bias than open RCTs; therefore, the definitive evidence on vertebroplasty rests with placebo-controlled blinded trials. The first two blinded trials^{3,4} were published together in 2009. Both were multicentre trials enrolling outpatients with fractures for less than 12 months. Hospital inpatients were not included in either trial. The larger 2009 trial³ aimed to enrol 250 patients but terminated enrolment with 131 patients (from multiple sites in 3 continents) after a 4-year enrolment period. Eligibility criteria were numeric rated scale (NRS) pain of $>3/10$, outpatient status and failure of conservative therapy (although enrolling patients with mild NRS pain suggests that some patients already had successful outcome from conservative therapy). The primary endpoint was mean population NRS pain and Roland-Morris Disability (RMDQ) score at 1 month following intervention. Following the primary outcome collection, patients were permitted to crossover at 1 month and 51% of the control group and 13% of the vertebroplasty group crossed over after 1 month, diluting the secondary data at follow-up beyond this. At 1 month, there was no significant difference in mean NRS pain or RMDQ scores between the placebo and vertebroplasty groups. The mean duration of fracture at enrolment was 23 weeks and the mean injected poly (methyl methacrylate) (PMMA) volume was 2.6cc.

The smaller of the 2009 blinded trials⁴ enrolled outpatients from 4 centres in Melbourne, Australia. This trial targeted 200 patients but completed with 78 patients after a 4-year enrolment period. Eligibility criteria were back pain (although an entry NRS pain threshold level was not defined) and MRI evidence of recent vertebral fracture. Although not specifically excluded by protocol, hospital inpatients were not reported to be included. The primary endpoint was NRS pain at 3 months post-intervention and showed no difference in mean NRS pain between the vertebroplasty and placebo groups. The mean duration of fracture at enrolment was 12 weeks and mean injected PMMA volume was 2.8cc.

The third blinded trial is the VAPOUR trial⁵ published in 2016. Authors of this trial had participated in the larger of the earlier blinded trials³, the INVES trial. We reconfigured the INVEST trial protocol to use a similar placebo-controlled, blinded trial methodology but enrolled patients with an acute, severe pain syndrome rather than patients with chronic back pain. Changes from the 2009 blinded trial protocols were as follows:

1. Elevating enrolment pain requirement to severe pain only (NRS pain $\geq 7/10$).
2. Restricting fracture duration to <6 weeks.
3. Including hospital inpatients.
4. Excluding crossover.
5. Primary endpoint directly measured the nominated, desired clinical outcome from vertebroplasty, i.e., improvement to mild pain (NRS $< 4/10$) at 2 weeks post-intervention having enrolled with severe pain (NRS $> 7/10$). This replaced the mean population NRS pain score used in previous trials.

The VAPOUR trial⁵ achieved its target enrolment of 120 patients in 3 years from 4 centres. The mean fracture duration was 3 weeks. The mean PMMA volume per fracture was 7.5cc. Hospital inpatients comprised 57% of the patients compared with zero in previous blinded trials. The primary endpoint was positive with an increased proportion of patients with NRS pain of $<4/10$ at 2 weeks in the vertebroplasty group (44%) compared with those in the placebo group (21%). The between-group difference (23%) was significant ($P=0.01$). The between-group difference in favour of the vertebroplasty group persisted at similar levels at 1 month, 3 months and at the final data collection point of 6 months. There were also clinically important reductions in RMDQ disability scores, duration of hospital stay and height loss in the fractured vertebra at 6 months.

The sum evidence from vertebroplasty RCTs does not indicate an increase in serious adverse events or incident fractures with vertebroplasty compared with those with conservative care.

Considered together, the evidence from the three published blinded trials on vertebroplasty shows that vertebroplasty should be reserved for patients with acute, severe pain of <6 weeks due to osteoporotic fractures. The earlier blinded trials^{3,4} did not indicate the efficacy of vertebroplasty in outpatients with predominately non-acute (duration >6 weeks) fractures and including patients with non-severe pain.

On the other hand, the VAPOUR trial⁵ demonstrated clinically important pain reduction after vertebroplasty in patients with osteoporotic fractures of $<6/52$ duration with severe pain. Hospitalised inpatients should be a central part of the vertebroplasty programme as they have very fresh fractures and severe pain and disability. Hospitalised inpatients were excluded in the earlier trials but comprised 57% of the VAPOUR trial⁵.

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2602.2

The role of cement (beyond PMMA)

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Learning Objectives

1. To learn how to choose between different cement properties
2. To learn how to choose the most appropriate material in different settings
3. To learn how to use data to improve safety and efficacy

No abstract available.

2602.3

Augmentation techniques

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Learning Objectives

1. To learn how to recognise patients indicated for augmentation techniques
2. To learn how to choose the most appropriate technique in different settings
3. To learn how to use data to improve safety and efficacy

Introduction

Vertebral compression fracture (VCF) is defined by a reduction in the height of the individual vertebral body by 20% or 4 mm and can be secondary to various pathological conditions, such as osteoporosis, trauma or neoplasms. The collapse of the vertebral body associated with VCF can lead to hyperkyphosis, a potential source of persistent spinal deformation. Whenever possible, correction of the kyphotic deformation is, therefore, indicated. Vertebral augmentation procedure (VAP) is a general term for several techniques used for treating VCFs. VAPs are minimally invasive interventions which aim to consolidate the fracture and try to achieve height restoration. VAPs can be divided into percutaneous vertebroplasty, kyphoplasty and implant techniques.

Percutaneous vertebroplasty

Percutaneous vertebroplasty is an image-guided procedure that includes injection of radio-opaque bone cement into a collapsed vertebral body to provide pain relief and stability. The first percutaneous spinal injection of acrylic cement was performed in 1984 to treat a painful vertebral haemangioma of C2. Since then, the field of indications has enlarged and vertebroplasty is now a recognized treatment for osteoporotic, malignant and traumatic compression fractures of the spine. Although some authors report an increase in the vertebral body height after percutaneous vertebroplasty, this technique usually does not allow restoration of the vertebral body height in majority cases.

Osteonecrosis represents an exception as stand-alone vertebroplasty can partially restore the vertebral height by filling the necrotic cavity. In such cases, it is important to properly install the patient on the operating table with the spine extended to maximize the correction of the vertebral body height.

Percutaneous vertebroplasty also represents a valuable option for consolidation of the traumatic or osteoporotic fracture with minimal deformation (kyphotic angle < 15°).

Percutaneous kyphoplasty

The basic principle of kyphoplasty was introduced in the early 1990's. It was stated that the inflation of two balloons inside the vertebral body should restore the height of the fractured vertebra and thus could overcome one of the drawbacks of vertebroplasty. Many

studies confirmed that kyphoplasty is superior to vertebroplasty for correction of the vertebral deformation and reduction of the rate of cement leakage.

Kyphoplasty requires general anaesthesia to improve the restoration of the vertebral body height (complete patient relaxation). The best results were obtained for acute fractures (less than 7 days ideally). The inflammatory process of fracture healing in the spine starts a few hours after the trauma and lasts for 1 to a maximum of 2 weeks. An attempt to restore the vertebral height with vertebral augmentation devices in trauma patients should, therefore, be performed as early as possible before the repair phase starts.

In trauma patients, kyphoplasty may be indicated for A1 fractures as per the classification of Magerl. Some incomplete burst fractures (A3.1) might also benefit from a kyphoplasty procedure, which represents a minimally invasive alternative to surgery for some selected cases.

One major drawback of kyphoplasty is the loss of restored height after balloon deflation, which could limit the benefit of the technique in terms of correction of the vertebral deformation. To overcome such limitations, percutaneous implant techniques were developed.

Percutaneous implant techniques

The goal of implant-mediated cementoplasty is to impede the secondary loss of vertebral body height encountered with kyphoplasty after balloon deflation and till cementation. Indications and contraindications were similar to those from kyphoplasty. Treatment should be performed as soon as possible after the fracture to maximize the chance of height restoration before the repair phase starts. Different devices have been released on the market: vertebral body stents made of cobalt-chrome, expandable nitinol devices, jacks and PEEK implants. The basic principle of each technique is very similar: the device is inserted and deployed within the vertebral body with the help of a guiding cannula and then cement is injected to stabilize the device in position.

Literature shows that these percutaneous implant techniques are either equal or superior (depending on the available papers) to balloon kyphoplasty for vertebral height restoration. To date, there is no prospective randomized study comparing the results obtained with each device.

Conclusion

Percutaneous vertebroplasty is the cornerstone of minimally invasive treatment of vertebral compression fractures. However, balloon kyphoplasty and implant techniques may represent a valuable alternative for recent fractures with kyphotic deformation as restoration of vertebral height can be obtained with such techniques. Implants are theoretically superior to kyphoplasty as they limit the loss of height restoration, which can be observed after balloon deflation. However, the results of the literature are still unclear as some studies failed to prove the superiority of different devices compared with kyphoplasty, while other studies showed a benefit.

2602.4

Sacroplasty

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Learning Objectives

1. To learn how to recognise patients indicated for sacroplasty
 2. To learn how to choose the most appropriate approach and technique in different settings
 3. To learn how to use data to improve safety and efficacy
- Sacroplasty, sometimes termed as sacral vertebroplasty, is a minimally invasive procedure whose goal is stabilization and relief of pain associated with sacral fractures or lytic sacral masses. Majority

sacral fractures are insufficiency fractures related to osteoporosis. However, high-energy trauma can also result in sacral fractures with normal underlying bone density. Additionally, pathologic sacral fractures related to lytic osseous metastatic disease can be a source of severe pain and disability. Although a pathologic fracture is often associated with lytic tumors of the sacrum, there can be a significant amount of pain related to the tumor even in the absence of a fracture. Sacroplasty can be an effective treatment for osteoporotic insufficiency fractures by introducing poly (methyl methacrylate) cement through a needle directly into the fractured sacrum similar to traditional vertebroplasty. Combined treatments for pathologic tumor-related lesions can sometimes include initial endovascular tumor embolization and/or tumor ablation techniques prior to the introduction of cement into the sacrum.

Although sacral fractures can be preceded by an identified fall or traumatic event, it is very common for patients to describe the onset of symptoms that are unrelated to any specific event. Furthermore, the symptoms of a sacral fracture can sometimes be insidious in onset and nonspecific in nature. Hip, buttock, groin, tailbone, perineal, and back pain have all been described by patients with a sacral fracture. Most patients will have significant difficulty in walking as this erect weight-bearing act places additional shear stress to the fractured sacrum. Although less common than pain and difficulty walking, some patients will also experience bowel or bladder dysfunction and decreased strength and sensory complaints in the lower extremities. Similar to patients with thoracic and lumbar vertebral compression fractures, pain and disability associated with a sacral fracture can lead to a downward spiral in overall health. Bedridden patients can develop bedsores, deep venous thrombosis, pulmonary emboli, loss of muscle mass, further loss in bone density, and even death. Patients requiring long-term narcotic treatment for alleviation of pain may also experience cognitive decline and constipation associated with the narcotics.

Sacral fractures often go undiagnosed or are diagnosed in a delayed fashion. Factors contributing to the delay in diagnosis include nonspecific and often nonlocalizing symptoms, lack of inclusion in the differential diagnosis, and challenges in imaging. Sacral insufficiency fracture is relatively new to the medical community and was first described by Dr. Lourie in 1982. As the disease becomes more familiar to medical professionals, the timely diagnosis will inevitably improve as they begin to look for the fractures with tailored imaging techniques. Currently, patients with sacral fractures are often initially imaged with CT of the pelvis or MRI of the lumbar spine depending on the predominant symptoms. Careful attention to the imaging studies is necessary to make the correct diagnosis. CT imaging can be insensitive to the diagnosis of a sacral fracture, particularly in the absence of sclerotic healing and offset fracture margins in the osteoporotic bone. Attention to subtle cortical disruption at the periphery of the sacral ala or along the circular sacral neural foramina is mandatory, and edema in the presacral fat adjacent to the fracture may be the only sign in an acute sacral insufficiency fracture. On the contrary, the presence of a pathologic metastatic lesion should be readily apparent. With respect to MRI of the lumbar spine, the difficulty generally lies in the field of view parameters that include little, if any, of the sacrum in the axial sequences and often neglect the lateral sacral ala in the sagittal sequences. Therefore, it is incumbent upon the radiologist to specifically look at all portions of the sacrum visible on a routine lumbar spine MRI keeping the diagnosis of sacral fractures in mind as a cause of most generic symptoms that beset MRI of the lumbar spine. If there is a question of sacral fracture, bone scintigraphy with SPECT can be useful and is highly sensitive to the diagnosis. However, the relative lack of spatial resolution generally requires additional cross-sectional imaging to evaluate the relationship of the fracture(s) to the sacroiliac joints, neural foramina, and sacral spinal canal. If possible, MRI of the pelvis is an ideal study. It is just as sensitive as bone scintigraphy but also allows for high spatial

resolution and the depiction of sacral foramina and common anatomic variations in the shape of the sacrum and sacroiliac joints. If the patient cannot undergo an MRI, CT can be useful in addition to scintigraphy.

The use of cement in the treatment of pathologic sacral lesions and insufficiency fractures was first described between 2000 and 2002. Injecting cement through a needle into the abnormal sacral bone was a natural extension of the more common vertebroplasty techniques used in the thoracic and lumbar spine at that time. Since those initial case reports, there have been numerous case reports and case series describing the technique of sacroplasty and its clinical utility. Despite the similarities with traditional thoracolumbar vertebroplasty, sacroplasty is generally considered more challenging because of the variation and complexity of the sacral anatomy compared with thoracic and lumbar vertebrae anatomy. Naturally, any proceduralist wanting to learn sacroplasty should first be highly experienced in the traditional thoracolumbar vertebroplasty technique. Majority reports in the literature claim that pain relief and improvement in disability with sacroplasty is similar to those with vertebroplasty and kyphoplasty. Furthermore, every proceduralist who performs sacroplasty on a routine basis will assert the undeniable benefit of the procedure for insufficiency fractures and pathologic lesions of the sacrum. However, a true randomized controlled trial has yet to be published comparing sacroplasty with standard medical therapy. Consequently, the same controversy that surrounds the effectiveness of vertebral augmentation in the thoracolumbar spine is undoubtedly present in any discussion on the use of cement in the sacrum. A well-planned multicenter randomized trial that focused on the use of sacroplasty for osteoporotic insufficiency fractures would be valuable in affirming the use of this procedure.

As sacroplasty has slowly advanced as a recognized procedure for pain relief related to sacral lesions, multiple techniques for percutaneously depositing cement into the sacrum have been described. Fluoroscopy, CT, and a combination of both modalities have been described as safe and effective for treating sacral insufficiency fractures. The choice of image guidance is often based upon the resources available at an institution as well as the personal preference of the proceduralist. Each modality has benefits as well as limitations when compared with the other modality. Fluoroscopy allows for exaggerated camera angles to assist with precise needle placement, whereas the use of CT allows for more direct visualization of anatomic structures, such as the SI joints and foramina. Beyond the modality used for performing the procedure, nuances of needle placement and cement injection techniques also vary widely. Given the shape of the sacrum and the typical configuration of sacral fractures, percutaneous needle placement strategy should be tailored as per the individual sacral fracture. Multiple ipsilateral needles placed perpendicular to the long axis of the sacral ala have been described as the preferred technique for sacroplasty. However, others have demonstrated equivalent safety and success with a single needle advanced parallel to the long axis of the upper sacral ala and generally parallel to the vertical fracture component. While proponents of each technique tend to defend their method as superior, there is no convincing evidence that one technique is any safer or more successful than the other. As opposed to thoracolumbar vertebral cement augmentation, the widely varied techniques and modalities used to treat sacral insufficiency fractures will undoubtedly make the design of any randomized sacroplasty trial difficult. For pathologic lytic sacral masses, with or without associated fractures, the treatment techniques are even more diverse. If the lesion is potentially hypervascular, initial angiography and possible embolization can be useful prior to subsequent penetration and manipulation of the tumor. This is particularly true if the lesion is adjacent to critical structures that might be affected by iatrogenic bleeding. Ablation techniques to create a void within the tumor of a lytic sacral mass can also be a critical adjunct to successful sacroplasty.

This allows for the controlled deposition of cement and limits the displacement of tumor cells into the circulation or into adjacent spaces, such as the sacral spinal canal or foramina.

In summary, percutaneous sacroplasty has emerged as a promising procedure for treating sacral insufficiency fractures and pathologic lytic sacral lesions. There is an abundance of case series in the literature describing the successful outcomes and safety of the procedure and its utilization will likely increase over time, particularly as awareness of its availability permeates the medical community. Ideally, a well-designed randomized trial is desired to clarify the future expansion of sacroplasty. There are various techniques described in the literature for performing sacroplasty. While there is no consensus on the superiority of one technique over the others, proceduralists need to be comfortable with the anatomy of the sacrum and the imaging modality chosen for guidance if they expect to achieve success.

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Special Session Establishing an acute intra-arterial stroke service

2604.1

Optimal logistics for a stroke service

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Learning Objectives

1. To learn how to set up a stroke service in regard to the administrative support and interdisciplinary communication
2. To learn optimal needs of any new stroke service
3. To understand how to optimise the manpower and workflow

No abstract available.

2604.2

Imaging based decision-making

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Learning Objectives

1. To learn about the recent imaging algorithms in acute stroke
2. To learn how to select patients with imaging, based on the most recent evidences
3. To learn how the imaging is optimised in established high-volume stroke services

In the last few years, several randomized controlled trials have shown effectiveness of endovascular treatment for acute ischemic stroke. Guidelines have been rewritten worldwide to include this new treatment for patients with acute ischemic stroke due to an intracranial large vessel occlusion of the anterior circulation which can be treated within 6 hours of symptom onset. Two important questions arise: 1. can we define patients who will not benefit from this treatment although they comply with the indications in current guidelines and 2: can we define patients who might benefit from endovascular treatment although they do not comply with the indications in these guidelines.

Besides clinical indicators, imaging biomarkers might play a role in the selection strategy. Several (advanced) imaging options are available: ASPECTS, clot burden score, collateral scoring, venous filling, CT perfusion, and diffusion-weighted MRI.

The different imaging options will be discussed and their value for selecting or deselecting patients potentially eligible for endovascular treatment after acute ischemic stroke will be evaluated based on available data in current literature.

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2604.3

From admission to access: how could we speed up?

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Learning Objectives

1. To learn how to optimise the workflow from admission in ER to angiography
2. To learn the tricks of faster interdisciplinary communication in favour of patients
3. To learn how to reduce the time spent on the angiography till obtaining the access; from sedation/anaesthesia to initial access before thrombectomy stage

Recent randomised trials have demonstrated the benefit of endovascular thrombectomy for large vessel occlusion, leading to guideline changes in many countries. Workflow analyses highlighted the impact of time on patients with acute ischaemic stroke undergoing endovascular therapy. Optimised workflow structures include early information and preparation of a multidisciplinary team consisting of different players, including the neurointerventionalist, neurologist and anaesthesiologist, for standardised patient selection. A short median time from admission to the neurointerventional centre to groin puncture in the cath lab and structured preinterventional protocols have proven the efficiency of this workflow in these incoming emergency patients.

A door to groin puncture time of 90 minutes was achieved in the SWIFT PRIME trial compared with the guideline-recommended 120 minutes. The median time intervals achieved in key trials range from 113 minutes with EXTEND-IA trials to 109 minutes with the REVASCAT trial. An assessment of 643 patients in the Neurovascular Net Ruhr showed a median time from admission to groin puncture of 82 minutes in 300 patients primarily admitted and of only 34 minutes in 343 patients secondarily transferred. There are still options for improvement in reducing delays immediately before revascularisation. Keeping a 'thrombectomy tool box' (Flensburg stroke tool box) in the interventional suite can be implemented in daily practice as well as use of the CIRSE checklist immediately prior to the procedure itself. It has been suggested that neuroimaging (CT and CTA) could be performed in the angiography suite. However, this concept may lead to an inefficient use of angiography room resources. There has been a lot of debate on additional imaging beyond CT and CTA or MRI and MRA, such as CT perfusion or diffusion- and perfusion-weighted MRI, for selecting patients. The benefits of time-consuming add-on imaging before endovascular therapy are still unknown (Guidelines American Stroke Association, Class IIb; Level of Evidence C).

Furthermore, the selection of anaesthetic techniques, such as local anaesthesia combined with sedation versus general anaesthesia, has various advantages and disadvantages, but the strategy employed should be fast. The MR CLEAN investigators have reported that the outcome for 137 endovascular patients who did not receive general anaesthesia had a better outcome than the 267 control patients who underwent conscious sedation. These data have been criticised because of a selection bias. Similar retrospective data were reported in a recent meta-analysis of 9 nonrandomised studies comprising 1956 patients (814 received general anaesthesia and 1142 received conscious sedation), with the largest study including 1079 patients and the smallest study including 66 patients. In SWIFT PRIME, hospitals using general anaesthesia for the procedure were as efficient as those using conscious sedation in all cases. According to the SIESTA trial, both general anaesthesia and conscious sedation were safe and feasible. The anaesthetic technique should be individualised on the basis of patient risk factors, clinical characteristics, tolerance to the procedure and experience of the neuro-interventionalist. Concepts for improved stroke management workflow algorithms will be presented.

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2604.4

Optimal techniques for revascularisation with the current tools

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Learning Objectives

1. To learn about pros and cons of different revascularisation techniques
2. To learn about technical tricks for each revascularisation approach
3. To learn how to optimise the revascularisation with the most recent tools

In patients with large vessel occlusion, mechanical thrombectomy with stent retrievers in combination with intra-arterial lysis has become the standard of care since 2014 based on evidence from various randomized clinical trials.

For stent retriever-based techniques, the use of a balloon-guiding catheter seems to be essential. The US STRATIS registry provided further evidence for the use of a balloon-guiding catheter with a significantly higher rate of good functional outcome after 90 days compared with that after the use of distal access catheters.

Recently, aspiration techniques without the use of stent retrievers became popular. In 2015, the THERAPY Trial using the Penumbra System failed to show a significant therapeutic effect compared with i.v. tPA.

The so called "a direct first pass aspiration technique" (ADAPT technique) is an aspiration technique using large-bore direct aspiration catheters without stent retrievers. This approach showed similar technical results compared with those after the use of a stent retriever in the recent French ASTER trial.

In summary, the use of a stent retriever in combination with a balloon-guiding catheter is the method of choice with the current tools, although the clinical efficacy of the ADAPT technique needs to be proven.

Special Session Management of abdominal pelvic trauma

2701.1

Patient selection and imaging work-up

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Learning Objectives

1. To learn different imaging modalities available for trauma work-up
2. To learn the imaging modality of choice in acute and subacute situations
3. To learn the use of optimal imaging protocols

Modern multidetector computed tomography (MDCT) is without doubt the most potent weapon in the diagnostic armamentarium for patients who have suffered significant trauma. It is clearly more sensitive and specific than even experienced clinical examination, plain films, or ultrasound examination in assessing such patients. It can define the need for surgical and/or interventional radiological treatment promptly.

The patients who benefit the most from MDCT are in fact the most severely injured patients. The traditional teaching that such patients should immediately undergo surgery is, therefore, challenged by technological developments in MDCT and the clinical evidence. To complicate matters, focussed abdominal sonography in trauma (FAST scanning) performs very poorly in these situations and is arguably worse than experienced clinical assessment. Therefore, processes should be put in place to maximize the proportion of patients undergoing MDCT examination while taking individual hospital environments into account. There should be cogent reasons for bypassing MDCT and going straight to surgery. Rehearsal is important.

An awareness of the time to achieve physiological correction is important; even if the start of the therapeutic procedure might be delayed by MDCT, its completion will not be delayed if relevant information is available promptly. In most severely injured patients, it is possible to estimate the time taken for completion of an interventional radiological procedure to achieve haemostasis, thereby allowing discussion with trauma surgeons.

The exact protocol used for MDCT is probably less important than the processes that have been designed to perform and report the examination promptly and act on the findings. It is important that examinations are kept as simple and as fast as possible and this may be best achieved if the same type of protocol is always performed, even if time is not at a premium. The advantages of using a dual contrast bolus to achieve arterial and parenchymal imaging in one CT pass will also be highlighted.

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2701.2

Solid organ embolisation

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Learning Objectives

1. To learn the patterns of vascular injury
2. To learn the embolisation technique and materials used
3. To learn the pitfalls and complications of embolisation

Introduction

Injury is the major cause of mortality worldwide accounting for approximately 5 million fatalities per year [1], which is approximately 13,900 a day, approximately 578 per hour or approximately 10 per minute. Most of the preventable deaths in trauma are due to unrecognised and untreated haemorrhage [2]. Uncontrolled bleeding contributes to approximately 30%–40% trauma-related early mortality [3]. Although pancreas is rarely affected during abdominal trauma, the most frequently involved solid organs are the spleen and liver followed by the kidneys. The spleen is the most commonly affected organ in blunt abdominal trauma followed by the liver. Liver injury is often associated with splenic injury [4].

Diagnosis:

Contrast-enhanced CT (if possible in the arterial and parenchymal phases) is the diagnostic modality of choice for detecting solid organ injury [5, 6]. Modern state-of-the-art multidetector CT (MDCT) scanners can perform a whole-body trauma scan in <1.5 seconds with excellent temporal and spatial resolution [7]. The American Association for the Surgery of Trauma (AAST) Organ Injury Scale grades liver injury from I to VI and splenic and renal injuries from I to V, where the higher grade indicates more severe injury [8]. CT is highly accurate in detecting injuries (up to 98% for detecting splenic injuries) with an overall accuracy of 83% for detecting vascular injury [4]. Arterial extravasation detected by MDCT is between 13% and 17% for splenic injuries and approximately 9% for hepatic injuries [9, 10]. Signs of vascular injury in a solid organ in MDCT are active extravasation (contrast blush) in the arterial phase that does not wash out in the delayed phase, haematoma, haemoperitoneum in the appropriate clinical setting, pseudoaneurysm, A-V fistula, vessel cut-off (truncation) or significant irregularity of the vessels.

Management:

Open surgery/laparotomy is the treatment modality of choice for haemodynamically unstable patient or patients with signs of hollow viscus injury or signs of peritonitis [5, 6, 8]. However, during the last two decades, the paradigm of management for haemodynamically stable patients with blunt abdominal trauma has shifted from operative to non-operative management (NOM). Haemodynamic stability is defined as haemorrhagic shock not greater than class 2, i.e. normal BP, normal or elevated pulse rate, respiration rate < 30/min, normal or decreased pulse pressure and rapid response to initial fluid therapy of 2L crystalloid [11].

NOM is the standard of care for haemodynamically stable patients with blunt splenic and hepatic injury with success rates of 82%–100% for hepatic injury and failure rates of 8%–38% for splenic injury. Higher grades of injury had greater risk of haemorrhage and higher probability of failure of NOM. Besides, NOM should only be considered in a centre with capabilities for monitoring and serial clinical evaluation and a operation room available for urgent surgery

[5,6]. Most renal trauma is minor (80%) and managed conservatively in the absence of haemodynamic instability. Renal pelvic avulsion, vascular pedicle injury and haemodynamic instability are indications for open surgery [4].

Embolisation:

Angiography and embolisation should be considered in haemodynamically stable patients with splenic trauma AAST grade greater than III, presence of contrast blush, moderate haemoperitoneum or other evidence of ongoing bleeding. Complications of embolisation occur in up to 20% cases, including failure in controlling bleeding (11%–15%), missed injuries and abscess formation.

Similarly, stable patients with hepatic injury AAST grade > III, presence of contrast blush, free intraperitoneal blood and evidence of hepatic venous injury are candidates for embolisation [5,6]. Embolisation is highly efficacious for solid organ trauma demonstrating splenic salvage rates above 85% and success rates between 85% and 100% for severe hepatic injuries [7].

Renal vascular injury occurs in approximately 2.2% of all patients, and percutaneous embolisation is the therapeutic modality of choice for haemodynamically stable patients with success rate as high as 94% in patients undergoing embolisation as a primary management. Technical failure and repeat embolisation can occur in up to 9.5% cases and renal abscess can occur in up to 5% cases [4].

Embolisation has also a high success rate for penetrating truncal injuries with a success rate over 90% as a primary therapeutic modality, adjunct to surgery or as a first line management after failure of operative management [12, 13, 14].

Embolisation materials can be temporary (Gelfoam) or permanent (macro coils; micro coils; vascular plugs; liquid embolic agents, such as glue or Onyx; and particles). Most frequently used embolic agents are coils and Gelfoam. Covered stents can sometimes be used in larger and straighter vessel lesions. Most embolisation agents require an intact coagulation cascade and it is important to perform embolisation before severe coagulopathy sets in, particularly due to massive transfusion. Non-selective embolisation is indicated to expedite haemostats in cases of patient instability, massive bleeding or multiple sites of haemorrhage. Super-selective embolisation is otherwise preferred for preserving tissue and function [3].

Spleen:

No difference in effectiveness has been documented for proximal, distal or combined technique for embolisation of splenic injuries. Proximal embolisation is used when no focal bleeding is present in the setting of grade IV/V injury or in the presence of multiple bleeding sites. The aim is to reduce the arterial pressure and promote clot formation [15]. Either macro coils (1–2mm upsized) or vascular plugs (approximately 30%–40% upsized) can be used for proximal embolisation. To avoid ischaemic pancreatitis, proximal embolisation should be performed between the dorsal pancreatic artery and arteria pancreatica magna or distal to both the arteries. Distal embolisation is recommended for focal parenchymal lesion/bleeding for which a microcatheter is coaxially introduced for super-selective placement and embolisation is performed with micro coils, Gelfoam or glue [16]. Failure to achieve haemostasis is approximately 8%–10% without statistically significant difference between proximal versus distal embolisation [17].

Liver:

Organs with extensive collaterals, such as the liver, require embolisation distal and proximal to the bleeding points (so called 'sandwich technique') to prevent distal reconstitution of injured vessels. Usually, use of a coaxial microcatheter is required for hepatic embolisation. Sometimes a triaxial system may be needed for extra stability. However, because of the smaller calibre of vessels, it is not always possible to cross the site of injury to perform the sandwich technique. Distal embolisation with Gelfoam or particles followed by proximal embolisation with coils is an effective technique in this scenario. Embolisation of the common or proper hepatic artery by

macro/micro coils can be performed and is tolerated because of dual blood supply and extensive collaterals in the liver. However, placement of a covered stent is recommended if technically possible [3].

Kidneys:

Because the kidneys are supplied by end-arteries, extensive embolisation is not well-tolerated with the risk of nephron loss, infarction and potential long-term renal dysfunction, besides other risks, e.g. contrast induced nephropathy and acute tubular necrosis due to blood loss [7]. Therefore, super-selective catheterisation of the injured vessel and embolisation with micro coils (or liquid embolics) is recommended. Technical and clinical success of embolisation for renal bleeding has been described to be as high as 90% and approximately 80%, respectively [18]. Dissection of the main renal artery can be treated with stents/stentgrafts.

Conclusion:

Embolisation is an important life-saving tool in the armamentarium for the management of solid organ trauma with bleeding. In splenic trauma, it has been demonstrated to increase the success rate of NOM from 79% to 96% when mandatory angiography was performed in all high grade injuries [19], whereas in the liver, angiography for urgent haemostasis increased liver specific success rate to 100% and overall success rate to 85% [20]. In the kidneys, the success rate after intervention is over 94%. In many leading trauma centres, intervention with embolisation has been utilised as a component of primary resuscitation. One recent study has, in fact, shown a high success rate of 93% even in haemodynamically unstable patients [21]. It is likely that the utility of embolisation in trauma will evolve further and expand in the coming years.

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2701.3

Pelvic trauma embolisation

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Learning Objectives

1. To learn the difference between solid organ and pelvic trauma patterns
 2. To learn the approaches to pelvic trauma embolisation
 3. To learn major complications of pelvic embolisation
- Approximately 1%–2% patients with pelvic ring fractures are hemodynamically unstable and one in 5 cases of instability will be due to arterial bleeding (1). The early management of hemodynamically unstable patients with pelvic fractures poses a significant challenge owing to competing clinical priorities. The reported mortality is approximately 10%–40% of these cases, and uncontrolled pelvic bleeding is the main contributing factor with exsanguination as the leading cause of death within the first 24 hours. Successful management depends on accurate diagnostic staging and control of fracture-related hemorrhage. To improve the survival of these patients, the source of hemorrhage needs to be identified during the early phase of resuscitation for enabling rapid control of bleeding. Nontherapeutic laparotomy should be avoided in the initial phase, concentrating instead on arresting pelvic hemorrhage (2). The total time from patient injury to stopping the hemorrhage critically affects the outcome in which early whole-body CT plays an important role and improves the outcome (evidence level 3) (1,3). There is, however, no evidence that immediate whole-body CT is superior to conventional imaging and selective CT scanning in patients with severe trauma (4). In pelvic trauma, the negative predictive value of contrast extravasation is close to 100%, and thus, the pelvis will not be the source

of hemorrhagic shock (evidence level 4) (5). The CT injury assessment provides the indication for and guides arterial embolization in a patient with stable injury. In very unstable patients, CT should be followed immediately by surgery or balloon occlusion to control bleeding (evidence level 2) (1,6,7,8). First-line treatment should include temporarily stabilizing the pelvic ring and secondarily preperitoneal packing and/or embolizing the artery depending on the organization of the local trauma center (9). Patients who demonstrate arterial bleeding on CT or who are hemodynamically unstable despite pelvic wrap are candidates for IR treatment. External fixation is mostly effective in controlling bleeding from bony and venous injury; if used in arterial bleeding, it may compromise the performance of embolization. The abnormalities, which represent embolization targets, include active bleeds, blush on CT, and/or vascular injuries (slow flow, irregularity in diameter, obstruction/cut-off sign with no-flow, arterial dissection, pseudo-aneurysm, and arteriovenous shunt). Angiography of the iliac bifurcation and common iliac arteries is performed together with that of the internal iliac arteries, femoral artery and its branches, and recurrent branches of the external iliac artery. No visible extravasation does not exclude an active bleed or vascular injury as the bleed might be intermittent with arterial collapse or arterial spasm which may recur when hemodynamics is restored. Embolization is highly effective (close to 100%) in stopping arterial bleeding in the context of pelvic injury (1) and therefore, justifies readily available access to this technique (24/24 hours, 7/7 days) in all level 1 trauma centers (9). The aim of arterial embolization is to obtain hemostasis without causing ischemic complications (by obstructing the artery involved proximal to the pre-capillary collaterals). Arterial embolization performed too proximally (proximal to the arterial collaterals) carries a risk of failing in terms of stopping the bleeding and re-bleeding. Excessively distal arterial embolization (distal to the pre-capillary collaterals) may cause ischemic tissue necrosis (9). Catheterization of the contralateral internal iliac artery to the bleeding side should always be performed after embolization of the target bleeding artery to observe if there is cross-over collateral arterial supply to the bleeding region.

There are three types of embolization agents: 1) resorbable gelatin foam which provides temporary (approximately 4–6 weeks) proximal mechanical thrombotic obstruction. 2) Coils provide permanent thrombotic obstruction (or even mechanical if the packaging is dense or hydrocoils or plugs are used). The use of fibrous or active coils improves the occlusive effectiveness of the implantable device. Coagulopathy results in a reduction in the thrombogenic effectiveness of fibrous coils. 3) Liquid agents provide permanent mechanical obstruction. Their effectiveness is independent of the presence or absence of coagulopathy but they carry a risk of distal embolization. They can be used for non-selective embolization if hemostasis using gelatin foam has failed and in patients who are eligible for selective embolization with a target which is inaccessible by selective catheterization particularly if the patient is at high risk of re-bleeding from anastomoses (9). Glues can be delivered rapidly and can be used in extremis patients. Onyx requires preparation and slow delivery and cannot be used in extremis patients. Non-selective embolization with unilateral or bilateral obstruction of the internal iliac artery trunks using gelatin foam might be indicated in unstable patients, in patients who are stable with multiple bleeding targets, and if selective embolization has failed. If unstable hemodynamics persists on the angiography table, patients should be investigated for recanalization of the internal iliac arteries (as a result of release of spasm and restoration of normal volemia) and where appropriate, further embolization of the internal iliac arteries should be performed. If the internal iliac arteries have not recanalized, patients should be investigated for arterial bleed from another territories using dedicated angiography. Pseudoaneurysms require the artery to be embolized both proximal and distal to the pseudoaneurysm ("sandwich" packing) to prevent back door bleeding. Distal pseudoaneurysms,

however, can be treated by obstructing the feeding artery proximal to the pseudoaneurysm only. Recurrent bleeding through anastomoses must be excluded with contralateral (internal iliac artery) and ipsilateral diagnostic arteriography. Complications after embolization are rare. For both surgical and IR treatments, complications are difficult to discriminate from those caused by the injury itself. Groin hematoma (particularly in coagulopathy) and more specific complications like gluteal, bladder, uterine, or rectal wall necrosis have been described after pelvic embolization. Sciatic and femoral nerve paralyses have also been described. Lower limb ischemia (particularly after prolonged balloon occlusion) and spinal cord arterial ischemia are also potential results after embolization. Most of these complications are described in case reports and in some cases might also be ascribed to the traumatic injury itself. Sexual dysfunction frequently occurs after pelvic trauma, and its incidence is not obviously increased by embolization. There is no significant increase in the risk of most evaluated long- and short-term complications in trauma patients who underwent internal iliac artery embolization versus those who did not. However, internal iliac artery embolization is associated with a marginally significant increased rate of buttocks, thigh, or perineal paresthesia (evidence level 3) (10). The infection rate after pelvic embolization and internal fixation of acetabular fractures has been shown to be approximately 4% and did not increase compared with that of patients who did not undergo embolization but underwent internal acetabular fracture fixation (therapeutic evidence level 3) (11). Embolization should be used to manage arterial bleeding resulting from pelvic trauma and should precede treatment other than pelvic binder (evidence level 3) (1).

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2701.4

Treatment of major arterial injuries

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Learning Objectives

- To learn the mechanisms of major arterial injury
- To learn the possibilities of interventional management of lesions
- To learn the technical challenges of treating major arterial trauma

Major artery trauma is generally associated with acute life-threatening situations for the patient because of relevant blood loss with consecutive hypovolemic shock and urgent treatment is indicated. In patients with major artery trauma, there is one simple rule: treat first, what kills first. As no randomised controlled trials are available in literature, evidence-based level of information about treatment options is low. With the surgical or interventional approach, two different invasive treatment options can be chosen depending on the settings in the respective trauma centres and on the skills and experience of the operators. With respect to interventional repair, either repair by endograft placement or vessel occlusion by embolisation may be performed. Endograft placement must be preferred when perfusion of the distal vasculature and target organs must be preserved. Adequate sizing of the specific endograft devices is of utmost importance to cover the bleeding site sufficiently. The interventionalist has to take into account that patients with major artery trauma are usually unstable and hypotonic and that target vessels may show spasms. Once an endograft is deployed at the lesion site, the bleeding is stopped immediately. No further action is necessary in the short-term follow-up besides regular examinations of such patients. Embolisation of the major artery may be the intervention of choice if the target artery can be occluded as collaterals maintain the perfusion of the distal vasculature or if the loss of a particular organ function is acceptable. During embolizing procedures at bleeding sites, it is mandatory to occlude both the "front door" and the "back door". In ruptured arteries, it is sometimes impossible to cross the lesion sites with wires and catheters; thus, surgical repair is the method of choice. When embolizing, it is also mandatory to pack the vessel segment completely with the chosen embolizing materials to stop the bleeding immediately. The interventionalist must be aware that arteries with bleeding sites have spasms and that the embolisation may be insufficient when arteries relax and widen post intervention. Thus, a close short-term follow-up with adequate imaging may be indicated. As both interventional approaches, i.e. endograft placement and embolisation of the major artery, should be performed as definite therapy within a very limited time range after diagnosis, the interventionalist must be skilled and experienced. The specific materials and machinery must be available and accessible on a 24/7 basis as well as a dedicated team must be present in the angio suite. Last but not least, interventional repair of major artery trauma should be part of an interdisciplinary algorithm in the acute treatment setting of such patients. Therefore, continuous and comprehensive education and training are basic prerequisites of an interdisciplinary team that offers interventional repair of major artery trauma on a 24/7 basis.

Fundamental Course

Modern IR clinical practice

2702.1

Education and training in IR

M.J. Lee

Radiology, Beaumont Hospital, Dublin, Ireland

Learning Objectives

1. To learn how and if differences in IR training across Europe affect IR practice
2. To learn how to use safety checklist, EBIR and IR subspecialty to reduce differences in IR training and education
3. To learn how to apply a common model of education and training

No abstract available.

2702.2

Pre-assessment and consent

D.K. Filippiadis

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Learning Objectives

1. To learn how to create a proper advertising strategy
2. To learn how to use main remarks in patient consultation before an IR procedure
3. To learn how to avoid complications by recognising the risks during patient assessment

The armamentarium of interventional radiology (IR) includes numerous treatment alternatives ranging from standard minimally invasive diagnostic techniques to every day routine interventions and even innovative approaches for cases otherwise considered untreatable. Pre-assessment and consenting of the patient are pillars of utmost importance for a safe and efficacious practice. Patient contact prior to IR procedures should be extensive and detailed in order to be possible for the interventionist to gather all the necessary clinical information. Whether or not the patient is receiving anticoagulation medication, whether the patient is allergic to contrast material, and whether the patient has abnormal renal function requiring prophylaxis for contrast-induced nephropathy are important issues requiring concern in order to avoid complications and thus augment safety and efficacy of each technique. Furthermore, a detailed description of patient's specific health issues along with the familial and personal medical records will provide invaluable information for the correct and appropriate therapy selection from the IR armamentarium. The Cardiovascular and Interventional Society of Europe has produced a checklist for IR, aiming to ensure that forgetting key steps in patient preparation, intraprocedural care, and postoperative care be avoided; additionally, the adoption of the checklist can ensure that patient's personal health issues will be recognized before time and dealt with appropriately.

Informed consent is the process by which the interventionist provides appropriate information to the patient so that he/she may make a voluntary choice to accept or refuse treatment. The basis of this process stands upon the patient's legal and ethical right to select what happens to him/her and upon the interventionist's ethical duty to involve the patient in his/her own decision for health-care. A full and detailed informed consent should be obtained during patient contact prior to IR procedures and should include a discussion of the nature of the decision/procedure, mentioning any reasonable alternatives to the proposed intervention, including the relevant risks, benefits, and uncertainties related to each alternative.

Additionally, when obtaining the informed consent, patient's understanding should be assessed along with the acceptance of the intervention by the patient. Patient should be an adult capable of providing informed consent; alternatively, parents or a responsible escort should be informed and should provide the consent. Exceptions to a full informed consent include lack of patient's decision-making capacity with inadequate time to find a relative or any other responsible escort for decision making (e.g., a life-threatening emergency in an unconscious patient or in dementia cases).

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2702.3

Clinical care in IR

R. Patel

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Learning Objectives

1. To learn how to provide clinical care in patients undergoing in-patient procedures
2. To learn how to provide clinical care in patients undergoing out-patient procedures
3. To learn how to deal with post-therapeutic clinical issues (pain, post-embolisation etc.)

Interventional radiology is a clinical specialty that requires the interventional radiologist to assess the patient prior to any intervention, determine the optimal treatment plan taking in to consideration the relative merits of other treatment modalities and explain this to patients to gain appropriate consent within a partnership model of care, optimise the patient for intervention and deal with potential side-effects or complications, as well as provide longer term follow-up and care after completion of the procedure. In addition, it is vital that data on patient selection, procedures, and outcomes are entered into appropriate registries or research or audit databases to provide confidence that high-quality outcomes are achieved as well as maintained and areas of improvement are identified.

Even when there are some uncertainties and contradictions, there is a plethora of information and guidance in nearly all areas of IR practice. To implement this in everyday practice, it is essential to make appropriate use of safety checklists, standardized protocols, and patient pathways whilst being aware of the unique implications and suitability of such approaches in individual patients being treated so that care can be personalized whilst maintaining high standards of safety.

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2702.4

Working within an interdisciplinary team

T. de Baère

Dept. of Interventional Radiology, Institut Gustave Roussy, Villejuif, France

Learning Objectives

1. To learn how to participate in an interdisciplinary team
2. To learn how to persuade decision-makers
3. To learn how to use comparative effectiveness research in interdisciplinary teams

No abstract available.

Special Session Resurgence of carotid stenting

2704.1

Current evidence

T.J. Cleveland

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Learning Objectives

1. To learn about the most recent publications in regard to current evidence on CEA versus CAS
2. To learn how the recently published long-term results of previous carotid stenting trials induce resurgence of carotid stenting
3. To learn if there exists a clinical equipoise in regard to CEA versus CAS or not

Carotid artery stenting (CAS) is no longer a new concept. Way back in the 1990's angioplasty was applied to the carotid bifurcation, and the CAVATAS Trial was born and completed¹. This showed that angioplasty (and the majority was simple angioplasty with no stents) could successfully be performed, with acceptable immediate complications. Indeed within the confines of that randomised trial there was no difference in the immediate significant neurological outcomes between angioplasty and endarterectomy (CEA). However, the CAVATAS trial came in for considerable criticism, in that the overall event rates for both CEA and angioplasty was higher than would have been hoped. On reflection, perhaps it was inevitable because the patients recruited to this trial were both symptomatic (therefore at high risk of recurrent and procedure related stroke) and at high risk of CEA (otherwise there was no equipoise and uncertainty to allow randomisation).

As a result of this, and other trials (for example the Leicester Trial - which was stopped due to the high event rate during stenting²), further investigation into the procedure was undertaken. In addition, the environment was a challenging one, as CEA was (and is) a procedure that has been very carefully investigated and one that is beloved of the vascular surgical community.

Over the following years CAS has developed, continuously under scrutiny and criticism from traditional vascular surgery³, into a much more mature procedure, which continues to develop. It has been noticeable that the level of industry enthusiasm for CAS waned for a while, as a direct result of the relentless skepticism of the establishment.

However, the march of medicine away from large open operations towards the minimally invasive and medical therapy/prevention is compelling. There remains considerable variation in the rates of CAS throughout the world, with the proportion of symptomatic patients being treated by CAS ranging from 0% (Denmark) to 19% (USA)⁴.

CAS has survived and is undergoing resurgence. One may ask why this is so? It probably comes from a combination of drivers, firstly that trials assessing modern CAS techniques have been completed, and long term follow up data are now available. Secondly, acute stroke thrombectomy has been shown to be effective (see later), and carotid bifurcation disease (and its treatment) is integral to these therapies.

CAS v CEA – Current evidence

In 2012 a Cochrane Library review of percutaneous transluminal balloon angioplasty and stenting for carotid artery stenosis was published⁵, and included data from trials published as early as 1998. Also included in the analysis were results from the ICSS, SPACE and EVA3S (all randomised trials of patients who were recently symptomatic). In all there were 16 trials included which involved 7572 patients. In patients who had symptomatic carotid artery disease and were considered at "standard" surgical risk, endovascular treatment was

associated with a higher risk of having, within the first 30 days, death or any stroke, death or any stroke or myocardial infarction, and any stroke. It was noted that the odds ratio for the same outcomes were not different between CAS and CEA in patients under 70 years of age (OR 1.16 range 0.80-1.67), but were higher in patients of 70 years and over. This relationship between age and peri-procedural strokes was confirmed in the CREST Trial⁶, with equal risk at around the slightly lower age of 64 years. The treatment-by-age interaction was not altered by symptomatic status (CREST included both symptomatic and asymptomatic patients) or by sex.

However when the data in the systematic review were interrogated for the rate of death and major or disabling stroke, they did not differ significantly between CAS and CEA. In addition endovascular treatment was associated with lower risk of myocardial infarction, cranial nerve palsy and haematoma.

Considering more long-term outcomes in the 2012 review, the rate of ipsilateral stroke after the peri-operative period was not different, comparing CEA and CAS.

Restenosis of the treated segment was seen to be more common after endovascular treatment, but it should be remembered that this group included treatment with angioplasty as well as stents, and restenosis is only relevant if this translates to clinical problems, such as recurrent stroke (see later).

It is interesting to note that in the trial data, cranial nerve palsy is not regarded/recorded as a neurological event. Of course it is not a cerebral event, but it is neurological one, which in the ICSS Trial was 5.5% in the peri-procedural period⁷, in time the majority recover.

More recently the long-term results from two important randomised trials have become available. The 10 year results of the CREST⁸ and the ICSS trials⁹.

The CREST trial included 2502 patients who were randomly assigned to stenting or endarterectomy at 117 centres. The peri-procedural composite end point of stroke, death or myocardial infarction did not differ significantly between the two groups. As in the Cochrane review there were more peri-procedural strokes in the stenting group, but fewer myocardial infarctions. The 10 year risk of the primary composite end point (any stroke, myocardial infarction or death during the peri-procedural period or ipsilateral stroke thereafter) did not differ significantly between the two groups. There was also no difference at any other year of follow up between 1 and 9 years. The CREST Trial included both symptomatic and asymptomatic patients, and there were no treatment differences according to the symptomatic status.

As far as restenosis was concerned, there was no significant difference between the groups in terms of the percentage who had restenosis or underwent revascularization.

The ICSS trial included only patients who had recently been symptomatic from a high-grade carotid artery stenosis. 1713 patients were included in the study at 50 centres worldwide. They were followed up for a maximum of 10 years (median 4.2 years). The cumulative 5-year risk of fatal or disabling strokes did not differ between the two treatment arms (6.4% CAS v 6.5% CEA). Any stroke was more frequent in the stenting group (8.9% v 5.8%), but the excess number were mainly non-disabling strokes. The distribution of modified Rankin scale scores at 1 year, 5 years or final follow up did not differ significantly between the groups. This demonstrated that in symptomatic patients treated with either CAS or CEA there was an equivalent ability of the two treatments in stroke prevention, up to 10 years after treatment. CAS was associated with a higher procedure-related risk of non-disabling stroke than CEA (amounting to 1 extra stroke per 156 patient-years of follow up), but that functional ability did not differ overall. Both treatments seemed to be equally preventive against ipsilateral stroke and severe restenosis of the treated carotid artery.

It is also of interest to consider, not only the long-term consequences of neurological events, but also the effect of peri-procedural myocardial infarction. In the CREST Trial, peri-operative heart attack was

associated with a 3.5 fold increased risk of death at 4 years¹⁰. Thus, myocardial events cannot just be considered as events that do not result in subsequent risk, even if recovered from, at the time or considered a simple biochemically discovered event.

As the CAS procedure has developed over time, it has become more complex and the equipment has become more sophisticated. This includes the routine use of stents rather than simple angioplasty balloons, low profile balloons and cerebral protection devices. As data started to become available indicating that CAS was/is a viable alternative to CEA (in patients suitable for both), one of the arguments against the use of CAS was the equipment cost, and therefore the overall cost. This additional up front cost for devices needed to be considered on the background of a procedure that required local rather than general anesthetic, was generally quicker to perform, and required less hospital and high dependency care. A cost utility analysis was performed from the ICSS trial¹¹. Published in 2016, the mean costs per patient were \$10,477 for the stenting group and \$9,669 in the endarterectomy group. There were no differences in mean quality adjusted life years per patient or in the adjusted costs between groups.

CAS IN ASSOCIATION WITH THROMBECTOMY

A series of trials have demonstrated the benefit of thrombectomy, for the early treatment of large vessel occlusion embolic strokes¹²⁻¹⁶. Whilst tandem lesions of carotid artery stenosis alongside an acute embolic event is not common (approximately 8% of cases¹⁷), such a scenario is associated with a poor outcome. The exact indications for, and techniques are yet to be defined, however there are a number of case series showing the potential benefit of combined CAS and thrombectomy which is sufficiently compelling to have CAS skills listed as a requirement for training in stroke thrombectomy.

CONCLUSIONS

There remains controversy surrounding the role of CAS in stroke prevention. The published evidence would indicate that patients should expect a higher risk of peri-procedural minor stroke if they have CAS compared with CEA. However, it is to be expected that the effects of this will even out in the 6-12 month period following the intervention, and that the individual functional ability having had either treatment will be equivalent taken out to a 10 year time period.

There is a higher risk of a peri-procedural myocardial event if CEA is undertaken, and that this will translate into a higher risk of a fatal cardiac event.

Cranial nerve injury has not been included in the neurological events associated with CEA, it is likely to occur in around 5% of patients in the peri-procedural period, and that like, minor stroke, these are likely to recover in time.

Younger patients (less than 70 years old) are more suited to CAS, and have better outcomes than those in an older age group, which possibly reflects adverse aortic arch anatomy and disease.

Patients not included in the randomised/comparative trials, who are at high risk of recurrent stroke, and are also high risk for CEA, should be considered for suitability of CAS (including restenosis, a history of radiotherapy, high carotid bifurcation or previous recurrent laryngeal nerve injury).

In the context of acute stroke, and large vessel occlusions being considered for thrombectomy, tandem CAS may be performed. This is in the expectation that it will aid in the success and long term benefit, but this has yet to be confirmed.

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2704.2

Patient selection

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Learning Objectives

1. To learn how to select patients for carotid stenting in regard to clinical features
2. To learn about the lesion features which determine the indication, e.g. patient anatomy, degree of stenosis, plaque morphology etc.
3. To learn about vulnerable plaque without severe stenosis

No abstract available.

2704.3

Limitation of medical management

G.K. Tsivgoulis

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Learning Objectives

1. To learn about recent protocols in the medical management of carotid stenosis
 2. To learn about the importance of individual anti-aggregation sensitivity testing for successful medical management
 3. To learn and understand the limitations of medical management
- Although aggressive medical therapy has been shown to reduce the degree of atherosclerotic carotid artery stenosis (CAS) and prevent distal embolization, there are several efficacy and safety concerns that need to be taken into consideration. This lecture aims to summarize the current available evidence regarding potential limitations of medical treatment in the non-invasive management of asymptomatic and symptomatic CAS. Main strengths and limitations of the best medical therapies including double antiplatelets, high-dose statins, and effective blood pressure and diabetes control will be outlined. The main focus of this presentation will be on the association of intensive medical management with potential complications from the drug regimens used, including intracerebral or gastrointestinal hemorrhagic complications, rhabdomyolysis, renal impairment, syncope, cardiac arrhythmias, cerebral hypoperfusion, and cognitive decline. Potential interactions between drugs will be further discussed. Concerns regarding the efficacy of best medical management compared with that of revascularization procedures in patients with asymptomatic and symptomatic CAS will also be summarized. In the conclusion of the presentation, all potential limitations of medical management with the corresponding levels of evidence will briefly be reviewed and an optimal decision-making algorithm will be highlighted.

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2704.4

Technical innovations for carotid stenting

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Torino, Torino, Italy

Learning Objectives

1. To learn about recent carotid stents in comparison with the conventional ones
2. To learn about last generation protection filters and flow reversal as another way of protection
3. To learn about new access tools/techniques to deal with the tortuous arches

Background:

Carotid artery stenting (CAS) is still associated with higher peri-procedural cerebrovascular events (CEs) than those with vascular surgery. Roadsaver carotid artery stent is a double-layer micromesh stent that reduces plaque prolapse and embolization by improving plaque coverage. Its clinical impact on short- and long-term neurological outcomes is poorly known.

Methods:

In total, 150 patients (age 74±8 years, 75% males, 29% symptomatic) treated with CAS using Roadsaver carotid stents in three high-volume Italian centers were included in this study. Intra-procedural optical coherence tomography (OCT) evaluation was performed in 26 patients, with an off-line analysis by a dedicated core laboratory. All patients underwent duplex ultrasound and neurological evaluation at 24 h, 30 days, and 1 year.

Results:

CAS was technically successful in all cases (stent diameter: 8.6±0.8 mm, stent length: 25.0±4.5 mm). OCT detected a low rate of plaque prolapsed (2 patients, 7.7%). Duplex ultrasound showed stent and external carotid artery patency in all cases both before discharge and at the 30-day follow-up. No in-hospital and 30-day CEs were observed.

There were no CEs at the 1-year follow-up. Three patients (2%) died; 2 died because of non-cardiovascular causes (1 had cancer and 1 died in an accident) and 1 had a fatal MI at 10 months from the procedure. Duplex ultrasound showed significant in-stent restenosis in 3/147 patient (2%); all restenosis cases were asymptomatic.

Conclusions:

Roadsaver stent is a safe and promising technology for CAS, with a low percentage of plaque prolapse and a good clinical outcome. The restenosis rate does not seem to be different from that of other stents, but larger and properly addressed clinical studies are recommended to better investigate this issue.

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CIRSE Meets

CIRSE meets EWMA: Standards of wound care – the essentials

2706.1

Clinical and imaging assessment of wounds of the lower extremity

M. Collier

United Lincolnshire Hospitals NHS Trust, c/o Pilgrim Hospital, Boston, United Kingdom

No abstract available.

2706.2

Basics of wound care for IR

M. Collier

United Lincolnshire Hospitals NHS Trust, c/o Pilgrim Hospital, Boston, United Kingdom

No abstract available.

2706.3

Arterial perfusion to optimise arterial ulcer healing

M. Palena

Policlinico Abano Terme, Abano Terme, Italy

No abstract available.

2706.4

Surgical coverage of non-healing ulcers

A. Jawien

Department of Vascular Surgery and Angiology, University of Nicolaus Copernicus, Collegium Medicum, Bydgoszcz, Poland

No abstract available.

Honorary Lecture Josef Roesch Lecture

2901.1

Taming the systemic effects of interventional oncology through mechanistic study

N. Goldberg

Radiology, Hadassah University Hospital, Jerusalem, Israel

No abstract available.

Hot Topic Symposium

Prostate artery embolisation: ready for prime time?

2902.1

Current evidence

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Benign prostatic obstruction (BPO) is very common in elderly men. Symptoms associated with this obstruction are summarized as lower urinary tract symptoms (LUTS), which have a major impact on the quality of life (QoL).

According to studies, LUTS related to BPO affects up to 60% of men between 50 and 60 years of age, and two third of patients with severe LUTS are not happy with their current urinary situation.

Transurethral resection of the prostate (TURP) is considered the surgical "gold-standard" treatment in symptomatic patients. Due to well-known peri- and postoperative complications of TURP, including long-term urinary incontinence in up to 2% as well as erectile dysfunction in up to 6.5%, prostatic arterial embolization (PAE) has gained special interest in the interventional radiological community and among affected patients.

Since the first publication on PAE as an alternative method in patients suffering from BPO in 2010, a variety of different studies have been published. During the first years, several retrospective single-center studies showed promising results regarding the reduction of the international prostate symptom score (IPSS), improvement of the quality of life (QoL) as well as significant reduction in the prostate volume, and improvement in the urodynamics of patients. An important issue was the relatively low complication rate of PAE in all these studies.

In 2014, the first prospective, randomized controlled trial comparing PAE with TURP showed a similar reduction of IPSS, gain in QoL, as well as improvement in the urodynamic studies after 24 months in both groups. The PAE group had a significantly more number of minor complications, especially early ones. A year later, a second randomized trial comparing 15 PAE patients with 15 TURP patients showed similar results regarding IPSS and QoL but better urodynamic results for the TURP group after 12 months. Long-term data have been published in 2016, confirming the good clinical success in up to 76% of patients after 5 years.

PAE has the potential to become an alternative to surgical or perhaps medical treatment in patients with LUTS due to BPO. It is minimally invasive, can be performed without the need of hospitalization, and has a low rate of complications.

More randomized controlled trials with more patients and a longer follow-up compared with surgical or medical therapies are mandatory to finally reach level 1a evidence.

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2902.2

Technique

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PerFecTED technique

Proximal embolization first

Initial pelvic angiography is performed to evaluate iliac vessels and the prostate arteries. Selective digital subtraction arteriogram of the internal iliac artery with a 5-French cobra or vertebral diagnostic catheter placed at the common internal iliac trunk is performed to assess the blood supply to the prostate and perform the internal vesical artery (IVA) catheterization under an ipsilateral 25°–55° oblique view. We have started to use the new Carnevale's prostate catheter (CPC), a 5-French guiding catheter dedicated to pelvic arteriograms. After entering the inferior vesical artery, the vasodilator (nitroglycerine or isosorbide mononitrate) is injected through the microcatheter to prevent vasospasm and increase artery size for facilitating microcatheter navigation and distal positioning. The microcatheter should cross any branch collateral to the bladder, rectum, corpus cavernosum, gonad, or penis and be placed distally into the prostatic artery before its branching to the central gland (urethral group of arteries) and peripheral zone (capsular group of arteries). Collimation with a very slow embolic injection using a 1-cc syringe is highly recommended. We use 100–300-µm and 300–500-µm trisacryl gelatin microspheres. The association of both sizes can be an alternative. However, any embolic agent can be used. To each 2-mL syringe of microspheres, we add 10 mL of iodinated contrast medium and 10 mL of saline, resulting in a total volume of 22 mL comprising 50% contrast and 50% normal saline solution. When reaching "near stasis," a manual injection of contrast is performed with a 3-cc syringe before proceeding to the second step of observing any collateral shunts.

Next, distal embolization

At this point, the microcatheter should be advanced into the prostatic parenchyma branches for intraprostatic embolization. When possible, the urethral and capsular intraprostatic groups of arteries should be embolized separately. After moving forward into the intraprostatic branches, a very slow manual injection of DSA may demonstrate some of these microvessels, and more embolics can be delivered. Be cautious during injection because extravasation may occur if the microcatheter is wedged into the gland. At this point, 300–500 µm should be used to reduce the risk of non-target embolization. After this second and true stasis, the microcatheter should be retracted to the origin of the IVA and a manual contrast injection run should be performed for final control and to search for additional prostatic branches.

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2902.3

Patient selection: which are the most suitable patients

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No abstract available.

2902.4

Challenges and obstacles

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The following aspects will be covered along with some outcome data from the UK-Registry of PAE (UK-ROPE):

Challenges

- Training in Embolisation
- Training in PAE
- Gaining Experience
- Gaining Evidence: RCTs and Registries

Obstacles

- Local Policy on new IR procedures
- National policy on New IR Procedures
- Time Constraints
- Turf Issues
- EAU Guidelines

Special Session Embolotherapy for HCC

3201.1

Bland embolisation

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Learning Objectives

1. To understand the pathophysiological background to perform bland embolisation for HCC
2. To learn about the embolising agents to perform bland embolisation for HCC
3. To learn about safety and results of bland embolisation for HCC

Historical studies/publications:

Primary blood supply to tumor from hepatic arteries¹

1. Surgical hepatic artery ligation in 1970s^{2–4}
2. Transcatheter treatments +/- chemotherapy 1970s–1980s^{5–7}

Conventional chemoembolization

1. Lipiodol introduced 1985⁸
2. Conventional lipiodol TACE described 1980s^{9,10}
3. Evidence for chemotherapy “trapping”
 - a. Few patients¹⁰
 - b. Atypical methods of preparation¹¹
 - c. Use of lipophilic agents¹²
4. Evidence against lipiodol as carrier
 - a. Drug in tumor¹¹
 - b. Pharmacokinetic^{13,14}
 - c. Tumor response¹⁵ or survival¹⁶
5. Randomized cTACE trials, 2002
 - a. Lo, Asian population¹⁷
 - i. Cisplatin + Lipiodol+ gelatin sponge vs symptomatic treatment (BSC)
 - ii. Demonstrated actuarial survival significantly better in cTACE group
 - iii. Death from liver failure more frequent in cTACE group
 - b. Llovet, Western population¹⁸
 - i. 3 groups
 1. Doxorubicin + Lipiodol + Gelfoam
 2. Gelfoam fragments + contrast
 3. Symptomatic treatment (BSC)
 - ii. Study stopped after 9th inspection
 1. Survival benefit demonstrated in cTACE group
 2. When study stopped more patients needed to be recruited into the embolization group to enable any valid conclusion about efficacy
 3. Probability of survival at 1, 2, and 3 years
 - a. cTACE 82%, 63% and 29%
 - b. Gelfoam 75%, 50% and 29%
 - c. BSC 63%, 27% and 17%
 4. Response
 - a. cTACE 14/40 = 35%
 - b. Gelfoam 16/35 = 46%

Bland embolization evidence

1. Early cohort study 1998¹⁹
2. Larger cohort study 2008²⁰
 - a. Overall median survival – 21 months
 - b. Excluding patients with EHD or PVTT

- i. Median survival 40 months
- ii. 1, 2 and 3 year survival 84%, 66% and 51%

Drug eluting beads (DEB)

1. Available in EU (DC Bead) 2005 and US (LC Bead) 2008
2. Loaded with doxorubicin for HCC
3. Excellent pharmacokinetics demonstrating delivery and elution^{21,22}
4. Randomized trial comparing drug-eluting microspheres to microspheres alone
 - a. Malagari 2009²³
 - i. Analyzed treated patients only
 - ii. Evaluated local response, TTP and OS
 1. Local response better at 9 months only in DEB group
 2. TTP DEB group 42.4 weeks unloaded beads 36.2 weeks
 3. No difference in OS
 - b. Brown 2016²⁴
 - i. Intent to treat analysis
 - ii. No difference in response at any time point by any measure
 - iii. No difference in TTP
 - iv. No difference in OS

Radio-embolization

1. Non-embolic
2. Device delivers internal radiation therapy
3. Literature
 - a. Long-term results²⁵
 - i. Median OS 17.2 months
 - ii. TTP 7.9 months
 - b. Improved TTP
 - i. Compared to cTACE, cohort study²⁶
 - ii. Compared to TACE, RCT²⁷
 - c. RILD/portal hypertension
 - i. Can preclude resection²⁸
 - ii. Can develop in patients without underlying liver disease²⁹
 - iii. Can result in deterioration of liver function in patients with HCC and underlying liver disease that may preclude retreatment when disease recurs³⁰

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3201.2

Conventional TACE

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Learning Objectives

1. To understand the pathophysiological background to perform conventional TACE for HCC
2. To learn about drugs and embolising agents to use to perform conventional TACE for HCC
3. To learn about safety and results of conventional TACE for HCC

No abstract available.

3201.3

Drug-eluting beads TACE

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Learning Objectives

1. To understand the pathophysiological background to perform drug-eluting beads TACE for HCC
2. To learn about the available beads to perform drug-eluting beads TACE for HCC
3. To learn about safety and results of drug-eluting beads TACE for HCC

Drug-eluting beads (DEBs), introduced over a decade ago, have been proposed as a valid tool that increases the efficacy of transarterial chemoembolization (TACE) and reduces systemic and hepatic toxicity, thereby allowing selective and prolonged intratumoral drug release [1].

Although initial clinical experiences in selected patients with hepatocellular carcinoma (HCC) reported excellent results in terms of toxicity, radiological tumor response, and overall survival [2-4], subsequent studies comparing DEB-TACE with lipiodol-TACE have reported conflicting results [5,6]. The multicenter European Precision V randomized trial did not show a statistically significant improvement in radiological tumor response in the total enrolled population [7]. Nonetheless, the lower toxicity profile of DEB-TACE allowed improvement in tumor response in subgroups of patients, with more fragile clinical conditions [7]. In 2014, the multicenter Precision Italia trial reported no significant advantages in overall survival with DEB-TACE compared with that with lipiodol-TACE [8]. However, the safety profile of DEB-TACE was further confirmed. Finally, a recent monocentric randomized study has reported no advantage of DEBs compared with bland embolization. Thus, the debate on how to perform transarterial treatments of HCC is still ongoing [9].

Despite these results, DEBs are still widely used in clinical practice. In fact, DEB-TACE offers the advantage of high tolerability and low toxicity, allowing safe treatment in patients with more extensive tumor load and/or fragile clinical conditions (such as patients with Child-Pugh B) [7]. Moreover, recent cost-effectiveness analyses have demonstrated that, despite the increased costs of DEBs compared with those of lipiodol, overall procedural costs of DEB-TACE are reduced

because of the improved safety profile, which reduces the duration of hospitalization, rates of complications and readmissions, and ultimately, the consumption of inpatient and outpatient resources [10,11].

Moreover, DEBs are currently under further improvement. Smaller particles have been introduced that can upload higher drug doses in the attempt to increase the therapeutic efficacy [12-14]. Particles are also under investigation to determine a potential optimal platform for superselective intratumoral delivery of novel drugs, such as molecular-targeted agents [15], which may enable expansion of the horizons of TACE in patients with HCC.

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3201.4

Radioembolisation

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Learning Objectives

1. To understand the pathophysiological background to perform radioembolisation for HCC
2. To learn about the available spheres to perform radioembolisation for HCC
3. To learn about safety and results of radioembolisation for HCC

No abstract available.

Special Session

Treatment of peripheral vascular malformation

3301.1

Current classification

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Learning Objectives

1. To learn the current consensus on vascular malformations
2. To learn common misconceptions and misnomers in practice
3. To learn clinical relevance of classification

No abstract available.

3301.2

Low-flow malformation

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Learning Objectives

1. To learn about the challenges in treating paediatric patients
2. To learn about technical aspects of treating extensive venous malformations/syndromes
3. To learn about different materials used and their potential complications

In the field of vascular anomalies, the treatment of low-flow vascular malformations constitutes the majority of IR work. This work very often starts with MR imaging and establishing the correct diagnoses, followed by information on the patient and correction of various misunderstandings regarding the disease and treatment. The treatment of low-flow malformations is aimed at diminishing symptoms such as pain or disfigurement. The lesions are congenital and although present at birth, they often become symptomatic later during childhood. Paediatric patients are challenging in different ways. They very often need anaesthesia not only for the actual procedure but also for MRI. The procedure can be challenging because of the small anatomic structures. The dose of the sclerosing agent has to be adjusted depending on the weight of the child. Pain management in the postoperative period must be assessed. Where relatively localised vascular malformations can be treated successfully by IR using sclerotherapy, the more extensive malformations need a multi-disciplinary approach involving orthopaedic and/or plastic

surgery treatment. Sclerotherapy can be used for local symptomatic areas. Patients with large venous malformations affecting an entire limb often have coagulation issues that have to be corrected before sclerotherapy or surgical procedures. The treatment involves puncturing the malformation using ultrasound guidance and injecting the sclerosant after establishing correct needle tip location. Various sclerosants are used. For venous malformations, sodium tetradecyl sulphate is a common material but absolute ethanol, polidocanol or bleomycin is also used. For the treatment of lymphatic malformations, many agents can be used. They work by inducing inflammatory changes in the lining of the cavities. The agent very often depends on availability and local knowledge. The treatment is effective in ca. 70% cases often requiring more than one procedure. Absolute ethanol is not only the most effective agent but also the agent with the most complications. Complications can be divided into local and systemic symptoms. Local complications are the most common and include ulceration and/skin necrosis, nerve damage and compartment syndrome. Meticulous technique with careful fluoroscopic monitoring of the sclerosing procedure is mandatory for avoiding these complications. Most skin damage heals spontaneously but a few % need skin grafting. Most skin damage will leave a scar. When using absolute ethanol, the maximum recommended dose is 1 ml/kg per procedure. The maximum volume per injection is 0.2 ml/kg with 10 minutes between injections. Systemic complications are rare and almost always occur when using absolute ethanol. They include cardiac arrest and pulmonary hypertension with acute cor pulmonale. Renal failure and pulmonary emboli have also been reported. The treatment of systemic complications is symptomatic.

3301.3

High-flow malformation

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Learning Objectives

1. To learn different types and grades of high-flow malformations
2. To learn about the approaches to treating high-flow malformations
3. To learn about the technical challenges and major pitfalls

No abstract available.

3301.4

Complex malformations and associated syndromes

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Learning Objectives

1. To learn about the most common complex malformations and their associated syndromes
2. To learn optimal practice approaches in treating such complex malformations
3. To learn about potential complications in treating such complex malformations

Vascular malformations can occur as part of a much wider abnormal growth pattern. A huge array of malformations can co-exist in this way but there are some patterns that are observed more commonly than others. Historically, these have been given a variety of names, many of which are eponymous and poorly defined, such as Klippel-Trénaunay syndrome and Proteus syndrome. Such nomenclature has led to much confusion in the medical community regarding the diagnosis and more importantly, the treatment of these conditions. It is now better understood that almost all of these 'syndromes' or

clusters of malformations are related to underlying somatic mutations in growth genes. Currently, the most commonly recognised mutation lies in the PIK3CA gene, giving rise to abnormal activation of the PIK3-AKT-mTOR pathway. PIK3CA mutations are also well-recognised in a number of malignant tumours. In the context of this lecture, mosaic somatic mutations in PIK3CA underlie many of the complex overgrowth syndromes and are also recognised in an increasing number of isolated malformations [1,2]. This is of significance on two counts: it suggests that medical therapies can be used to target overgrowth at a cellular level and it, hopefully, encourages a more simplistic and methodical approach to treatment, recognising that the condition as a whole cannot be cured by any one surgical or IR intervention.

The use of sirolimus (rapamycin) to treat what is now increasingly commonly labelled as PIK3CA-related overgrowth spectrum (PROS) is widely debated, but it is clear that such medical therapies are still in their infancy [3]. More specific gene mutations need to be identified so that the vast range of differing phenotypes can be targeted more effectively.

Patients with complex overgrowth syndromes require a truly multidisciplinary approach. Vascular malformations occurring as part of a wider syndrome can be challenging to treat, as they occur in difficult-to-reach sites and they often present late. These can include the urogenital tract, mesentery, bone marrow and orbit. These patients may well not present directly to an IR clinic and radiologists may need to reach out to other specialties to find these patients. As observed in the past for so many other conditions, it is often to the onus of the IR to suggest minimally-invasive interventions and encourage collaborative and innovative approaches for treatment. IR is well-placed to offer innovative treatments for some aspects of these conditions that are not traditionally part of the vascular malformation tool box. These include endovenous laser therapy (EVL) for malformations with a predominantly 'dysplastic-vein' type anatomy and cryoablation for more solid overgrowth lesions [4-6].

This lecture will cover some more innovative applications of basic sclerotherapy techniques and suggest uses for EVLT and cryoablation in the treatment of some complex overgrowth conditions.

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PART 2

**Abstracts of
Free Papers
News on Stage
(oral communications)
sorted by presentation
numbers**

News on Stage Session Vascular News on Stage

404.1

Accelerated thrombolysis for post-thrombotic syndrome using the acoustic pulse thrombolysis EkoSonic® Endovascular system (ACCESS PTS) study: initial results of a multi-centeric study

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Purpose: Post-thrombotic syndrome (PTS) occurs in up to 50% of patients (pts) with DVT. Chronic DVT and PTS is debilitating, reduces the quality of life, and treatment options are limited. A multi-centeric, prospective, single-arm study evaluated the efficacy/safety of endovascular recanalization, including ultrasound-accelerated, catheter-directed thrombolysis (USCDT) in pts suffering from chronic DVT and PTS.

Material and methods: Inclusion criteria were as follows: femoral DVT diagnosed ≥ 6 months earlier, Villalta Score (VS) ≥ 8 , and failure of 3 months conservative therapy. Exclusion criteria were as follows: isolated iliofemoral DVT, high bleeding risk, popliteal vein occlusion, and filling defect ≥ 3 cm into IVC. Pts underwent initial PTA of the occlusive DVT segments followed by >12 h USCDT and adjunctive therapy as needed. The primary efficacy endpoint was a reduction in VS of ≥ 4 at the 30-d post-USCDT in $\geq 50\%$ pts. The primary safety endpoints were major bleeding events within 72h of starting the procedure and pulmonary embolism (PE) within 30d post-USCDT.

Results: Overall, 81 pts enrolled with 3 failures to cross. Seventy-eight pts (mean age 55 years, male 68%) underwent treatment with USCDT for 23 ± 5.4 h and at a tPA dose of 18.5 ± 7.6 mg. Of 77 evaluable limbs in 73 pts, VS improved from 15.97 to 9.64 at 30d ($p < 0.0001$), 8.53 @ 90d (72 limbs) and 8.15 @ 180d (60 limbs), with an overall improvement in VS of 7.82 from baseline. 67% ($p = 0.001$) met the primary endpoint. One major bleed occurred within 72h post-USCDT. One PE occurred within 30d post-USCDT.

Conclusion: In chronic DVT pts suffering from PTS, endovascular intervention using USCDT with PTA was safe and effective in recanalizing chronic venous occlusions while improving the Villalta score and thereby improving the signs and symptoms of PTS.

404.3

Randomized clinical trial to compare ultrasound-enhanced delivery of paclitaxel and DEB in patients with critical limb ischemia and femoral-popliteal disease: outcome of the PACUS trial after 18 months

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Purpose: Treatment of femoral-popliteal calcific lesions and CTO is characterized by poor clinical outcomes. The biggest challenge in treating patients with calcific lesions is the inability of therapeutic drugs to penetrate through the media-intima calcium to reach the vessel wall. In this study, ultrasound plasty associated with local paclitaxel delivery was compared with drug-eluting balloon for the treatment of femoral-popliteal disease in patients with critical limb ischemia.

Material and methods: This single-center, single-blinded randomized trial included 56 patients with critical limb ischemia randomly assigned to 2 treatment groups: 28 patients (control group) were treated with DEB and 28 patients (study group) were treated with ultrasound followed by local administration of paclitaxel in liquid mixture with iopromide 370 at $1 \mu\text{g}/\text{mm}^3$. In the study group, the mean lesion length was 168.8mm and 21 patients had calcifications. In the control group, the mean lesion length was 164mm and 23 patients had calcifications.

Results: No adverse procedural events were observed. At the 6-month follow-up, no patient suffered from myocardial infarction, underwent amputation, or died in either group. At 18 months, the rate of TLR was 7.6% (2/26) and the rate of amputation was 0% (0/26). In the control group, the rate of TLR was 44% (11/25) and the rate of amputation was 20% (5/25).

Conclusion: Ultrasound-enhanced delivery of paclitaxel was associated with improved patency, less need for TLR, and less amputations.

404.4

Multicenter feasibility study of microwave radiometry thermometry for noninvasive differential diagnosis of critical limb ischemia in diabetic patients

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Purpose: Diagnosis of vascular involvement in diabetic foot ulcer (DFU) disease remains challenging. We conducted a proof-of-concept study to investigate the feasibility of microwave radiometry (MWR) thermometry for the noninvasive differential diagnosis of critical limb ischemia (CLI) in patients with DFU.

Material and methods: This prospective, multicenter study included 80 patients divided into four groups (group N: normal control subjects; group DN: diabetic patients with verified neuropathic ulcers without vascular involvement; group DC: diabetic CLI patients; and group NDC: non-diabetic CLI patients). Vascular disease was confirmed with angiography. All subjects underwent MWR (RTM-01-RES: University of Bolton, UK) to record mean tissue temperatures at various predetermined foot sites. Comparisons of temperature measurements between study groups were performed using the one-way ANOVA and Dunn tests. ROC analysis was used to determine sensitivity, specificity, and cut-off value of MWR for CLI diagnosis.

Results: Temperatures recorded in diabetic CLI patients were similar to those in non-diabetic CLI patients but significantly lower than those in patients with neuropathic ulcers without vascular involvement and normal controls (group DC: $29.30^{\circ}\text{C} \pm 1.89^{\circ}\text{C}$ vs. group NDC: $29.18^{\circ}\text{C} \pm 1.78^{\circ}\text{C}$ vs. group N: $33.01^{\circ}\text{C} \pm 0.45^{\circ}\text{C}$ vs. group DN: $33.39^{\circ}\text{C} \pm 1.37^{\circ}\text{C}$; $P < .0001$). According to ROC analysis, cut-off temperature value to diagnose CLI was $<31.8^{\circ}\text{C}$ (area under the curve: 0.984; 95%CI: 0.965–1.005; $P < .001$), with a sensitivity of 100.0% (95%CI: 90.26–100.0) and specificity of 88.37% (95%CI: 74.92–96.11).

Conclusion: MWR detected significantly lower tissue temperatures in diabetic and non-diabetic CLI patients compared with non-ischemic controls. MWR could be used as an adjunct for differential diagnosis of arterial ischemia in patients with DFO.

404.5

Supervised exercise therapy versus percutaneous angioplasty versus combined angioplasty and exercise for intermittent claudication: systematic review and Bayesian network meta-analysis of randomized controlled trials

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Purpose: The authors report the results of a Bayesian network meta-analysis of randomized controlled trials (RCTs) comparing supervised exercise therapy (SET) alone, percutaneous transluminal angioplasty (PTA) alone, or a combination of SET and PTA for the treatment of intermittent claudication.

Material and methods: Medical databases were searched with the PRISMA statement, and 39 RCTs (including five 3-arm studies) comprising 2,983 patients with a 12-month median follow-up (range, 3–24 months) were analyzed in total. Outcome measures included improvements in the maximal walking distance capacity (MWD; meters on treadmill) and quality of life (QoL; SF-36 and EQ-5D instruments) compared with the best medical therapy (BMT) as the anchor control treatment. Bayesian random effects models were employed (WinBUGS).

Results: There were significant improvements in MWD with PTA (+85m, 95%CrI: +4 to +170), SET (+180m, 95%CrI: +130 to +230), and PTA+SET (+290m, 95%CrI: +180 to +390). SET was better than PTA alone (MWD difference +85m, 95%CrI: +16 to +170). PTA+SET was the best treatment with an MWD difference over SET of +110m (95%CrI: +16 to +200). QoL was significantly and strongly improved only in case of PTA+SET (QoL Cohen's d standardized effect size 1.8; 95%CrI: 0.21 to 3.4). Results were stable on sensitivity and consistency analyses without any significant publication bias.

Conclusion: Healthcare systems need to invest in supervised exercise programmes as the first standalone treatment for intermittent claudication and in order to augment the results of peripheral revascularization.

404.6

Peripheral endovascular interventions using human Thiel-embalmed cadavers with extracorporeal flow for medical device testing, development, and training

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Purpose: The numerous benefits of the Thiel method of embalming human cadavers over alternative methods of preservation include a patent vascular system. A femoral artery model was used to demonstrate peripheral interventions within the anatomy of the human arterial system with the texture, tactile feel, and additional function of extracorporeal driven flow. Applied to clinical training simulations and pre-clinical testing, this model is designed to offer a superior alternative to benchtop and virtual simulations.

Material and methods: In six cadavers, extracorporeal flow was introduced into the femoral artery of both legs. A distal port was most commonly located within the dorsalis pedis artery to form a circuit. Antegrade pulsatile flow introduced within the circuit (200–400 mL/minute) facilitated fluoroscopically guided endovascular interventions such as angioplasty and stenting at various arterial locations. Interventions are assessed using fluoroscopic, CT imaging, and ultrasound imaging.

Results: The results demonstrated that this model can be used to effectively assess the delivery, device apposition, and device-induced effects on flow patterns to the extracorporeal perfused circuit.

Conclusion: The model's versatility and robust preparation and durable over long periods provide the basis to repeatedly assess devices in numerous leg positions, such as knee bend, facilitating options not viable in fresh cadaveric models or animal models. In addition to multimodal imaging providing the tools to assess the device, it also provides the basis for the application of this model for training purposes in full simulation of clinical interventions.

Free Paper Session Prostate intervention

606.1

Prostatic artery embolization versus transurethral resection of the prostate in the treatment of benign prostatic hyperplasia: 6-month results of a clinical trial

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Purpose: The aim of this study is to compare clinical and urodynamic results as well as the quality of life of prostatic artery embolization (PAE) and transurethral resection of the prostate (TURP) in the treatment of lower urinary tract symptoms (LUTS) in patients with benign prostatic hyperplasia (BPH).

Material and methods: This is a prospective, randomized, non-inferiority clinical trial comparing efficacy and safety of PAE and TURP. Patients are male, older than 60 years of age, diagnosed with BPH and obstructive moderate or severe LUTS refractory to 6-month medical therapy. In our study, 80 patients were selected, 29 were assigned to the PAE group, 30 to the TURP group, and 21 were excluded. Data on maximum urinary flow rate (Qmax), international prostate symptom score (IPSS), quality of life (QoL), international index erectile function (IIEF), PSA, prostatic volume (PV), and post-void residual volume (PVR) were collected at 1, 3, and 6 months after treatment.

Results: Technical success was achieved in 100% patients in both techniques. The results after 6 months of PAE were a decrease of 25 points in IPSS, an increase of 3 points in IIEF, and a decrease of 37.2% in PV. All patients with acute urinary retention could remove bladder catheter 3 weeks after PAE. There were no complications, and only one patient (14%) had pain after embolization.

Conclusion: PAE has proved to be safe and effective in the treatment of BPH with a symptomatic improvement related to the decrease in prostatic volume.

606.2

Prostatic artery embolisation (PAE) for haematuria/haematospermia in the absence of an upper urinary tract pathology

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Purpose: PAE is rapidly establishing itself as a robust treatment for benign prostatic hyperplasia (BPH). The use of PAE in haematuria/haematospermia in the presence of BPH and prostatic carcinoma is less well-established.

Material and methods: Fifteen consecutive patients with haematuria/haematospermia were included in the prospective study. All patients had prior imaging and cystoscopy to exclude other causes of haematuria. Patients were embolised with PVA particles (200 µm) and followed up at 3 months and 12 months following the procedure. QOL questionnaires, IPSS, IIEF, urodynamics and clinical review were all employed to assess the success of the treatment.

Results: All 15/15 cases were technically successful with bilateral PAE being performed. All cases of haematuria resolved by the 3-month follow-up (100%). Of the 2 cases of haematospermia, 1 had fully resolved at 3 months (50%) and the other fully resolved at 6 months (100%) (noted at the 12-month review). If BPH was present, there was a reduction in lower urinary tract symptoms noted by improvements in QOL indices, IPSS, IIEF and urodynamics. There was continued success even if the patient was subsequently anticoagulated. There was no associated sexual dysfunction.

Conclusion: PAE is a very useful technique for controlling the quite debilitating condition of haematuria in patients with normal upper urinary tracts. PAE has shown promise in controlling haematospermia, which is a notoriously difficult condition for Urologists to treat. Controlling haematuria in patients with inoperable cancer and BPH allows an improved QOL. Further studies on PAE and prostatic cancer are warranted.

606.3

A simple and efficient classification of intra-prostatic arterial vascularization and its application in prostatic artery embolization (PAE)

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Purpose: The origin of prostatic artery (PA) has been previously described, but no description exists regarding the intra-prostatic arterial distribution of the PA and its practical consequence in prostatic artery embolization (PAE). We aimed to analyze this distribution and apply it to the step-by-step performance of PAE.

Material and methods: In 101 patients (202 hemipelves), we analyzed the pattern of the PA after its penetration into the prostatic lobe using selective angiography. We focused on the distribution of its medial and lateral branches and the presence of large extra-prostatic branches. The presence of a vesical or rectal branch with a common origin was also monitored.

Results: We found a single PA in 70% (143) of the 202 hemipelves. In these 143 hemipelves, we classified the intra-prostatic anatomy as follows: types A, B, and C (39% + 11% + 12%) had exclusive intra-prostatic feeding with no large extra-prostatic shunting; types D and E (18% + 10%) had intra-prostatic feeding and a large and direct penile or rectal direct shunt, respectively. The occlusion of an extra-prostatic shunt to avoid non-target embolization was performed in 0% of type A/C hemipelves, 7% of type B hemipelves, and 87% and 20% of type D and E hemipelves, respectively. The PERfectED technique could be performed in 46%–64% of the hemipelves depending on the type of artery.

Conclusion: The protection of anastomosis is rarely required in type A, B, or C hemipelves but is required in most type D hemipelves and often in type E hemipelves.

606.4

Does prostate artery embolization (PAE) improve voiding symptoms, storage symptoms, or both?

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Purpose: Many studies have shown a global improvement in the international prostate symptom score (IPSS) after PAE; however, no studies have examined how PAE improves voiding and storage symptoms in isolation. Understanding which symptoms PAE can improve is essential for optimal patient selection and also understanding PAE's mechanism of action. Therefore, we examined the effect of PAE on all aspects of IPSS.

Material and methods: Patients undergoing PAE for urodynamically confirmed benign outflow obstruction (BOO) from July 2014 to January 2016 were prospectively followed up for 12 months. An IPSS questionnaire was completed prior to PAE and then repeated at 3, 6, and 12 months post-procedure in all patients, with recording of individual IPSS categorical scores.

Results: Forty-three patients were identified (mean age 65.1±5.9 years, mean prostate volume 60.0±25.6 cm³), with a mean reduction in global IPSS at 12 months of 15.2±8.4. PAE triggered a significant reduction in both voiding and storage symptoms (paired t-test p<0.001), but voiding symptoms improved to a greater extent (t-test 1.9 vs 1.5, p=0.023). The symptoms that improved most were

"incomplete emptying" and "intermittency" (both reduced by a mean 2.2 points). Despite a greater improvement in voiding symptoms after PAE, severe pre-embolization "frequency" and "urgency" symptoms correlated best with a good symptomatic outcome (Pearson's bivariate correlation $r=0.44$, $p=0.006$ and $r=0.54$, $p=0.001$, respectively).

Conclusion: PAE improves both voiding and storage symptoms, which suggests that neural denervation plays a considerable role in symptomatic improvement. If BOO is confirmed with formal urodynamic studies, severe storage symptoms are the best predictors of a good symptomatic improvement.

606.5

Adenomatous–dominant benign prostatic hyperplasia (AdBPH) as a predictor of clinical success following prostate artery embolization

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Purpose: To investigate the clinical impact of performing prostate artery embolization (PAE) on patients with adenomatous–dominant benign prostatic hyperplasia (AdBPH).

Material and methods: Twelve patients from the ongoing proSTatic aRtery EmbolizAtion for the treatMent (STREAM) of benign prostatic hyperplasia trial were identified as having AdBPH, defined as two or more adenomas within the central gland of ≥ 1 cm diameter on multi-parametric MRI (MP-MRI). These patients were age-matched with patients from the STREAM cohort without AdBPH. Patients were followed up with repeat MP-MRI at 3 months and 1 year. International prostate symptom score (IPSS), international index for erectile function (IIEF), and quality of life assessment from the IPSS and EQ-5D-5S questionnaires were recorded pre-PAE and at 6 weeks, 3 months, and 1 year.

Results: The mean age of patients was 68 (61–76) years. All patients underwent PAE as a day-case procedure. The technical success in the cohort was 23/24 (96%). Following multivariate analysis, there was a significant reduction in prostate volume post-embolization with a mean reduction of 36% (30–55) in the AdBPH group compared with a mean reduction of 25% (9–44) in the non-AdBPH group ($p=0.04$). There was a significant reduction in IPSS in the AdBPH group following PAE when compared with the control group [AdBPH median IPSS 8 (3–15) vs non-AdBPH median IPSS 13 (8–18), $p=0.01$]. IPSS QOL scores significantly improved in the AdBPH group ($p=0.007$). There was no deterioration in sexual function in either group post-PAE.

Conclusion: This is the first time that AdBPH has been identified as being a predictor of clinical success following PAE.

606.6

The 6-month – 7.5-year outcome of prostatic artery embolization in 1100 patients with benign hyperplasia

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Purpose: To evaluate the short-, mid-, and long-term outcomes of prostatic artery embolization (PAE) in patients with benign prostatic hyperplasia (BPH).

Material and methods: Between March 2009 and September 2016, 1100 patients with BPH underwent PAE. Overall, 118 patients were in acute urinary retention (AUR) and 221 patients had a prostate volume over 100cm³. All patients were evaluated up to 5 months, with 982 patients at mid-term between 1 and 3 years and 600 patients at long term between 3 and 7.5 years.

Results: Mean patient age was 68.7 years. There were 18 (1.6%) technical failures. The cumulative clinical success rates at short-, mid-, and long-term follow-ups were 90%, 84.1%, and 79.2%, respectively. The results of the 118 patients in AUR were as follows: 110 (93.2%) had the catheter removed between 2 days and 3 months and 106 (89.8%) and 99 (83.9%) had good results at the mid and long terms, respectively. The results of the 220 patients with prostate volume larger than 100cm³ were as follows: 190 (86.4%) had a short-term clinical success and 178 (80.9%) and 171 (77.7%) had mid- and long-term clinical successes, respectively. There were 2 major complications, bladder wall ischemia and perineal pain for 3 months.

Conclusion: PAE is a safe procedure for patients with BPH with good short-, mid-, and long-term results.

Free Paper Session Imaging

607.1

Comparison of imaging quality and adverse effects of hepatic arterial angiography: Iopamidol 250 versus Ioversol 320

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Purpose: To compare the imaging quality and adverse effects of hepatic arterial angiography during transcatheter arterial chemoembolization between Iopamidol 250 and Ioversol 320.

Material and methods: We enrolled 104 patients with hepatocellular carcinoma prospectively and randomized them into two groups. When angiography was performed, 54 patients received Iopamidol 250 (group A) and 50 patients received Ioversol 320 (group B). The quality of vessel visualization was evaluated by two radiologists (grade 1: clearly visible, grade 2: poorly visible, and grade 3: invisible). The number of hepatocellular carcinomas on hepatic angiography was compared with dynamic CT scan (concordance score 1: same, score 2: more on angiography, and score 0: more on CT scan). The incidence of adverse events and level of creatinine were monitored before and after angiography.

Results: The quality of vessel visualization on angiography shows no significant difference (hepatic artery distal branches: $p=0.711$, right gastric artery: $p=0.138$, and pancreaticoduodenal artery: $p=0.296$). Concordance rate of tumor detection on angiography and CT scan was not statistically different between two groups ($p=0.945$). There was no significant difference in adverse events between the group A and B after angiography ($p=0.513$). The creatinine level did not increase after angiography in both groups.

Conclusion: The iodine concentration of 250 mg/mL, which has low viscosity, would be safe and effective to visualize hepatic arterial branches and to detect hepatocellular carcinoma during transcatheter arterial chemoembolization.

607.2

Proof of concept: semi-automated alignment of EVAR surveillance radiographs, increasing sensitivity to device migration and distortion

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Purpose: Biplanar radiography used in EVAR surveillance varies in rotation and projection even when conducted according to standardised protocols, thus compromising the sensitivity of the technique. This is further exacerbated by the limitation inherent to the

side-by-side visual comparison of sequential films. This necessitates large movements/changes in stentgrafts to confidently diagnose migration and other complications.

Material and methods: We developed a protocol using commercially available medical software (i2K Retina, DualAlign) to create automated alignment of serial radiographs, which compensates for variations in magnification and angulation. Aligned images are displayed serially in the same frame for ease of visual comparison. Optimum settings were developed to allow 1) the largest proportion of sequential radiographs to be automatically registered and aligned and 2) to achieve the smallest variation in alignment of reference landmark, as defined by pixel coordinates of the four corners of the L1 vertebral body. This was tested on 119 sets of AP and LAT radiographs of 18 patients.

Results: Overall, 110 (92%) AP and 83 (70%) LAT radiographs could be registered and aligned. Changes in bone morphology, most commonly due to a wedge fracture of the lumbar spine, were noted in 39 out of the 45 unaligned radiographs. Aligned radiographs showed low variance of L1 alignment with the SD of positional alignment being only 41 pixels for AP radiographs and 63 pixels for LAT radiographs.

Conclusion: Automatic registration and alignment of plain radiographic images in EVAR surveillance is possible. This could improve the sensitivity and utility of plain radiography in detecting stent-graft migration and distortion.

607.3

Evaluation of PTA outcomes in patients with critical limb ischemia using the volumetric CT perfusion technique: preliminary results

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Purpose: To evaluate hypoperfusion of foot in patients with critical limb ischemia (CLI) using quantitative perfusion multidetector-row computed tomography (MDCT) and estimate perfusion parameter changes after percutaneous transluminal angioplasty (PTA).

Material and methods: Ten patients (median age 69.5 years, range 51–84 years) with CLI [Rutherford 4 (n = 1), Rutherford 5 (n = 6), and Rutherford 6 (n = 3)] were investigated following the Institutional Review Board approval. They underwent foot CT perfusion examinations using a 128-slice dual-source CT scanner 1 day before and 1 week after PTA. Key parameters such as permeability surface (PS), blood volume (BV), blood flow (BF), and mean transit time (MTT) were analyzed and applied for statistical comparison.

Results: Revascularization was technically successful in all patients and the ankle-brachial index (ABI) increased from 0.34 ± 0.15 to 0.76 ± 0.21 . Between baseline and post-PTA, mean PS increased from 3.12 ± 2.03 to 9.40 ± 3.52 , mean BV increased from 1.65 ± 0.80 to 4.78 ± 1.38 , mean BF increased from 16.74 ± 5.00 to 32.85 ± 6.22 , and mean MTT decreased from 7.56 ± 1.69 to 4.28 ± 0.77 ($p < 0.005$).

Conclusion: Foot CT perfusion examination can be a useful modality for the diagnosis of CLI and estimation of PTA outcome. After successful revascularization, there was significant improvement in perfusion parameters.

607.4

HCC screening behavior and IR interventions at a tertiary transplant center

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Purpose: Despite recommendations for biannual ultrasound screening for hepatocellular carcinoma (HCC), prior reports suggest compliance as low as 15%. We characterized screening compliance at a tertiary transplant center and referral patterns to IR for locoregional therapy (LRT) for diagnosed HCC.

Material and methods: All patients eligible for HCC screening by AASLD guidelines between 1/1/10 and 31/12/15 were included. Individual compliance (IC) was defined as the percentage of total eligible screening days within 6 months after a qualifying imaging exam. Eligibility was divided into 6-month intervals, and the average IC among intervals was compared using a Student's t-test. After HCC diagnosis, the rate of LRT and the time between diagnosis and first intervention were calculated.

Results: In total, 6783 patients met inclusion criteria. IC rates decreased the longer a patient remained eligible, with 50.3% average IC between 6 and 12 months compared with 16.9% for patients eligible for >36 months ($p < 0.001$). During the study, 209 patients were diagnosed with HCC at a median of 22.4 months after surveillance initiation. LRT was performed in 87 of these patients, with the first intervention occurring at a median of 33 days after diagnosis.

Conclusion: Average IC begins near 50%, suggesting that most patients underwent a screening exam, but falls below 20% after 36 months. This demonstrates a need for increased patient and provides education about ongoing screening, particularly noting that HCC diagnosis occurred at a median of 22 months. Once diagnosed with HCC, IR intervention was rapid, occurring within 1 month in most patients; however, majority of the patients diagnosed with HCC (58%) did not receive LRT.

607.5

Kinetic imaging as a novel analysis of X-ray angiography

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Purpose: Our objective was to compare images obtained by conventional digital subtraction angiography (DSA) with those obtained by our new kinetic imaging (KI) method. We wanted to verify the quality of KI for further use.

Material and methods: KI performs a statistical analysis of X-ray angiography image series as a whole to extract information about the morphology of blood vessels and the dynamics of the blood flow. Images representing different dynamic parameters of circulation of the lower extremity were also calculated. Based on 20 non-selective lower extremity angiography images, interventional radiology specialists filled out a questionnaire about the quality of DSA and KI. The signal-to-noise ratio (SNR) of the images was also analyzed. Box counting and analysis of the covered area were used to compare DSA and KI. We also used KI for the creation of several parametric images to quantify the degree of stenosis.

Results: The questionnaire and analysis indicated that KI visualized more blood vessels and more details than DSA. Box counting indicated that the images obtained by KI represent the same blood vessel structure as those obtained by DSA. The SNR ratio of images

obtained by KI was significantly better than that of images obtained by DSA. KI remains semiquantitative for stenosis quantification.

Conclusion: Based on our data, KI at least provides the same quality image of the blood vessel structures regularly visualized by DSA. The higher SNR is a promise for future decrease in X-ray dose and/or volume of contrast media. KI could provide enough information for achieving proper diagnostic results by performing an X-ray fluoroscopy with contrast media.

607.6

Quantification of perfusion reduction following transarterial chemoembolization with drug-eluting microspheres (DEB-TACE) using 2D-perfusion angiography (2D-PA)

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Purpose: To analyze the feasibility of 2D-PA for quantifying the perfusion reduction following DEB-TACE and to evaluate its potential to monitor arterial stasis during TACE.

Material and methods: Twenty patients with hepatocellular carcinoma (HCC) who underwent 24 DEB-TACE procedures were enrolled in this study. Contrast-enhanced digital subtraction angiography (DSA) was acquired to monitor DEB-TACE. To quantify changes in tumor or tissue perfusion due to DEB-TACE using 2D-PA, the acquired DSA series were post-processed using a dedicated software. A reference region-of-interest (ROI) in a proximal hepatic artery (arterial input) and two distal target ROIs in the embolized tumor and non-targeted liver parenchyma were placed in corresponding areas on DSA pre- and post-DEB-TACE. Time to peak (TTP), peak density (PD), and area under the curve (AUC) were assessed. The ratios of reference ROI to target ROIs for both the embolized tumor and non-targeted parenchyma ($TTP_{\text{tumor/parenchyma}}/TTP_{\text{inflow}}$, $PD_{\text{tumor/parenchyma}}/PD_{\text{inflow}}$, and $AUC_{\text{tumor/parenchyma}}/AUC_{\text{inflow}}$) pre- and post-DEB-TACE were calculated.

Results: Regarding the embolized tumor the ratios $PD_{\text{tumor}}/PD_{\text{inflow}}$ and $AUC_{\text{tumor}}/AUC_{\text{inflow}}$ decreased significantly ($p < 0.0001$), whereas the ratio $TTP_{\text{tumor}}/TTP_{\text{inflow}}$ missed significance ($p = 0.0732$). The measured 2D-PA parameters did not change significantly in the non-targeted liver parenchyma ($p > 0.05$).

Comparing the embolized tumor and non-targeted liver parenchyma, the ratio $PD_{\text{tumor}}/PD_{\text{inflow}}$ differed significantly compared with the ratio $PD_{\text{parenchyma}}/PD_{\text{inflow}}$ pre-TACE ($p < 0.0001$) and the ratio $AUC_{\text{tumor}}/AUC_{\text{inflow}}$ differed significantly compared with the ratio $AUC_{\text{parenchyma}}/AUC_{\text{inflow}}$ ($p = 0.0008$). Following DEB-TACE, the ratios $PD_{\text{tumor}}/PD_{\text{inflow}}$ and $PD_{\text{parenchyma}}/PD_{\text{inflow}}$ did not differ significantly ($p = 0.1286$), whereas the ratios $AUC_{\text{tumor}}/AUC_{\text{inflow}}$ and $AUC_{\text{parenchyma}}/AUC_{\text{inflow}}$ did ($p = 0.0332$).

Conclusion: 2D-PA provides an objective approach to quantify perfusion reduction of embolized HCC following DEB-TACE and may therefore be used to determine the precise embolization endpoint and quantify technical success for scientific purposes.

Free Paper Session Bone and spine intervention

706.1

Prospective randomized trial comparing intradiscal ozone injection with surgery for the treatment of disc herniation

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Purpose: Several studies have reported the comparative effectiveness of intradiscal ozone over steroids in the treatment of patients with disc herniations. Although specific protocols vary and a few serious infections have been reported, the technique shows promise as a non-surgical treatment for these patients. The purpose of this investigation is to compare an intradiscal ozone injection to discectomy in patients with lumbar disc herniation through a prospective randomized trial.

Material and methods: This is a multicenter randomized study in three countries. Key selection criteria include symptomatic lumbar disc herniation, leg pain greater than 5/10, persistent pain for more than 6 weeks, and no neurological deficit. The gas mixture was created using the Minimus Spine's Triojection System. Triojection uses a sterile syringe cartridge to produce 14 cc of gas at a concentration of 35 ± 3 ug/ml. Gas was slowly injected into the disc and allowed to flow through the herniation and into the epidural space. Leg pain, back pain, and function scores were collected at baseline, 1 week, and 1, 3, 6, 12, 18, and 24 months. The study was independently monitored.

Results: The primary endpoint is the improvement in leg pain during the first 6 months of treatment. The study will enroll 50 patients, projecting 80% power to detect a non-inferiority margin of 1.9 points with 95% confidence. Thirty-three subjects have been enrolled and full enrollment is anticipated in the second half of 2017. No major complications have been noted so far.

Conclusion: We present available data from a prospective randomized study comparing percutaneous treatment and surgery.

706.2

Clinical experience of an innovative implant for the prophylactic treatment of impending pathological hip fracture in 20 patients

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Purpose: To evaluate an innovative implant, Y-STRUT® (Hyprevention, Pessac, France), designed to provide prophylactic reinforcement of the proximal femur in metastatic patients.

Material and methods: A first prospective study was completed after 1 year of follow-up of the first 10 patients implanted with the studied device. The following 10 patients were included in an observational post-market study that is still ongoing and will focus on the

first 100 patients implanted with this innovative device. They have been followed up for 6 months until now and will be followed up for 2 years.

Results: All the patients enrolled (mean 62 years, 50% female) presented a pertrochanteric lesion shown on imaging with an average Mirels score of 9.42 (8–11). The procedures were performed by interventional radiologists in 97±33 minutes on an average, including CT scan acquisitions, with 9.2±3.1 ml of cement injected. Hospitalization duration was 2.3±1.4 days. Six patients deceased from cancer progression. One fracture occurred after a median follow-up of 237 days and was attributed to a non-optimal placement of the implant as well as to a rapid tumor progression. Wound healing was achieved in all patients at 6 months, with no case of wound infection, bleeding, leakage, or inflammation. Initial data shows a pain level diminution and an increase in OHS-12 score, indicating that both symptomatic and functional conditions of the patients were improved.

Conclusion: This minimal invasive procedure appears as a promising consolidation technique for oncologic patients with a poor performance status. Additional studies should now be conducted on a greater number of subjects to confirm these clinical benefits.

706.3

Palliation of pathological pelvic bone fractures using percutaneous screw plasty in 100 consecutive patients with cancer

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Purpose: Pathologic pelvic bone fractures are frequent in patients with cancer and results in significant pain and loss of function. The purpose of this study was to evaluate the efficiency and safety of percutaneous screw plasty (screw fixation in association with cementoplasty) performed by interventional radiologists in palliating pathological pelvic bone fractures.

Material and methods: This is a single-center retrospective study of the first 100 consecutive patients with cancer treated in our hospital by screw plasty for palliation of pathological pelvic bone fractures. Interventional radiologists performed all screw plasties percutaneously under cone-beam CT guidance and under general anesthesia. Using hospitalization' and medical consultation' reports and reviewing all post-op CT scans, we reported the hospitalization duration, pain improvement at 1 month, complications, and relapsing fractures during the follow-up.

Results: One hundred four procedures were performed from June 2006 to November 2016. The mean hospitalization duration was 2.3 ± 2.7 days. Pain was significantly improved at 1 month (mean NRS score: 6.27 ± 2.45 vs. 2.19 ± 2.76, $p < 0.001$) and 80% of the patients experienced complete or marked pain improvement (>50% NRS score decrease after treatment). The mean follow-up was 290 ± 325 days. Thirteen patients suffered from complications during the follow-up: 6 patients experienced pain at the puncture site for >48h, 2 had hematomas, 3 had site infections, and 2 had tumor seeding's along the screw tracks. Twelve patients suffered from relapsing fractures of the pelvis: four of these 12 patients were retreated by percutaneous screw plasty.

Conclusion: Percutaneous screw plasty is an efficient and safe approach for pain palliation of pathological pelvic bone fractures.

706.4

Intra-articular application of pulsed radiofrequency improves symptoms of knee osteoarthritis: a prospective study on efficacy and safety

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Purpose: To prospectively evaluate the effectiveness of intra-articular application of pulsed radiofrequency (PRF) in patients with knee osteoarthritis suffering from chronic pain refractory to conservative therapies.

Material and methods: During a 30-month period, PRF was performed on 53 cases of knee osteoarthritis (45 patients, 8/45 with bilateral knee osteoarthritis). A 20G/10cm cannula was percutaneously inserted from the anterolateral region of the knee joint under fluoroscopy. Coaxially, an RF electrode (10-mm "active tip") was introduced and neurolysis session was performed with PRF (1,200 pulses at 50 V with 10-ms duration followed by a 480-ms silent phase). Subsequently, hyaluronate was injected intra-articularly. Pain before and after 1 week and after 1, 6, and 12 months was compared using a numeric visual scale (NVS) questionnaire.

Results: The mean pain score prior to PRF was 8.19±1.4 NVS units. This score was reduced to a mean value of 2.47±2.5 NVS units at 1 week after, to 2.55±2.6 NVS units at 1 month, to 3.1±2.8 NVS units at 6 months, and to 5.02±3.09 NVS units at 12 months of follow-up ($p < 0.01$). Overall mobility improved in 47/53 (88.6%) patients. No complication was observed.

Conclusion: PRF seems to be an effective and safe technique for palliative management of chronic pain in patients with knee osteoarthritis. Results seem to be reproducible and last longer than when only intra-articular hyaluronate is injected. There seems to be a need of repeating the session at 1 year.

706.5

Comparison between ultrasound-guided percutaneous double-needle lavage in the treatment of calcific tendinopathy of the rotator cuff performed with or without an ultrasound-guided block of the suprascapular nerve

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Purpose: To compare the outcome of ultrasound-guided percutaneous double-needle lavage (PCL) in the treatment of calcific tendinopathy of the rotator cuff performed with or without an ultrasound-guided block of the suprascapular nerve in terms of pain control and shoulder mobility.

Material and methods: We prospectively enrolled 47 patients treated with PCL during 2015 and 2016 diagnosed with calcific tendinitis of the rotator cuff. Twenty-seven patients were treated with PCL alone, while the remaining 20 were treated after an ultrasound-guided block of the suprascapular nerve of the same shoulder using Lidocaine. The visual analogy scale (VAS) and constant scores were assessed before and immediately after the procedure and at 7 days and 1 and 3 months.

Results: Overall, VAS and constant scores showed a significant improvement after the procedure during the follow-up ($p < 0.05$). The block group showed a significant reduction of the VAS immediately after and at 1 week with respect to the non-block group (mean values 4.4 vs 5.6 and 3.5 vs 4.1, respectively) ($p < 0.05$). At 1 and 3 month follow-ups, there was no significant difference between groups in terms of the VAS score ($p > 0.05$). Constant score values did

not show any statistical difference during follow-up between the block and non-block groups. No major or minor complication was encountered.

Conclusion: Ultrasound-guided PCL in the treatment of calcific tendinopathy confirmed to be effective both considering pain control and shoulder recovery. Ultrasound-guided block of the suprascapular nerve is effective in periprocedural pain control, while it does not improve shoulder mobility recovery.

706.6

EVOLVE: a prospective and multicenter evaluation of the outcomes pertaining to quality of life, pain, and activities of daily living after balloon kyphoplasty for the treatment of Medicare-eligible subjects with vertebral compression fractures

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Purpose: Vertebral compression fractures (VCFs) resulting from osteoporosis or cancer are common and painful. Worldwide, osteoporosis causes >8.9 million fractures annually. Quality of life is threatened, and mortality and morbidity rates increase following a VCF. Kyphoplasty is a minimally invasive procedure to stabilize a VCF, reduce pain, and improve the quality of life and mobility.

Material and methods: In total, 354 Medicare patients with painful, acute, or subacute VCFs were prospectively enrolled at 24 sites, with 350 undergoing balloon kyphoplasty. Primary objective was to show statistically significant improvement in four co-primary endpoints (SF-36v2 PCS, EQ-5D, NRS back pain, and ODI) at 3 months.

Results: Back pain improved from 8.7 (scale 0–10) by 5.2, 5.4, 6.0, 6.2, and 6.3 points at the 7-day and 1-, 3-, 6-, and 12-month time points, respectively ($p < 0.001$ for each). ODI improved from 63.4 (scale 0–100) by 30.5, 35.3, 36.3, and 36.2 points at the 1-, 3-, 6-, and 12-month time points, respectively ($p < 0.001$ for each). SF-36 PCS was 24.2 at baseline (scale 0–100) and improved by 10.7, 12.4, 13.4, and 13.8 points at 1, 3, 6, and 12 months, respectively ($p < 0.001$ for each). EQ-5D was 0.383 points (scale 0–1) and improved by 0.316, 0.351, 0.356, and 0.358 points at 1, 3, 6, and 12 months, respectively ($p < 0.001$ for each).

Conclusion: Our large, prospective, multicenter study trial demonstrates that balloon kyphoplasty is a safe, very effective, and durable procedure for treating Medicare patients with VCFs due to osteoporosis or cancer.

Free Paper Session EVAR

707.1

Anatomical applicability of endovascular aneurysm sealing techniques in a continuous cohort of fenestrated endovascular aneurysm repairs

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Purpose: In UK, the majority of juxtarenal aortic aneurysms are treated by fenestrated endovascular aneurysm repair (FEVAR). Endovascular aneurysm sealing (EVAS) with off-label use of chimneys (ChEVAS) offers a novel alternative to FEVAR. Both ChEVAS and FEVAR are complex endovascular interventions and have limitations associated with anatomical suitability. We undertook a comparison of how planned ChEVAS and FEVAR interventions varied in the same patient cohort.

Material and methods: An analysis of consecutive patients who underwent FEVAR at our institution between 2013 and 2015 was undertaken. Preoperative CT angiograms were anonymized and sent to two ChEVAS planners with an experience of over 40 ChEVAS interventions. ChEVAS planners were blinded to the study purpose and asked to agree upon a suitable EVAS/ChEVAS plan. The primary outcome was the percentage of FEVAR patients who were anatomically suitable for EVAS/ChEVAS. The secondary outcomes were a comparison of seal zones, number of target vessels, and device cost.

Results: Sixty patients, 54 males with median age of 76.3 years (IQR 71.7–79.7) and aneurysm diameter of 62.0 mm (IQR 59.3–69.0) were included. An EVAS-based intervention was possible in 56 (93%). The median seal zone was significantly more distal in EVAS/ChEVAS vs. FEVAR (median zone 8 vs zone 7, $Z = -6.650$, $p < 0.001$). Less target vessels were involved by EVAS/ChEVAS vs FEVAR (Median 2 vs 3, $Z = 5.908$, $p < 0.001$). The cost of the EVAS/ChEVAS device was 66% that of the FEVAR device.

Conclusion: EVAS interventions are anatomically applicable to most patients undergoing FEVAR. Seal zones or target vessel numbers should not be used as surrogates of anatomy when comparing outcomes of ChEVAS and FEVAR.

707.2

Use of endoanchors in the treatment of intraoperative type Ia endoleaks after EVAR with short necks: mid-term results

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Purpose: Aim of the study was to evaluate the mid-term performance of Heli-FX EndoAnchors for the treatment of type Ia endoleak in the completion angiography of endovascular aneurysm repair (EVAR).

Material and methods: Prospectively collected data from 795 patients undergoing EVAR between November 2007 and May 2015 were retrospectively reviewed. Inclusion criterion was the presence of type Ia endoleak in the completion angiography, which was treated directly by endoanchoring. Clinical and radiological data were retrospectively assessed. Primary endpoint was technical success, defined as successful placement of all EndoAnchors without

evidence of endoleak in the final angiography (CTA). Secondary end-points were aneurysm-related reinterventions, overall mortality, and aneurysm shrinkage.

Results: Seventeen patients (n=17, 1.9%) were included in the present study. Median neck length amounted to 8 mm (interquartile ratio, IQR, 6–9) and mean infrarenal angle to $44^{\circ} \pm 21^{\circ}$. Technical success amounted to 65% (n=11/17). After a mean follow-up of 24 ± 13 months, all patients were free from type Ia endoleak (88% at 6, 94% at 12, and 100% at 24 months). A single reintervention was performed to treat a type II endoleak with a liquid embolic agent. No aneurysm-related deaths were observed. The mean maximal aneurysm diameter decreased significantly (58 ± 11 mm versus 53 ± 11 mm, $P=0.032$).

Conclusion: Use of the Heli-FX EndoAnchors in the treatment of intraoperative type Ia endoleaks after EVAR shows persistent type Ia endoleak in almost 35% of patients, which disappeared in the 2-year CT follow-up in all cases. Possible explanation for this phenomenon could be the change from high to low flow type Ia endoleaks after the use of Heli-FX system.

707.3

Multi-centric evaluation of 111 open chimneys for endovascular repair of juxtarenal abdominal aortic aneurysms with discrepant renal arteries

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Purpose: Evaluate the technical feasibility and mid-term results of endovascular repair of juxtarenal aneurysms using the "open chimney" technique (revascularization of visceral arteries using parallel bare self-expanding stents).

Material and methods: A retrospective multi-centric (12) study was conducted from 2010 to 2016. High-risk patients, ineligible for open surgery/exclusive fenestrated approach, with ≥ 1 open chimneys were included. The procedure could be associated with covered chimneys and "custom- or home-made" fenestrations.

Results: Ninety-six patients [75.3 ± 7.6 years; 82 men (85.4%); 13 emergent repairs (13.5%)] were implanted with 111 open chimneys (2 ± 1 target vessels/patient). The cannulation success rate was 100% and the technical success rate was 95.8% [3 type Ia endoleaks (ELs)]. There were 5 early thromboses (4.5%) of open chimneys and 31 acute kidney injuries (32.3%). In-hospital and 30-day mortality rates were 11.8% and 9.4% (11 and 9 patients), respectively. The mean follow-up was 10 months (range 1–53). The reintervention rate was 22.9% (4 type Ia, 2 type Ib, and 2 type II ELs). Type Ia EL rates were 13.5% at 1 month, 9.4% at 3 months, and 7.4% from the 6th month onwards. According to Kaplan–Meier analyses, the open chimneys' patency rate was 94.2% from the 3rd month onwards; survival rates were 81.4%, 79.5%, and 61.5% at 6, 12, and 36 months. Decrease (≥ 5 mm) or stability of the aneurysmal sac was observed in 38 and 32/72 patients (52.8% and 44.4%), respectively.

Conclusion: The use of open chimneys in juxta-renal aneurysms results in excellent reconstruction rates of the target arteries and acceptable technical success, patency and type I EL rates at mid-term follow-up. It may constitute an alternative to open surgery in high-risk patients anatomically ineligible for an exclusive fenestrated approach.

707.4

A 20-year experience in the endovascular treatment of abdominal aortic aneurysms (AAA): lessons learned

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Purpose: To report the 20-year experience in the endovascular treatment of abdominal aortic aneurysms (AAA).

Material and methods: From September 1996 to January 2017, 1212 patients with AAA (mean diameter 62.7 ± 11.2 mm) have been treated using different commercially available endoprostheses. In 60 patients, custom-made devices were used. Procedures were performed electively (N=897) and during emergency (N=315) with patients under general (N=227), epidural (N=415) or local (N=570) anaesthesia. A bilateral surgical access was used in 412 patients and monolateral access was used in 227 patients. In the remaining 573 patients, a complete percutaneous approach was used. Only patients with a minimum follow-up of 6 months were evaluated.

Results: Before deployment, the hypogastric artery, IMA, lumbar arteries and accessory renal arteries were embolised in 212, 145, 15 and 87 patients, respectively. Technical success was obtained in 1107/1212 patients (99.2%). The mean procedure time was 82.7 ± 15.3 minutes. A 30-day mortality rate of 7.8% (142/1212) was recorded. Twenty-nine (2.6%) surgical conversions were performed. The minor complications rate was 5.5% and the major complications rate was 6%. Endoleaks occurred in 123/1107 patients (11.1%): perioperative N=45, early N=37 and late N=41. The sac increased in 64 patients (5.7%), remained stable in 310 patients (28%) and shrank in 238 patients (21.4%).

Conclusion: With the passage of time, results have tremendously improved due to advancements in procedures, patient selection and development of new different endoprostheses.

707.5

Mid-term evaluation of morphological changes in pararenal aortic aneurysms treated with the chimney endovascular technique using computed tomography angiography

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Purpose: To report the morphological changes of complex pararenal aortic aneurysms after treatment by the chimney endovascular technique (ch-EVAR).

Material and methods: Twenty-one patients with pararenal aortic aneurysms who underwent ch-EVAR and had two postoperative CT angiography (CTA) studies with an interval of at least 24 months between them were included in the study. CTA-based evaluations were made using three-dimensional (3D) reconstructed images.

Results: During a mean follow-up of 2.7 years (range 2.0–5.75), the mean migration of the aortic stentgrafts amounted to 2.76 ± 2.4 mm. The migration distance per year was 1.15 mm. The mean regression of the aortic aneurysm sac diameter was 3.25 mm ($p=0.048$). Large aneurysms with a diameter of more than 75 mm were associated with migration of the aortic graft of ≥ 5 mm. The right renal artery angle moved significantly upward by 6.54° ($p=0.025$) and the right renal proximal chimney stentgraft moved significantly downward

by 7.83° ($p=0.042$). The left renal artery angle also moved upward by 3.04° ($p=0.667$) and the left renal proximal chimney stentgraft moved downward by 6.95° ($p=0.133$).

Conclusion: CTA assessment over the mid-term showed statistically significant shrinkage of the aortic aneurysm sac and stable position of the aortic stentgraft (migration of less than 5 mm). A larger number of patients and longer-term CT follow-up data are needed to gain further insight of the interaction of the chimney graft with the aortic endograft and its consequences.

707.6

Low radiation and contrast dose CTA in EVAR assessment

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Purpose: To prospectively evaluate the image quality and diagnostic accuracy of low kV and low contrast media (CM) CT angiography (CTA) for the assessment of abdominal endovascular aortic repair (EVAR).

Material and methods: The study was approved by the local ethics committee. Fifty patients referred for CTA after EVAR were prospectively randomized in two groups. The low dose group (LD) performed CTA by using 80 kV and mAs modulation, injecting 50 mL of iomeprol (Iomeron 400, Bracco@4mL/sec). The standard dose group (SD) performed CTA by using 120 kV and mAs modulation, injecting 80 mL of iomeprol@4mL/sec. All images were reconstructed using adaptive statistical iterative reconstruction (ASIR). Subjective image quality has been evaluated using a 4-point Likert scale. Objective image quality has been evaluated calculating the signal-to-noise ratio (SNR) and contrast-to-noise ratio (CNR). The presence and type of endoleak, infection, and occlusion were reported. When available, angiography was used as the gold standard.

Results: Forty-seven patients completed CTA; 23 were enrolled in the LD group (21 men, mean age 73.9 ± 6.5 years; mean BMI 27.8 ± 4.5) and 24 in the SD group (20 men, mean age 75.1 ± 7.3 years; mean BMI 28.5 ± 4.8). Subjective image quality score was 3.3 in LD versus 3.5 in SD ($p<0.05$). Mean CNR was 6.6 ± 3.7 and 9.5 ± 2.4 and mean SNR was 11.1 ± 4.9 and 10 ± 2.3 in LD and SD, respectively ($p=0.07$ and $p=0.5$). The mean dose-length product (DLP) was 1315.2 mGycm (LD) and 2491.8 mGycm (SD) ($p<0.003$). A total of 7 endoleaks were registered ($n=4$ in group 1).

Conclusion: Low kV and low CM CTA for EVAR assessment result in a significant reduction in radiation and contrast media dose without affecting the image quality and accuracy.

Free Paper Session

Vascular intervention: renal and visceral arteries

708.1

Establishment and maintenance of hypertension intervened by RDN: an experiment on hypertensive canine

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Purpose: To observe the effects of renal denervation (RDN) on the establishment and maintenance of blood pressure in hypertensive canine models.

Material and methods: Fifteen canines were equally randomized into 3 groups. Canines in group A and B were treated with RDN and then followed with baroreceptor unloading (BU, a technique in which the carotid arteries were constricted to establish stable hypertension) or sham BU, respectively. BU was performed and followed with RDN in canines in group C. The results were recorded in terms of arterial pressure change and morphological changes in the renal arteries based on computed tomographic angiography (CTA) at pre-BU, and/or pre-RDN, 7, 28, and 42 days after RDN, respectively, and the pathological changes in the renal arteries 42 days after RDN.

Results: There were no procedure-related complications after RDN. There were no significant changes in arterial pressures between groups A and B at each time point [systolic arterial pressure (SAP): 145.1 ± 4.6 vs 147.5 ± 11.9 , 134.2 ± 6.0 vs 136.4 ± 12.2 , 133.9 ± 8.4 vs 147.4 ± 16.5 , 147.9 ± 13.1 vs 145.4 ± 12.5 , $p>0.05$]. SAP did not change significantly in each time point in groups A and B. SAP increased significantly after BU in group C (148.4 ± 1.4 mmHg vs 183.5 ± 5.5 mmHg, $p<0.01$) and decreased after RDN (145.1 ± 15.4 mmHg vs 183.5 ± 5.5 mmHg, $p<0.01$).

Conclusion: RDN before BU could prevent the development of hypertension. RDN could decrease the arterial pressure that was increased by BU.

708.2

Cryoablation for renal angiomyolipoma: is it a feasible and safe treatment?

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Purpose: Renal angiomyolipomas (RAML) are benign hamartomatous tumors. Angioembolization is often the preferred treatment for patients with RAML, but regrowth and postembolization hemorrhage remain a concern. Cryoablation (CA) has been reported to be a safe and feasible minimally invasive nephron-sparing alternative. The aim of the present study was to investigate the feasibility, safety, and efficacy of CA in patients with RAML.

Material and methods: Sixteen consecutive patients (5 males and 11 females) treated with CA for a total of 19 RAML lesions from 2008 to 2013 were included. One patient with a single lesion was lost to follow-up and thus excluded from the follow-up analysis.

Results: In 7/19 lesions, CA was performed as laparoscopic-assisted cryoablation, and in the remaining 12 lesions, CA was performed as percutaneous ultrasound cryoablation. The mean patient age was 46 years (IQR 30–63). In all cases, the procedure was successfully performed with no conversion to open surgery. One patient developed a hematoma in the left flank and required two portions of blood, and one patient had minor seepage from the laparoscopic port hole and developed subcutaneous emphysema. Follow-up imaging consisted of CT or MRI. Mean follow-up was 25 months (IQR 18–33). Mean maximum tumor volume was reduced from 50.07 cm^3 (IQR 9.8–67.7) to 12.17 cm^3 (IQR 0.2–19.0), $p=0.05$. No patients presented with retroperitoneal hemorrhage during follow-up.

Conclusion: CA appears to be a feasible and safe modality for the treatment of RAML. This series demonstrates a low postoperative complication rate and satisfactory tumor control.

708.3

Initial experience with the E-ventus® stentgraft for endovascular treatment of visceral artery aneurysms

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Purpose: To evaluate the safety and efficacy of a novel balloon-expandable stentgraft for the endovascular treatment of visceral artery aneurysms (VAAs).

Material and methods: Between September 2014 and January 2017, seven patients (69±15 years) with true (n=4) and false (n=3) VAAs were treated by implanting balloon-expandable stentgrafts (E-ventus®, Jotec, Germany) using a trans-femoral (n=2) or -brachial (n=5) vascular access. The stentgrafts were placed without prior passing of the landing zone with a sheath. In 3/7 patients, additional coil or plug embolization was performed to prevent retrograde VAA perfusion. Endpoints were technical success (defined as delivery and implantation of the stentgraft in the intended position with complete exclusion of the VAA), peri-procedural complications, and patency.

Results: Mean diameters of true VAAs (splenic artery: n=2, coeliac trunk: n=2) and false VAAs (common hepatic artery: n=2, gastroduodenal artery: n=1) were 26±9 mm and 19±11 mm, respectively. False VAAs presented as emergencies with active bleeding. Technical success was 100%. One peri-procedural complication was noted: pseudoaneurysm of the accessed brachial artery. After a mean follow-up period of 218 days, all stentgrafts were patent. One patient died 2 days after the procedure owing to multiorgan failure, which was judged to be not procedure related.

Conclusion: The endovascular treatment of true and false VAAs using the E-ventus® stentgraft is safe and effective. The flexibility of the stentgraft and shaft allows implanting without passing the lesion with a sheath, thereby enabling the treatment of distal as well as complex visceral lesions. Long-term studies using a larger patient cohort are needed to confirm these findings.

708.4

Endovascular treatment of splenic artery aneurysms: a multicenter retrospective review

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Purpose: Our objective was to review our 12-year multicenter experience in the endovascular management of true and false splenic artery aneurysms (SAAs).

Material and methods: Between August 2003 and December 2015, 104 patients (59 males) with a mean age of 32 years (range: 19–64) presented with SAAs. Overall, 68 (65.4%) patients presented with false aneurysms and 36 patients presented with true aneurysms with various endovascular techniques employed to treat a total of 144 aneurysms. Charts and pre-/intra-/postoperative diagnostic imaging results were reviewed, assessing patient demographics, medical comorbidities, laboratory findings, aneurysmal characteristics, radiological findings, procedural parameters, endovascular techniques/embolic agents, and potential complications. Average duration of follow-up was 5.3 years (range: 1.0–13.5). Primary outcomes were procedural success, clinical outcomes, and complication rates.

Results: Forty-six (44.2%) patients presented with intrasplenic pseudoaneurysms, all of which were related to trauma. Etiology of true aneurysms was uncertain in 44.4% (N=16) of cases with atherosclerotic disease with an underlying history of hypertension resulting in the most common known etiology comprising 13 (36.1%) cases. Mean aneurysmal diameter was 2.1 cm (range: 3–88). Proximal coil embolization was the most common embolic approach (44, 64.7%) for the treatment of false aneurysms, with the sandwich technique favored for the treatment of true aneurysms. Six stents were deployed (1 stent in a false aneurysm). Technical success was achieved in 98.1% of cases, with minor complications occurring in 45 (43.3%) cases and major complications occurring in 6.7% of cases. One post-procedural rupture was recorded, resulting in death.

Conclusion: The endovascular management of SAAs results in excellent technical and clinical outcomes, with few complications.

708.5

Percutaneous mesenteric artery stenting as the first-choice treatment in occlusive mesenteric artery disease in patients with mesenteric ischemia

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Purpose: Primary percutaneous mesenteric artery stenting (PMAS) of occluded mesenteric arteries remains controversial. It is presumed to be technically challenging with a higher risk of complications and compromised patency rates compared to PMAS of stenotic arteries. However, data supporting these presumptions are lacking. This study assesses the technical success and patencies of PMAS of occlusive and stenotic mesenteric artery disease.

Material and methods: We evaluated all consecutive patients treated with primary PMAS in our hospital, which is a nationwide referral center for mesenteric ischemia, between November 2004 and November 2012. Technical success; complications; and primary (PP), primary-assisted (PAP), and secondary (SP) patencies were statistically analyzed using per vessel analysis, comparing occluded and stenotic arteries.

Results: Primary PMAS was attempted in 125 occluded and 268 stenotic mesenteric arteries. Technical success of PMAS was 50.4% (CI 41.8%–59.0%) in occluded and 93.3% (CI 89.6%–95.7%) in stenotic vessels. Complication rate was low. The follow-up cohort included 40 occluded and 147 stenotic vessels (median follow-up 32 months). There was a significant difference in PAP (p<0.005), but no significant difference in PP and SP. Although PP for treated occlusions was slightly decreased (1-year PP 70.0% versus 78.6%; 5-year PP 28.9% versus 48.9%; p=0.066), SP remained excellent (1-year SP 97.5% versus 98.5%; 5-year SP 86.7% versus 95.8%; p=0.286).

Conclusion: PMAS in occlusive mesenteric artery disease is technically successful in more than 50%. Although re-occlusion is more likely to occur in occlusive disease, SP remains excellent. We advocate PMAS as a first-choice treatment, even in occluded arterial mesenteric ischemia.

708.6

Status update on EmboCoH visceral artery aneurysm international multi-central registry

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Purpose: To report an update on the status of EmboCoH international multi-central registry which aims toward collection of a large multi-central longitudinal sample on visceral arterial aneurysms.

Material and methods: EmboCoH is an international multi-central registry of visceral artery aneurysms which was started in 2014. It is an observational registry with no clinical decision mandated by the study. For patient enrollment, institutional review board approval and consent is needed, although only de-identified data are used. Currently, institutions from 5 different countries are involved in this project. Collected data include pre-procedural clinical presentation, fluoroscopy time, procedure time, aneurysm information (location, size, and type), embolization technique and material, immediate and long-term results, and complications.

Results: We will report the results on 92 patients. This includes 55 patients in the registry and 37 patients from the University of Minnesota registry. A total of 45 visceral artery aneurysms and 47 pseudoaneurysms were included. The most common site for visceral aneurysms in the series was the splenic artery followed by the renal and gastroduodenal arteries. This presentation includes information on aneurysm characteristics, embolization technique and material, technical success, long-term follow-up results, and complications as well the need for re-intervention.

Conclusion: Visceral arterial aneurysms are uncommon and heterogeneous vascular pathologies with no consensus on patient selection and treatment technique among interventionists. EmboCoH is an international multi-central registry aiming toward collection of a large longitudinal sample to facilitate more informed treatment decisions in the future.

Free Paper Session Biopsy

709.1

Performance of a new blunt-tip coaxial needle for percutaneous biopsies or drainages of "hard-to-reach" targets

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Purpose: To present the performance of a new blunt-tipped coaxial needle (SoftGuard) applied to approach "hard-to-reach" targets undergoing percutaneous image-guided biopsies or drainages.

Material and methods: Between August and December 2016, all consecutive patients presenting with "hard-to-reach" (<10mm from critical nearby structures such as vessels, nerves, bowel, or parenchymal organs) solid lesions needing biopsy (Group A) or abscesses needing drainage for septic reasons (Group B) were prospectively included. Patient and lesion features as well as technical and clinical data were collected and analyzed.

Results: Twenty-six patients (18 male, 8 female, mean age 59.81 ± 17.53 years) were enrolled in group A and 9 (6 male, 3 female, mean age 58.33 ± 13.8 years) in group B. Mean number of SoftGuard repositioning was 1.19 and 1 for groups A and B, respectively. Technical success was reached in 92.3% cases from group A and 100% cases from group B. Five (19.2%) minor complications were noted in group A, including 4 small self-limiting pneumothoraces and one small self-limiting peripancreatic hematoma. Patients from group B reported no complications. Histological results in group A accounted for 95% sensitivity, 100% specificity, and 95.2% diagnostic accuracy. In group B, mean postoperative reactive C-protein was 41 ± 48.3 mg/L (vs. 155 ± 117.5 mg/L at baseline; P = 0.004).

Conclusion: SoftGuard blunt-tipped needle is safe and effective when applied as a coaxial working cannula for percutaneous biopsy or drainage of "hard-to-reach" lesions.

709.2

A prospective, intra-patient, blinded study comparing 14-fragment random prostatic biopsy with mpMRI-TRUS fusion biopsy

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Purpose: To compare the incremental diagnostic value of real-time mpMRI-TRUS fusion prostatic biopsy with that of conventional 14-fragment sextant-extended biopsy in an operator-blinded controlled study using the same group of patients.

Material and methods: UNI IRB approved this prospective blinded study that compared TRUS-guided random and real-time mpMRI-TRUS fusion prostatic biopsies among 100 consecutive men. We included men with a clinical and laboratorial suspicion of prostate cancer and Likert score ≥ 3 mpMRI. Patients previously diagnosed with prostate cancer were excluded. All patients were subjected to 14-fragment TRUS-guided biopsy (mpMRI data was operator blinded), followed by mpMRI-TRUS fusion-targeted biopsy.

Results: An overall increase in cancer detection rate from 56% using random technique to 62% using TRUS-mpMRI fusion biopsy was observed; incremental diagnosis was relevant for clinically significant lesions (Gleason score ≥ 7) because more than 10% of clinically significant lesions were diagnosed using the fusion biopsy technique (40 versus 50 patients). Diagnosis upgrade occurred in 5 patients (5.0%) who demonstrated negative results using random biopsies but clinically significant tumors using the fusion biopsy technique and in 5 patients (5.0%) who were diagnosed with clinically significant tumors using fusion biopsies and clinically insignificant tumors using random biopsies (p = 0.0010).

Conclusion: The mpMRI-TRUS fusion prostatic biopsy technique demonstrated incremental diagnostic value and better detection of clinically significant prostate cancers compared with conventional random biopsy in the same group of patients.

709.3

Systemic air embolism after CT-guided lung biopsy: a not-so-rare complication

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Purpose: To assess the incidence of systemic air embolism after transthoracic lung biopsy, and to determine possible influencing factors.

Material and methods: Overall, 559 CT-guided lung biopsies performed between April 2014 and May 2016 were retrospectively evaluated. Variables analyzed were age, sex, spirometry data, emphysema on CT, target lesion characteristics (location, depth, and nodule size and type), patient position, length of intrapulmonary biopsy path, and number of pleural needle passes. Procedural air embolism and other associated complications (hemoptysis and pneumothorax) and their management and consequences (length of hospitalization and additional action) were recorded. Clinical and CT data of patients with and without air embolism were compared using Chi², Fisher, or Wilcoxon test.

Results: Twenty-seven (4.8%) patients had air embolism on post-procedure CT. All but one were asymptomatic. Post-biopsy CT detected pneumothorax in 4/27 and alveolar opacities in 10/27. Management included mobilization prohibition, oxygen therapy, respiratory and neurologic monitoring, and repeated CT scans for the 27 patients.

The length of stay was extended for 24 hours in 2 patients, including the only symptomatic patient who was also treated by hyperbaric oxygen therapy. Factors potentially impacting occurrence of air embolism were depth of the lesion ($p=0.074$), length of biopsy path ($p=0.036$), patient in procubitus or right-side decubitus position ($p=0.011$), and air flow obstruction on spirometry ($p=0.09$).

Conclusion: When systematically tracked down by the post-biopsy CT images, air embolism is a not-so-rare complication. Recognizing this potentially fatal complication allows to minimize its morbidity by the adapted management.

709.4

Comparison of complications rates between multiparametric magnetic resonance imaging–transrectal ultrasound (mpMRI–TRUS) fusion and conventional sextant-extended prostatic biopsies

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Purpose: To compare the complication rates between random transrectal ultrasound (TRUS) prostatic biopsy and random + fusion multiparametric magnetic resonance imaging (mpMRI)–TRUS prostatic biopsy techniques and identify possible features associated with an increased incidence of complications.

Material and methods: The UNI Institutional Review Board approved our retrospective study that compared TRUS-guided random and mpMRI–TRUS fusion prostatic biopsy complication rates among 967 consecutive men. We included men with clinical and laboratorial suspicion of prostate cancer and Likert score ≥ 3 mpMRI. In total, 319 patients were subjected to TRUS prostatic biopsy and 648 patients underwent mpMRI–TRUS fusion prostatic biopsy. Complications were divided into immediate (those that occurred during hospital observation period) and late (those that occurred within 5 days after biopsy).

Results: In total, 17 grade 2 and 3 complications were noted among patients subjected to TRUS-guided systematic or mpMRI–TRUS fusion prostatic biopsies. Grade 4 and 5 complications were not observed. Among patients who underwent TRUS prostatic biopsy, 6 (1.9%) developed complications, and among those who underwent mpMRI–TRUS fusion prostatic biopsy, 11 (1.7%) developed complications after the procedure ($p = 0.873$), with no difference in the distribution of early and late complications between these two groups ($p > 0.999$).

Conclusion: The complications were rare and well-defined in both groups, with no critical clinical outcomes and no significant difference in complication rates between the two groups. Despite a high incidence of cores close to the prostatic urethra and additional cores taken, no feature associated with an increased incidence of complications after mpMRI–TRUS fusion prostatic biopsy was identified.

709.5

CT-guided transjugular liver biopsy: phantom experiments

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Purpose: To assess the feasibility and accuracy of CT-guided transjugular biopsy in an in vitro model.

Material and methods: A phantom was designed for performing transvascular biopsies, with targets of various sizes made

from acrylic embedded in soft paraffin. A conventional vascular Y-prosthesis served as a vascular bed. All procedures were performed with a commercially available transjugular puncture set with a semi-automated core biopsy needle (Cook, Bloomington, IN). After a target lesion was identified, the procedure was performed under CT guidance. After the biopsy, a control scan was obtained and the distance from the needle tip to the centre of the target lesion was measured in three directions in space. A total of 50 punctures were performed via the left ($n=25$) or the right branch ($n=25$) of the Y-prosthesis. Data was quantitatively analysed.

Results: All CT-guided punctures were successfully completed. Size of the targeted lesions ranged from 8.5 to 16 mm. In only four lesions, the exact centre of the lesion was met. The mean distance from the lesion centre was 9.5 ± 5.0 mm and from the lesion surface was 5.3 ± 3.3 mm. There was no correlation between lesion size and precision of the puncture ($p=0.34$), but a correlation between number of performed procedures and deviation from the target ($r=0.62$) was observed, indicating a learning curve.

Conclusion: CT-guided transjugular liver biopsy appears to be feasible. The precision is not yet sufficient for targeting lesion <20 mm in diameter, but there is a learning curve indicating that smaller lesions may be accessible with sufficient training.

709.6

Comparison of diagnostic efficacy with 18-gauge and 20-gauge ultrasound-guided core needle biopsies for thyroid nodules

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Purpose: To compare the diagnostic efficacy of 18-gauge and 20-gauge ultrasound (US)-guided core needle biopsies (CNB) for diagnosis of thyroid nodules.

Material and methods: We included 81 consecutive thyroid nodules diagnosed by US-guided CNB with a 20-gauge core needle from September 2014 to November 2015 and 86 consecutive thyroid nodules diagnosed by US-guided CNB with 18-gauge core needle from December 2015 to September 2016 at one tertiary hospital. The diagnostic results of CNB were categorized based on the six-tier CNB pathology reporting system. The rate of inconclusive results, including non-diagnostic or atypia/follicular lesion of undetermined significance (AUS/FLUS), was compared between the 2 types of CNB needle. Diagnostic values of CNB for malignancy were assessed in nodules with the final diagnosis. The number and type of complications were also described in the included patients.

Results: The 18-gauge CNB showed lower rate of non-diagnostic result (1.2% vs. 8.6%, $P=0.026$) than the 20-gauge CNB; however, AUS/FLUS (27.9% vs. 28.4%, $P=0.176$) and inconclusive result (29.1% vs. 37.0%, $P=0.540$) were not significantly different. A total of 43 nodules of the 20-gauge CNB and 46 nodules of the 18-gauge CNB were finally diagnosed. With the criteria of category 5 and 6, the 18-gauge CNB showed a significantly higher sensitivity (75% vs. 66.7%), negative predictive value (83.9% vs. 75.9%), and accuracy (89.1% vs. 83.7%) for malignancy than the 20-gauge CNB. There were no major complications in all patients.

Conclusion: The CNB with 18-gauge core needle will be more effective for the diagnosis of malignancy in thyroid nodules than that with 20-gauge core needle.

News on Stage Session

Embolisation News on Stage

1204.1

Sublingual glyceryl trinitrate improves prostate artery visibility on CTA performed preoperatively for prostate artery embolization

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Purpose: Prostate artery embolization (PAE) is emerging as a safe and efficacious treatment for symptomatic benign prostatic hyperplasia (BPH) but remains a challenging procedure principally due to the complex and variable anatomy of the prostatic arteries. We present a case-control study investigating the use of sublingual glyceryl trinitrate (GTN) to improve the quality of CTA performed preoperatively for PAE.

Material and methods: Patients were identified from an ongoing prospective cohort of patients undergoing PAE (STREAM Trial). Cases where patients received pre-CTA GTN were compared with those where consecutive patients did not receive GTN. CT angiograms were examined for prostate artery visibility, contrast density (Hounsfield units), and cross-sectional area. These were also correlated with PAE technical success, screening time, and radiation dose. **Results:** A total of 32 prostate arteries were examined on CTA. GTN administration was shown to significantly improve the proportion of scans confidently demonstrating the whole prostate artery (88% vs. 44%, OR=0.1, P=0.023) and the cross-sectional area of the prostate artery (2.5 vs. 1.7mm²) (95% CI=0.08–1.6, P=0.03). There was also a significant reduction in the mean procedural dose in patients receiving GTN (1.5 vs. 2.7Gy, P=0.008). There was no significant difference in prostate artery density, screening time, or technical success. No adverse events were recorded in either group.

Conclusion: CTA is a highly useful tool for the procedural planning of PAE. The quality of preoperative CTA with regards to confidently demonstrating the prostate artery anatomy is significantly increased by the administration of sublingual GTN without any increase in adverse events.

1204.2

Are formal urodynamic studies an essential investigation prior to prostate artery embolisation (PAE)?

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Purpose: Despite promising early results using PAE, some patients fail to improve irrespective of technical success. Therefore, optimal patient selection is paramount to ensuring good outcomes; however, not all centres conduct formal urodynamic studies to confirm bladder outflow obstruction (BOO). Thus, we explored if formal urodynamics was a useful predictor of sustained symptomatic improvement.

Material and methods: Patients undergoing prostate artery embolisation from June 2012 to January 2016 were prospectively followed up. All patients underwent formal urodynamic assessment to confirm BOO in addition to completing an International Prostate Symptom Score (IPSS) questionnaire. Patients subsequently completed non-formal urodynamic assessment and IPSS questionnaires

at 3, 6 and 12 months. Pre-embolisation variables were assessed for correlation with IPSS change at 12 months using the Pearson's bivariate correlation.

Results: Eighty-two patients with confirmed BOO were treated with PAE (mean age 64.5 years, mean Abrams–Griffiths score 77.7±33.0, mean post-void residual (PVR) 178.8±153.9, mean Qmax 8.1±3.0, mean IPSS 22.8±5.3) and were followed up for 12 months. Mean PVR and Qmax improved significantly (PVR 101.3±86.4, p=0.001; Qmax 12.1±7.0, p=0.037) and IPSS reduced to 12.1±7.5. A high Abrams–Griffiths score pre-PAE correlated with a better symptomatic outcome at 12 months (r=0.37, p=0.002), as did detrusor pressure at maximum flow rate (r=0.33, p=0.048). Pre-PAE PVR and Qmax did not correlate well with symptomatic outcomes (r=−0.10, p=0.55 and r=−0.10, p=0.50, respectively).

Conclusion: Formal urodynamic assessment is considerably more reliable at identifying good candidates for PAE; therefore, it should be routinely performed to ensure optimal outcomes.

1204.3

A common woodchuck (*Marmota monax*) as a model for hepatic embolization

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Purpose: Hepatocellular carcinoma (HCC) can be treated by a variety of local and regional interventional therapies, but we may benefit from a more predictive preclinical model to better understand, study, and treat HCC. This study clarifies the value of utilizing woodchucks with HCC for the study of hepatic embolotherapies.

Material and methods: Animal Model Woodchuck neonates commonly infected with woodchuck hepatitis virus develop neoplasms similar to human HCCs associated with hepatitis B. Woodchucks with and without tumor were provided by Northeastern Wildlife, Inc. (Harrison, ID). The animal study was approved by the NIH Clinical Center IACUC and performed in accordance with US regulations. Embolic Procedure Animal livers were examined via ultrasound and CT prior to instrumentation. A 3-F introducer sheath was placed in the femoral artery, and 1.7–2.8-F microcatheters were guided by fluoroscopy to select hepatic arteries for diagnostic angiography.

Results: Embolic particles (40–150-µm radiopaque spheres, Biocompatibles UK LTD) were deployed until angiographic stasis was observed. uCT of the explanted liver was conducted. Analysis of segmented arteries provided a 3D geometric and anatomic definition of the tumor-negative and -positive liver. Gross pathology and histology was described. CT and US showed a solid hypervascular tumor without major pools of necrosis, as is common in other IR preclinical medium-sized animal models for liver tumors.

Conclusion: These data may help guide future studies using a more predictive HCC model for hepatic embolization. Additional research is needed to refine the methods and validate the model; however, a more realistic HCC model than previously described could be an informative surrogate for clinical research and may be more realistic than rodent or rabbit models.

1204.4

Embolization of the geniculate arteries is a safe and effective treatment for recurrent hemarthrosis following TKA

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Purpose: Recurrent hemarthrosis is a late complication in up to 1.6% patients following total knee arthroplasty (TKA). In the absence of intrinsic coagulopathy, the probable etiology is bleeding of the hypertrophic vascular synovium. The aim of this study was to evaluate the clinical outcome of patients referred to our center who underwent angiographic embolization of the geniculate arteries for the treatment of recurrent hemarthrosis following TKA.

Material and methods: We retrospectively studied a cohort of patients who were referred for embolization of the geniculate artery following TKA between August 2011 and September 2016.

Results: A total of 24 embolization procedures were performed on 14 patients. Seven (50%) of these 14 patients underwent one embolization procedure. Because of symptom recurrence, four patients underwent a repeated procedure and three patients underwent a third procedure. All embolization procedures were technically successful. Two patients reported an inguinal hematoma that healed without further treatment. At a mean follow-up of 26.8 months, clinical success was achieved in 12 of the 14 patients (86%).

Conclusion: Embolization of the geniculate arteries in our study was a safe and effective treatment for recurrent spontaneous hemarthrosis following TKA. We report 100% technical and 86% clinical success rates. No patient experienced cutaneous ischemic complications even though reinterventions were performed in 50% patients. Our results showed that embolization could probably be the treatment of choice when conservative measures fail.

1204.5

CT liver perfusion for hepatocellular carcinoma nodule detection and follow-up after trans-arterial chemoembolization and comparison with hepato-specific contrast MRI: work in progress

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Purpose: To compare CT liver perfusion (CTLP) findings obtained using a dedicated processing tool with those obtained with MRI using gadoteric acid injection before and after trans-arterial chemoembolization (TACE) treatment.

Material and methods: Twenty patients (9 with cirrhosis) with 57 nodules, suspicious for hepatocellular carcinomas (HCCs) underwent CTLP on a 128 GE CT system. Perfusion maps of the mean slope of increase and blood flow were derived using CT-perfusion body processing tools. ROIs were appropriately drawn on non-treated HCCs or on partially treated tumors. MRI examination was performed on a 1.5-T system at ± 1 week after CTLP and included DWMRI images and dynamic contrast images acquisition (arterial/hepato-biliary phase) using gadoteric acid. HCC findings, when confirmed with invasive hepatic angiography (DSA), were treated by TACE. Follow-up was performed with CTLP and MRI.

Results: Forty-five HCCs were equally detected by both methods and were confirmed by DSA. Ten suspicious nodules ≤ 1 cm in size, detected by MRI, could not be found on CTLP or DSA. Two nodules seen in CTLP and MRI could not be found on DSA. Post-treatment follow-up was not statistically different ($p > 0.05$) for CTLP and MRI, but CT spatial resolution allowed better delineation/detection of viable tumor areas.

Conclusion: CTLP provides reliable perfusion maps which are useful in assessing untreated or percutaneously treated HCC lesions. There is some evidence that MRI has higher sensitivity in detecting suspicious sub-centimeter nodules, but this has to be confirmed with follow-up. CTLP seems to have higher specificity in diagnosing completely or partially treated lesions. DSA might fail in detecting small nodules from non-typical feeding arteries.

1204.6

When the prostatic artery does not originate from hypogastric branches, what to do for attaining good results in prostatic artery embolization?

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Purpose: The angiographic pelvic anatomy has a high variability, and its knowledge is crucial for PAE. The prostatic artery does not always originate from internal iliac artery branches (type-I–IV-USP classification) and can have less common origins (type-V). The purpose of this study is to assess, through a multicentric evaluation, the prevalence of type-V prostatic arteries and the technical changes and results of PAE.

Material and methods: Angiographic prostatic arteries (USP classification) were used to retrospectively assess type-V arteries in 444 PAE procedures. PAE was performed according to the PerFecTED technique with 100–300 or 300–500 μ m Embosphere microspheres in patients with BPH and LUTS. Cone-beam CT was used in every case.

Results: The prevalence of type-V was 15/441 (3.4%). When re-embolization was considered, type-V was observed in 21/444 (4.7%). One case was due to agenesis of the right internal iliac artery (0.2%) and the prostatic artery originating directly from the external iliac artery. In 6 patients, type-V arose from the accessory internal pudendal (1.4%), in 4 patients, from the inferior epigastric artery (0.9%), in 2 patients, from the inferior gluteal artery (0.4%), in 1 patient, from the inferior mesenteric artery (0.2%), and in another patient, from the trifurcation of the internal iliac anterior trunk (0.2%). In cases of re-PAE, type-V was observed in 5 (1.3%) cases from the accessory internal pudendal and in 1 case (0.2%) from the inferior gluteal artery.

Conclusion: The knowledge of angiographic anatomy is imperative to PAE success. Not recognizing type-V prostatic artery can lead to unnecessary catheterization of multiple vessels, which increases the procedure time and use of mdc and radiation exposure. Cone-beam CT should be used to confirm prostate vascularization and evitate non-target embolization. Good clinical results can be obtained through expert hands.

Free Paper Session

TIPS and portal vein intervention

1406.1

Transjugular intrahepatic portosystemic shunt through the left branch vs. the right branch of the portal vein in patients with refractory portal hypertension and cirrhosis

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Purpose: The transjugular intrahepatic portosystemic shunt (TIPS) is technically divided into TIPS through the left branch of the portal vein (TIPS-LBPV) and TIPS through the right branch of the portal vein (TIPS-RBPV). To compare outcomes of both techniques in patients with refractory portal hypertension and patients with advanced cirrhosis.

Material and methods: Sixty-two TIPS patients were randomly assigned to this study. They were divided into group 1 (31 patients) subjected to TIPS-LBPV and group 2 (31 patients) subjected to TIPS-RBPV. Both groups were prospectively followed up for 2 years after TIPS implantation.

Results: The incidences of overall encephalopathy and de novo encephalopathy in the TIPS-LBPV group were significantly lower than those in the TIPS-RBPV group during the follow-up ($P = 0.03$ and 0.046 , respectively). The incidences of rebleeding or reintervention and improvement of ascites were similar between groups ($P > 0.05$). Patients undergoing TIPS-LBPV required less rehospitalization and incurred less costs than those undergoing TIPS-RBPV ($P = 0.036$ and 0.039 , respectively). There was no significant difference between the two groups in survival based on a survival curve constructed according to the Kaplan–Meier method ($P > .05$).

Conclusion: TIPS-LBPV is more beneficial than TIPS-RBPV.

1406.2

Plug-assisted retrograde transvenous obliteration (PARTO) for gastric varices and hepatic encephalopathy: the role of cone-beam computed tomography during PARTO

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Purpose: To investigate the safety and efficacy of plug-assisted retrograde transvenous obliteration (PARTO) in the treatment of gastric varices and hepatic encephalopathy and to evaluate the role of cone-beam computed tomography (CBCT) performed during PARTO.

Material and methods: From March 2016 to December 2016, 18 patients who had undergone PARTO were retrospectively evaluated, 15 of whom had gastric varices (GV) and 3 had hepatic encephalopathy (HE). When afferent veins were identified on fluoroscopy, CBCT images were obtained. In patients with incomplete filling of gel-foam into GV, additional gelfoam was injected. Follow-up contrast-enhanced CT, upper intestinal endoscopy, and clinical and laboratory data were collected.

Results: PARTO procedures were technically successful in all 18 patients. In 2 patients, incomplete filling of gelfoam into GV was detected on CBCT; therefore, additional gelfoam was injected. No procedure-related complication was observed. Follow-up CT obtained within 1 week after PARTO showed complete thrombosis of GV and portosystemic shunt in all 18 patients. Seventeen patients who had more than a 2-month follow-up period showed marked shrinkage or complete obliteration of the thrombosed GV as well as

the portosystemic shunts on both CT and endoscopy. No case of variceal bleeding or HE was observed during a mean follow-up period of 181 (range, 46–318) days.

Conclusion: PARTO is technically simple and safe and is clinically effective in the treatment of GV and HE. In addition, CBCT can be considered as an adjunct tool to fluoroscopy during PARTO.

1406.3

Percutaneous transhepatic intrahepatic portosystemic shunt for variceal bleeding with chronic portal vein occlusion after splenectomy

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Purpose: To introduce a modified transjugular intrahepatic portosystemic shunt (TIPS), percutaneous transhepatic intrahepatic portosystemic shunt (PTIPS), and to evaluate its feasibility and efficacy in patients with variceal bleeding with chronic portal vein occlusion (CPVO) after splenectomy.

Material and methods: 24 cirrhotic patients with CPVO after splenectomy receiving PTIPS between 2010 and 2015 were enrolled in this retrospective study. Indication was variceal bleeding. Success rates, efficacy, and complications were evaluated, with comparison of pre- and post-portosystemic pressure gradient (PPG). Patients' clinical outcomes and shunt patency were followed periodically.

Results: PTIPS was successfully placed in twenty-two patients (91.7%) and failed in two. Mean PPG fell from 23.1 ± 6.1 mmHg to 12.4 ± 3.4 mmHg after successful PTIPS ($P < 0.05$). No fatal procedural complications were observed. During the median follow-up of 29 months, shunt dysfunction appeared in five cases with four rebleeding. Hepatic encephalopathy appeared in four cases. Three patients died due to rebleeding, hepatic failure and pulmonary disease, respectively. The other patients remained asymptomatic and shunt patency.

Conclusion: PTIPS is a modified TIPS procedure with high success rate, and it is safe and effective for variceal bleeding with CPVO after splenectomy.

1406.4

Outcomes of percutaneous portal vein intervention in a single UK paediatric liver transplantation programme

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Purpose: To describe the mid and long-term outcomes of treatment of portal vein (PV) stenosis/thrombosis following paediatric liver transplantation.

Material and methods: 227 children received 255 transplants between 01/11/2000 and 30/09/16. Median age at transplantation was 3.1 years (range 0.05–17.75). 30 patients developed portal vein stenosis or thrombosis: 7 patients had operative PV reconstruction, 2 had no treatment, and 21 had percutaneous intervention. Retrospective clinical, procedural and outcome data on the latter 21 patients was collected and is presented.

Results: 21 patients, median age 1.72 years (range 0.4–16.2), underwent 42 procedures with percutaneous transluminal angioplasty (PTA) or stenting. 37 procedures were for PV stenosis and 5 for PV thrombosis. Treatment was with primary PTA, with stenting reserved

for suboptimal PTA result or restenosis <3 months. 28 procedures were performed with PTA and 13 with stenting. Median trans-stenotic pressure gradients of 10 mmHg (range 2-22) and 2mmHg (range 0-10) were measured pre and post intervention respectively. Technical success (>50% reduction in mean pressure gradient or absolute pressure gradient ≤ 4 mmHg) was achieved in 41 procedures. Failure to recanalise a thrombosed PV occurred in 1 procedure. There were no major procedural complications. Patients were followed up with serial Doppler ultrasound surveillance. Kaplan-Meier estimated median primary patency was 9.9 months, with primary assisted patency of 95% after median follow-up of 45.3 months (range 6.5-171.6).

Conclusion: With on-going surveillance, excellent patency rates can be achieved following percutaneous intervention for portal vein stenosis/thrombosis post paediatric liver transplantation.

1406.5

Portal vein malignant thrombus recanalisation by endoport RFA with metal stent placement (VesOpen procedure): rationale, technique, and application

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Purpose: A novel technique for portal vein (PV) malignant thrombus recanalisation is presented.

Material and methods: Eighteen patients underwent percutaneous endoport RFA treatment attempts. The PV tributary was accessed under US guidance; manipulation by a 5-Fr-diameter guiding catheter was used to conduct the guidewire across the blocked segment and portography was performed. Fifteen watts power was applied for 2 minutes using a bipolar endoluminal RF device (Habib™ EndoHPB, EMCision Ltd., London, UK) placed in the blocked PV segment with the guidewire. The number of RF application sessions depends on the tumour thrombus extent as shown on portography. After RF application, a self-expanding 14-mm-diameter vascular stent was positioned, and PV patency restoration was documented by final portography. The procedure was completed by procedure track RF ablation and/or coil embolisation.

Results: The procedure was completed in 13 (72.2%) cases; in 3 (16.7%) cases, we could not conduct the wire across the thrombus and in 2 (1.1%) cases, we could not conduct the RF device and the procedure was completed by stenting. The portal vein obstructed segment showed restored blood flow in all completed cases as documented by postprocedural portography, follow-up Doppler, and CT studies; this resulted in liver function improvement in 8 (61.5%) cases of the 13 cases with procedure technical success. Recanalised PV patency varied from 3 weeks to 22 months; 4 cases underwent successful TACE procedure after PV recanalization.

Conclusion: PV thrombus percutaneous recanalisation by endoport RFA with subsequent stenting is an effective technique and should be suggested as a possible treatment option for patients with HCC and PVT.

1406.6

Portal vein embolization with an ethylene-vinyl alcohol copolymer: a histopathological analysis

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Purpose: Presurgical portal vein (PV) embolization can be performed with different embolic agents, and the superiority of any of them has not been demonstrated. Preserving the function of the embolized liver is crucial when contralateral hypertrophy fails or when the patient cannot be operated on. An ethylene-vinyl alcohol-copolymer (EVOH) liquid embolic has not been deeply studied for this indication. The preliminary histological findings after PV embolization with EVOH are shown.

Material and methods: Histopathological analysis was performed on 12 right hepatectomies that had previously been embolized with EVOH 5 to 8 weeks before. A mean of 25.3 ml (range 13-36) of EVOH was used to fully occlude the right portal branches. Pre- and post-embolization PV hemodynamic studies were performed.

Results: Macroscopic occlusions in portal branches were complete without recanalization. Embolus consisted of black material surrounded by a reparative foreign body reaction composed of multinuclear giant cells without an acute inflammatory component. Microscopically, the embolic material systematically entered into the portal spaces. There was no disruption of the venous wall or migration of EVOH into the portal space or into hepatic parenchyma. No areas of cytolysis or regenerative phenomena were found in the liver tissue. Mean pre- and immediately postembolization PV pressure were 11 mmHg and 15.4 mmHg, respectively.

Conclusion: EVOH causes deep, extensive, and irreversible occlusions both on macro- and microscopic analysis. No cytolytic or regenerative phenomena have been identified. EVOH deposits and fibroinflammatory changes were limited to the occluded lumens and walls of either macro- or microscopic PV.

Free Paper Session Oncology 1

1407.1

Systemic T cell reactivity with respect to immune status and survival following ablative treatment of locally advanced pancreatic cancer by irreversible electroporation

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Purpose: For patients with locally advanced pancreatic cancer (LAPC), ablation through irreversible electroporation (IRE) may offer a novel therapeutic option. IRE induces apoptosis of tumor cells by creating nanopores through high-voltage electric pulses. This leaves much of the vasculature intact, allowing for effective immune infiltration. We investigated the induction of systemic antitumor immunity following IRE treatment in an immune monitoring pilot study.

Material and methods: In the first ten patients enrolled in a clinical trial exploring the safety and efficacy of percutaneous image-guided IRE in LAPC (the PANFIRE study), flow cytometric analysis was

performed to determine the frequency and activation state of various lymphocytic and myeloid subsets in pre- and post-treatment peripheral blood samples. Systemic T cell responses to the pancreatic cancer-specific antigens mesothelin and Wilms Tumor (WT)-1 were determined after in vitro stimulation at baseline and at 2 weeks and 3 months after IRE.

Results: A transient decrease in systemic regulatory T cell (Treg) frequencies and a simultaneous transient increase in activated T cells was found, consistent with the temporary lifting of Treg-imposed immune suppression after the IRE procedure. In addition, we found post-IRE boosting of a pre-existing WT-1-specific T cell response in two out of three patients as well as the de novo induction of these responses in another two patients. There was a trend pertaining to these WT-1 T cell responses being related to a longer overall survival ($p=0.055$).

Conclusion: Our findings are consistent with a systemic immune stimulatory effect of IRE and support the combination of percutaneous IRE with therapeutic immune stimulation.

1407.2

Prospective randomized controlled trial comparing efficacy of microwave ablation and radiofrequency ablation for the treatment of hepatocellular carcinoma in patients with a chronic liver disease

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Purpose: We performed the first prospective randomized multicentric study comparing the efficacy of radiofrequency ablation (RFA) and microwave ablation (MWA) in terms of local tumor progression and survival in patients with hepatocellular carcinoma (HCC) <4cm with chronic liver disease.

Material and methods: From 2011 to 2015, we prospectively randomized patients with HCC with ≤ 3 lesions of ≤ 4 cm non-surgical candidates. Our final groups consisted of group RFA ($n=73$, 15% female, 73% Child-Pugh A, 104 lesions treated) and group MWA ($n=71$, 17% female, 80% Child-Pugh A, 98 lesions treated). The primary outcome was rate of local tumor progression (LTP) at 1 year in the intention-to-treat analysis. Secondary outcomes included time to progression (TTP), incomplete treatment rate, safety, and survival time.

Results: We found no difference in LTP at 1 year of follow-up (RFA: LTP 2.8%; MWA: 5%, $p=0.65$) and at more than 20 months of follow-up (RFA: LTP 8.6%; MWA: 7.1%, $p=0.98$). Mean TTP was not different [RFA 15 months (SD: 7) and MWA 12 months (SD: 8); $p=0.48$]. This was confirmed by competing risk and inverse probability of censoring weighting analyses accounting for transplantation or death. Rate of incomplete treatment after one session of thermoablation was similar (4% and 5%, respectively; $p=0.93$). No major complication occurred. Two grade 4 complications (SIR classification) occurred, both in MWA group. Rate of survival at 20 months was 88.5% and 88.8%, respectively ($p=0.88$).

Conclusion: In a prospective randomized study with patients with HCC eligible for thermoablative treatment, we found no difference in local tumor progression and survival at more than 20 months of follow-up for lesions treated by RFA or MWA.

1407.3

Toward transpulmonary chemoembolization with degradable starch microspheres: systematic analysis of local and systemic effects in a porcine model

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Purpose: To systematically investigate local and systemic effects of transpulmonary chemoembolization (TPCE) with degradable starch microspheres (DSM) and doxorubicin. The long-term goal was to establish DSM-TPCE as a treatment option for pulmonary malignancies.

Material and methods: Nine pigs underwent TPCE via a catheter placed in the right or left lower lobe pulmonary artery (LLPA) and bland embolization (TPE) of the contralateral LLPA. Pulmonary arterial pressure, heart rate, and oxygenation were recorded immediately before and at 1, 3, 5, and 10 minutes after treatment. To investigate possible non-target embolization, animals underwent cerebral MRI. Animals were sacrificed after a contrast-enhanced chest CT for pathologic examination 12 (3), 24 (3), and 72 hours (3) after treatment.

Results: Mean injected DSM dose until stasis was similar in TPCE and TPE (4.2 ± 1.4 vs. 4.5 ± 1.5 mL). Pulmonary arterial pressure increased significantly 3 minutes after treatment (TPE: 17 ± 5 , before vs. 27 ± 7 mmHg, 3 minutes after the treatment and TPCE: 22 ± 6 , before vs. 36 ± 8 mmHg, 3 minutes after the treatment). No systemic cardiovascular effects, i.e., no change in heart rate or oxygenation pre- vs. post-TPCE or TPE were observed. No evidence of structural lung damage or permanent perfusion obstruction was observed on contrast-enhanced CT. No non-target embolization was found on cerebral MRI. Pathologic assessment revealed nonspecific local inflammation of the lung parenchyma, with increasing degree from 12 to 72 hours after treatment.

Conclusion: In this large-animal model, TPCE and TPE appear to be feasible and safe. Only a clinical, asymptomatic, mild increase in pulmonary arterial pressure was observed. Non-target embolization to the brain did not occur. TPCE as well as TPE did not cause significant damage to the normal lung parenchyma.

1407.4

Extended liver venous deprivation: the most powerful interventional radiology technique for liver preparation before major hepatectomy

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Purpose: Relatively high rates of post-hepatectomy liver failure (PHLF) have been reported after portal vein embolisation (PVE) or ALPPS despite adequate future remnant liver (FRL) volume. The FRL function is probably a better endpoint than the FRL volume for deciding if resection needs to be performed and can be calculated by ^{99m}Tc-mebrofenin hepatobiliary scintigraphy (HBS). The aim of this study was to assess the safety and efficacy of extended liver venous deprivation (eLVD), i.e. combination of right PVE and right and middle hepatic vein embolisation before major hepatectomy for FRL functional increase.

Material and methods: eLVD was performed in patients without cirrhosis referred for major hepatectomy in the context of small FRL (baseline FRL < 25% of the total liver volume or FRL function < 2.69%/min/m²). All patients underwent ^{99m}Tc-mebrofenin HBS and computed tomographic evaluations.

Results: Ten consecutive patients underwent eLVD before surgery for liver metastases (n=8), Klatskin tumour (n=1) and gall-bladder carcinoma (n=1). The FRL function increased by 64.3% (range=28.1–107.5%) at day 21. In patients with serial measurements, the FRL function was maximum at day 7 (+65.7±16%). The FRL volume increased by +53.4% at 7 days (+25±8 cc/day). Thirty-one days (range=22–45 days) after eLVD, 9/10 patients underwent resection. No PHLF ("50-50" criteria or peak bilirubin>7 mg/dL) was reported. Two grade II and one grade III complications (Dindo–Clavien classification) occurred. No patient died within 90 days following surgery.

Conclusion: eLVD is safe and provides marked and very rapid increase in liver function, unprecedented for an interventional radiology procedure. If these results are confirmed prospectively, this technique could replace PVE and challenge ALPPS.

1407.5

Preliminary characterization of a novel coaxial electrochemical ablation device

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Purpose: Electrochemical ablation (ECh) involves the percutaneous application of direct current to induce toxic pH changes in tumors. Compared with thermal ablation, ECh allows tailoring of the ablation margins by (i) limiting heat sink and (ii) enabling real-time magnetic resonance (MR) imaging to monitor the ablation. Here we describe the design of a novel ECh device and characterize its physical properties, including electrical resistance and magnetic susceptibility.

Material and methods: A coaxial ECh ablation device was designed using the CAD software. Electrical resistance for the device was measured using an ohmmeter. Magnetic susceptibility of the device was determined in a water bath phantom using the Siemens Avanto MR imaging system operating at 1.5Tesla.

Results: The prototype coaxial ECh ablation device consisting of a central platinum anode encased by a size and shape adjustable nitinol cathode cage was successfully manufactured. Electrical testing demonstrated an average internal resistance of 0.41Ω ($\sigma=0.059$) in the nitinol tines and 0.027Ω ($\sigma=0.0042$) in the platinum anode. MR images of the standalone device in a water bath phantom demonstrated minimal magnetic susceptibility, enabling a clear delineation of the ablation zone. The theoretical minimum diameter for the zone of ablation that is resolvable on MR imaging was calculated to be 17.9mm, given an average susceptibility artifact of 5.47mm in the tines ($\sigma=0.472$ mm) and 6.95mm in the anode.

Conclusion: A novel coaxial ECh ablation device was fabricated and demonstrated favorable physical properties to enable concurrent MR monitoring of the ablation with the potential for real-time adjustment of the ablation zone.

1407.6

Single-injection dual-phase cone-beam computed tomography (CBCT) demonstrates occult HCCs and influences patient's intraprocedural management in the course of TACE

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Purpose: To evaluate the role of dual-phase cone-beam computed tomography (DPCBCT) in indicating occult HCC and its impact on intraprocedural management in cirrhotic patients undergoing TACE.

Material and methods: Imaging timeline included a pre-procedural MDCT within 1 month from the planned DPCBCT treatment. Comparison of HCC lesion visualization among techniques was performed. Two interventional radiologists together evaluated the datasets assessing the presence/absence of lesion, their morphology, and enhancement pattern. Fifty-six cirrhotic patients referred for TACE for hypervascular HCC were prospectively enrolled. DPCBCT was performed in all patients with standard delay of acquisition (first phase after 8 seconds; second phase within 30 seconds), and intra-arterial injection was performed in the proper hepatic artery (parameter adjusted to patient's vasculature caliber).

Results: Pre-procedural MDCT detected 157 hypervascular nodules, of which 144 exhibited typical HCC behavior and 13 exhibited typical benign aspects. DPCBCT detected 185 nodules, confirming the 157 aforementioned lesions and 28 occult HCCs with typical behavior, thereby providing an occult HCC nodule rate of 19.4% and statistically significant difference in lesion visualization among techniques ($P < 0.05$). In all patients, the nodules were intra-procedurally treated.

Conclusion: DPCBCT demonstrated a significant rate of occult lesions that could be defined as HCC because of the multiphasic nature of this novel imaging modality. This high tumor burden significantly impacted patient management by identifying a subgroup of patients with particularly aggressive tumors.

Free Paper Session Embolotherapy

1408.1

Use of Amplatzer vascular plugs in patients with congenital heart disease (CHD)

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Purpose: To present the role of Amplatzer vascular plugs (AVPs) in vascular embolisation in patients with congenital heart disease (CHD).

To the best of our knowledge, this is one of the largest case series that describes the use of AVPs for vascular embolisation in patients with CHD.

Material and methods: A retrospective review of procedures employing AVP at our institute between January 2005 and June 2016 was performed. AVP was used for embolisation and it has different models so as to fit different vascular sizes, anatomies and varying haemodynamic situations. Indications for the use of AVP, type and number of AVP used and follow-up details were determined.

Results: A total of 76 AVPs of all 4 types were implanted in 56 patients.

Nineteen (28%) vessels were occluded using AVP type I, while 51 (67%) received AVP II. Four patients received AVP III, while two patients received AVP IV. The major indications for embolotherapy included embolisation of pulmonary arterio-venous malformations (n=30), pulmonary aneurysms (n= 3), coronary and systemic AVMs (n=10), aorto-pulmonary collaterals (n=19), closure of patent Blalock-Taussig shunt (n=5), patent ductus arteriosus (PDA) (n=3), and veno-venous collaterals (n=2).

In total, 97% of the plugs could be deployed successfully with target vessel occlusion. No procedure-related complications occurred.

Conclusion: AVPs are the preferred devices to occlude a variety of abnormal vascular channels, particularly in medium and large vessels where coils are ineffective.

AVP II was most commonly used and was found to be particularly useful in the closure of vessels with high flow.

1408.2

Safety and efficacy in the use of superselective radiofrequency embolization wires in small animal arteries

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Purpose: To investigate the safety and efficacy of selective radiofrequency wire embolization (RFE) of small arteries in a swine model.

Material and methods: The arterial closure experiments were performed in 2 pigs, one acutely and one with a 7-day follow-up. A microcatheter compatible guidewire with an RF active tip was navigated under fluoroscopic guidance to 12 (acute) and 13 (7-day follow-up) arteries located in the thigh, liver, and left kidney. Inclusion criteria were arteries with an inner diameter of 1.5–2.5 mm. The animals' activated clotting time was kept between 140 and 170 seconds with intravenous heparin administration. Energy was applied at increasing power levels up to 40 W for a variable time up to 60 seconds until an electrical impedance change was observed, indicating vessel occlusion. The RFE wire was then retracted and occlusion was evaluated by digital subtracted arteriogram (DSA). For the 7-day survival animal study, the patency of the target arteries was analyzed by DSA.

Results: Of the 25 targets, 23 were successfully occluded and one of the remaining two targets was a trifurcating vessel. The inner diameter mean size of the treated arteries was 2.0 ± 0.3 mm. The activation time was 64 ± 32 seconds including the four vessels requiring double treatment. No acute complication, such as vessel rupture/distal embolization, was detected angiographically. Of the 13 vessels treated in the survival study, 10 remained occluded at 7 days.

Conclusion: In this animal model, the use of the RFE wire seems to be safe and efficacious in the selective embolization of the small thigh, liver, and kidney arteries.

1408.3

Selective occlusion of splenic artery aneurysms with the coil packing technique: the impact of packing density on recanalization correlated between contrast-enhanced MR angiography and digital subtraction angiography

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Purpose: The aims of the present study were to evaluate the correlation between coil packing densities after treatment using fibered detachable coils and rates of splenic artery recanalization and to assess a post-treatment surveillance protocol using contrast-enhanced MRA.

Material and methods: The review evaluated 16 patients (4 men; mean age 46.7 years, range 28–79 years) who underwent selective splenic artery aneurysm (SAA) embolization between June 2012 and March 2016 using fibered embolization coils. SAAs were treated by selective coil packing (CP) or stent-assisted coil exclusion (SAC). The first surveillance CE-MRA was performed at 3 months. Aneurysm occlusion was classified as follows: class 1, complete occlusion; class 2, residual neck; and class 3, residual aneurysm, as proposed by Roy et al.

Results: The largest mean SAA diameter was 18.05 ± 5.59 mm. Primary CP was used in 13 patients, whereas SAC was used in 3 patients. Complete aneurysm occlusion was observed in 7 patients (43.8%). Sac reperfusion occurred in 9 patients (56.2%) and was

demonstrated in all 9 patients on CE-MRA and in 6 of the 9 patients on DSA. There was a significant difference in the incidence of recanalization between CP and SAC on CE-MRA. No sac reperfusion or coil compaction was observed in aneurysms in which a packing density of 29% was achieved, irrespective of the embolization method.

Conclusion: Excellent mid-term results of CP for SAAs depend on coil packing density where the coil volume must amount to approximately a quarter of the aneurysm volume. Follow-up should involve CE-MRA as it is superior than DSA in detecting aneurysm recanalization and coil compaction.

1408.4

Ten years experience with an Onyx embolic agent in the percutaneous treatment of type II endoleaks

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Purpose: To report our experience in the treatment of type II endoleaks using an Onyx embolic agent.

Material and methods: From January 2007 to January 2017, 14 patients showed type II endoleaks after TEVAR and 25 patients showed enlargement of the sac/false lumen revascularization after EVAR. EVAR included only the transarterial approach with embolization of the feeding vessels in 13 (52%) patients, a direct translumbar puncture of the sac in 11 (44%) patients, and a combination of the transarterial approach and direct puncture in 1 (4%) patient. In nineteen cases (76%), a combination of coils and the Onyx embolic agent was used, whereas in the remaining 6 (24%) patients, only the Onyx embolic agent was injected into the sac. Catheterization and embolization of the sac/false lumen was obtained via the left subclavian artery or retrogradely between the stentgraft and the aortic wall in all 14 patients undergoing TEVAR. In 6 (43%) patients, a combination of coils and the Onyx embolic agent was used, whereas in the remaining 8 (57%) patients, only the Onyx embolic agent was injected.

Results: Technical success was obtained in all patients with immediate exclusion of the endoleak. All patients complained of mild lumbar-thoracic pain during injection of the DMSO polymer; no cases of non-target embolization were observed and no one experienced tissue necrosis after the procedure. After a mean follow-up of 49 months, only 3 (8%) patients showed recurrence of type II endoleaks with enlargement of the sac. In 1 patient, a second embolization was performed, whereas in the other 2 patients, surgical conversion was required.

Conclusion: The Onyx embolic agent was an effective and safe tool for the treatment of type II endoleaks.

1408.5

Efficacy and safety of balloon-assisted scleroembolotherapy (BAST) for subcutaneous high-flow arteriovenous malformation in the head and neck

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Purpose: We have developed a new scleroembolotherapy technique, balloon-assisted scleroembolotherapy (BAST), for subcutaneous high-flow arteriovenous malformation (AVM) using a micro-balloon catheter to control blood flow. The purpose of this study was to evaluate the effects and safety of BAST for AVMs in the head and neck.

Material and methods: Nine patients with subcutaneous AVMs treated from February 2014 to January 2016 were enrolled. Fifteen sessions were performed. Contrast-enhanced computed tomography (CT) was performed before each treatment session, and the size of the lesion was measured. Bilateral external carotid arteries were occluded by balloon catheters (5.2 Fr, ϕ 9 mm), through which a micro-balloon catheter (2.7 Fr, ϕ 4.0 mm) was inserted. The feeding arteries were selected by the micro-balloon catheter, and sclerotic agents were injected. Sclerotic agents were absolute ethanol, polidocanol, and/or monoethanolamine oleate foam. Follow-up CT was performed 1 month after each procedure. The size of the lesion was evaluated based on the following criteria: complete response (CR), disappearance of the target lesion; partial response (PR), 50%–100% reduction in the size of the target lesion; stable disease (SD), neither sufficient shrinkage to qualify for PR nor enlargement of the lesion; and progressive disease (PD), enlargement of the lesion. We define effective rate as $(CR+PR)/\text{all lesions} \times 100(\%)$.

Results: The percentages of lesions evaluated as CR, PR, SD, and PD were 27%, 47%, 20%, and 7%, respectively. The effective rate was 73.3%. No major complications occurred.

Conclusion: BAST for high-flow AVMs in the head and neck was effective and relatively safe in this cohort.

1408.6

Amplatzer vascular plug anchoring technique (AVP-AT) for additional microcoil embolization of a short internal iliac artery under unstable support of a delivery system

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Purpose: AVPI is a reliable embolic material; however, recanalization of AVPI has been reported. Therefore, we have been using AVPI in combination with coils to decrease the possible risk of recanalization. During embolization of a short internal iliac artery (IIA), a guiding sheath is unstable or slips out of the IIA after deployment of AVPI in the IIA. Therefore, it is sometimes difficult to put additional coils proximal to AVPI in IIA.

To evaluate the feasibility of the Amplatzer vascular plug anchoring technique (AVP-AT) in stabilizing a delivery system for additional microcoil embolization.

Material and methods: This retrospective study included four patients who underwent embolization of IIA prior to endovascular aortic repair (three patients) and IIA aneurysm (one patient). In all cases, AVPI was deployed through a guiding sheath in IIA without detaching of AVPI from a delivery wire to stabilize the guiding sheath in IIA. Then, a microcatheter was advanced through the same guiding sheath coaxially into IIA. Finally, additional microcoil embolization around and proximal to AVPI was performed.

Results: AVP-AT was successful in all cases. Because the guiding sheath was stabilized in the proximal portion of IIA by the delivery wire, microcoils were able to be packed tightly around and proximal to AVPI.

Conclusion: AVP-AT stabilized a guiding sheath and enabled the deployment of microcoils tightly in the proximal portion of IIA precisely.

Free Paper Session Experimental work in IR

1505.1

CT visibility of different types of embolic materials with particular deep penetration into the liver: 40- μ m visible bead versus iodized oil

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Purpose: To compare CT visibility of different types of embolic materials with particular deep penetration into the liver.

Material and methods: Twelve pigs underwent embolization of a liver lobe: iodized oil (n=2; I), 40- μ m standard bead suspended in normal saline (n=2; II), 40- μ m visible bead suspended in normal saline (n=2; III), iodized oil (n=2; IV), 40- μ m visible bead suspended in normal saline/iodinated contrast material (n=2; V), or 40- μ m visible bead suspended in normal saline/iodinated contrast material/heparin (n=2; VI). Animals were sacrificed 1 hour (I–III) or 1 week (IV–VI) after embolization. CT was performed before sacrifice (I–VI) and also after embolization (IV–VI). Study endpoints included X-ray visibility on CT and acute/sub-acute tissue reactions on histopathology studies.

Results: CT visibility with linear and patchy contrast within the embolized liver lobe was demonstrated for I/III/IV/V/VI. For II, there was no CT visibility. The degree of CT visibility was higher for I/IV than for III/V/VI. During follow-up, CT visibility decreased in the sub-acute groups (IV–VI). On histopathology studies, all three types of embolic material were detected within arteries, arterioles, and sinusoids, but with a pronounced sinusoidal distribution pattern for I/IV compared with that for II/III/V/VI. Hyperemia, as an early tissue reaction after embolization, occurred in the acute groups (I–III). In the sub-acute groups, tissue necrosis was only observed for V (in the center of the portal fields) and VI (exceeding the portal fields). Cellular inflammation was obvious for IV.

Conclusion: CT visibility of different types of embolic materials with particular deep penetration into the liver is qualitatively (but not quantitatively) comparable. Trifecta consisting of CT visibility, tissue necrosis, and biocompatibility is only achieved after embolization with a 40- μ m visible bead.

1505.2

Conductivity rise during irreversible electroporation: true permeabilization or heat?

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Purpose: Irreversible electroporation (IRE) uses high-voltage electric pulses to induce cell death. Although the working mechanism is primarily non-thermal, development of secondary Joule heating does

occur. This study investigated whether the observed conductivity-rise is accountable to an increased cellular permeabilization or to secondary Joule heating.

Material and methods: IRE was performed in a gelatin tissue phantom and in potato tubers using continuous vs. sequential pulsing protocols (10-90 vs. 10-30-30-30). Temperature was measured using fiber-optic probes. After temperature returned to baseline, 100 additional pulses were delivered. Seven patients, with colorectal liver metastases (CRLM; COLDIRE-2 trial: NCT02082782), received 10 additional pulses for 1 electrode pair after a 10-minute cool-down period. Primary efficacy rate of 30 CRLM patients was compared to the mean conductivity-rise.

Results: In both mediums the temperature- and conductivity-rise was higher for the continuous pulsing protocol (means: gel 13.05 vs. 9.55°C and 9A vs. 7A; potato 12.70 vs. 10.53°C and 6.0A vs. 6.5A). After cooling-down, conductivity returned to baseline in the gel phantom and nearly to baseline in the potato. The current of the first pulse was higher in a gel phantom of 40 degrees Celsius, compared to a gel phantom of 20 degrees Celsius. The conductivity also decreased after cooling-down (compared to the peak-amperage) in all 7 CRLM patients, although baseline values were not reached. There was a positive correlation found between conductivity-rise and efficacy (Pearson's $r(2)=0.02$).

Conclusion: The observed conductivity-rise during IRE is not solely accountable to a true tissue effect, but also subsidiary to the development of heat. Although there is a correlation between conductivity-rise and efficacy the widespread adoption may have been premature, since this endpoint lacks clinical practicability and the cut-off value defining successful ablation is not applicable for all tumor types, leading to overtreatment and an increased risk of thermal damage.

1505.3

Respiratory level tracking with visual biofeedback to facilitate consistent level of breath-hold after image-guided interventions

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Purpose: To present and evaluate a new respiratory level biofeedback system that aids the patient in returning to a consistent level of breath-hold after image-guided interventions.

Material and methods: The respiratory motion was recorded using a marker-less 3D depth camera mounted on a CT table. It measures the mean depth to the thorax and abdomen (d_{mean}) in real-time. After initial breath-hold, the system was calibrated, and subsequently, visual biofeedback was provided on a screen to the patient and radiologist as a ball moving up and down with respiration, with a stationary circle representing the initial level of breath-hold.

Using spirometry, a conversion factor from d_{mean} to relative lung volume (mL) was determined in 8 healthy volunteers in the supine and prone positions. Volunteers were given breathing instructions and asked to return to their initial level of breath-hold 10 times in both positions with and without visual biofeedback. For both positions, the mean deviation in lung volume from the initial breath-hold and its standard deviation (SD) were determined with and without biofeedback using independent sample t-tests for comparison.

Results: The mean deviations from initial breath-hold were 169±153mL and 234±194mL in the supine and prone positions, respectively, without the use of visual biofeedback. For all volunteers, this was decreased with the aid of biofeedback, with a mean of 42±36mL ($p<0.001$) and 30±25mL ($p<0.001$), respectively.

Conclusion: The use of a depth camera to provide visual biofeedback increases the reproducibility of breath-hold in healthy volunteers. It has the potential to eliminate targeting errors caused by respiratory movement in image-guided procedures.

1505.4

Chronic outward force (COF) of self-expanding arterial stents correlates with neointimal proliferation in swine

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Purpose: A self-expanding stent exerts a chronic outward force (COF) on the surrounding vessel wall. COF has been shown to trigger neointimal proliferation and restenosis in animal experiments when the stents were extremely oversized. In this study, stents with different expansion forces were implanted in swine with an average oversizing of 10%, which corresponds to clinically used values.

Material and methods: Landrace Yorkshire swine (28-day group) and Yucatan minipigs (90-day group) were each implanted with 4 doublets of a high COF (LifeStent, Bard) and 4 doublets of a low COF (AstronPulsar, Biotronik) in the iliac or femoral artery. Diameter of the stent and vessel was 7 mm and 5.3 mm, respectively. On sections of the arteries with stents in place, the area inside the lamina elastica interna (IEL) and the area of the lumen were measured. The difference between these measurements corresponds to the area of the neointima. COF that the stent exerts on the vessel wall at a given stent diameter was measured in bench tests for every stent-type.

Results: The mean COF of AstronPulsar and LifeStent were 0.06 and 0.11 N/mm, respectively. High-COF stents showed significantly more neointimal and IEL area at 28 and 90 days than low-COF stents and area stenosis tended to be higher. High-COF stents expanded during the observation time; consequently, there was higher absolute IEL in the high-COF group, which explains that the absolute lumen area remained similar between groups despite increased neointimal area in high-COF stents.

Conclusion: Even with moderate oversizing, COF of self-expanding stents correlates with neointimal proliferation. Potentially, low-COF stents trigger less restenosis.

1505.5

Feasibility of hepatic interstitial electrochemotherapy in a porcine model: in vivo evaluation of a newly developed expandable applicator

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Purpose: Irreversible electroporation (IRE) is a non-thermal technique for local tumor therapy. Electrochemotherapy (ECT) is the combination of electroporation and local chemotherapy and is being used to treat tumors of the skin and subcutaneous tissue. Until now, ECT has not been used for the treatment of tumors in parenchymal organs like the liver. The aim of our study was to evaluate the feasibility of interstitial ECT using a newly developed, needle-shaped applicator prototype with four expandable electrodes, which can be used for both injecting the chemotherapeutic agent inside the tumor and creating an electric field. Compared with common IRE interventions, five electrodes are placed with only one stitch and are powered together.

Material and methods: The applicator prototype was placed in two different liver lobes in 8 swines. In one lobe, electroporation (IRE) was performed (up to 1500 V, 120 pulses, pulse length 100 μ sec) without additional application of chemotherapy, whereas in another lobe, electroporation was performed after interstitial injection of a doxorubicin mixture through the expandable electrodes (ECT). Contrast-enhanced CT and MRI were performed to evaluate ablation volumes with a maximum follow-up of 1 week.

Results: Technical success was obtained in 8/8 swines. Follow-up CT one day after intervention showed a significant ($p < 0.05$) difference in the ablation volumes of ECT ablations (4.47 ± 1.78 ml) compared with those of IRE ablations (2.50 ± 0.93 ml). This difference remained stable during follow-up and was confirmed by MRI.

Conclusion: ECT provides a significant volumetric increase compared with IRE without interstitial injection of chemotherapy. Further investigations are needed to evaluate its efficacy in a tumor model.

1505.6

What happens to the drug on an effective drug-coated balloon: insights into results using a new coating composition

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Purpose: Local drug delivery by paclitaxel-coated angioplasty balloons is currently the only proven method of restenosis inhibition, which avoids implants. The presented data further elucidated the route of the drug to the target tissue and local pharmacological effects of an additive.

Material and methods: Standard nylon angioplasty balloons were coated with paclitaxel plus the natural antioxidant resveratrol. Balloons were investigated for appearance, the precision of the dose, and drug loss during the in vitro simulated way to the lesion. In swine, the proportion of drug reaching the target vessel, the transfer to the vessel wall (HPLC analysis), inhibition of neointimal proliferation, and inhibition of inflammation by resveratrol were determined. Images of paclitaxel distribution were obtained by matrix-assisted laser desorption ionization imaging mass spectrometry (MALDI). Residual paclitaxel on used balloons was measured (HPLC).

Results: Homogeneous white coating with precise dose ($\pm 1\%$) was achieved. Loss on the way to the lesion was $< 5\%$. On inflated balloons in the iliac arteries, $65\% \pm 13\%$ of dose was retrieved, whereas after deflation, $7.1\% \pm 6.1\%$ of dose was found in the vessel wall. MALDI image showed circumferential distribution of paclitaxel in the vessel. Subsequently, retraction balloons contained $20\% \pm 12\%$ of dose. Inhibition of neointimal proliferation by paclitaxel and anti-inflammatory effects of resveratrol were confirmed by histology.

Conclusion: Balloons were successfully coated with paclitaxel/resveratrol matrix. Studies in swine indicate inhibition of neointima proliferation and potentially beneficial effects of resveratrol. A large proportion of paclitaxel is available during balloon inflation.

Free Paper Session Biliary intervention

1506.1

Percutaneous placement of irradiation stents versus conventional metal stents for unresectable malignant biliary obstruction: a prospective, randomized, controlled phase 3 trial

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Purpose: To assess the efficacy of an irradiation stent compared with an uncovered, self-expandable metallic stent (SEMS) in patients with unresectable malignant biliary obstruction (MBO).

Material and methods: Patients with unresectable MBO from 20 centers in China were randomly assigned to receive percutaneous placement of an irradiation stent (irradiation stent group, ISG) or an uncovered SEMS (control group, CG). The primary endpoint was stent patency. Secondary endpoints included technical success, relief of jaundice, complications, and overall survival.

Results: The mean (SD) age of 328 trial participants was 64.6 (11.7) years and 63.4% were men. Considering death as a competing event, competing risk regression was used to analyze the effect of the stent type on restenosis instead of the stent patency. The first quartile stent patency time (when 25% of the patients experienced stent restenosis) was 212 days for the ISG and 104 days for the CG. The ISG group had significantly lower cumulative stent restenosis rates than the CG group (9 % vs 15% at 90 days, 16% vs 27% at 180 days, and 21% vs 33% at 360 days; $P = 0.01$). Compared with the CG group, the ISG group achieved comparable technical success rates (93 % vs 95 %; $P = 0.499$) and relief of jaundice (85 % vs 80 %; $P = 0.308$). The median survival in the ISG group was 202 days (95% CI, 171–232) which was longer than that of 140 days (95% CI, 117–163) in the CG group ($P = 0.02$). There was no significant difference in the incidence of grade 3 or 4 complications between the two groups.

Conclusion: Compared with an uncovered SEMS, insertion of an irradiation stent provides longer patency and improves the overall survival in patients with unresectable MBO.

1506.2

A novel irradiation stent for the treatment of malignant hilar biliary obstruction

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Purpose: To assess the feasibility, safety, and preliminary efficacy of an irradiation biliary stent in the treatment of malignant hilar biliary obstruction.

Material and methods: A total of eleven patients with malignant hilar biliary obstructions and symptomatic jaundice were consecutively recruited to receive the percutaneous placement of irradiation stent. The irradiation stent was designed as a double-layer stent consisting of an outer iodine-125 radioactive seed-loaded stent and an inner self-expandable metallic stent. The seed-loaded stent was first implanted and the self-expandable nitinol stent was immediately followed through the same guidewire and 10-F sheath. Technical success rate, complications, and time to recurrent biliary obstruction were evaluated. Successful stent placement was considered when the irradiation stent was deployed in the target position of the biliary tract with full expansion and complete overlap between the inner and outer stents.

Results: Technical success rate was 100% (11/11), with six irradiation stents (diameter of 10 mm and lengths of 50–70 mm) successfully placed in six patients. The activity of iodine-125 seeds used on the irradiation stent was 0.8 mCi. The median calculated surface radiation dose at the dose prescription point was 72 Gy (range 58–89 Gy). There was no immediate complication of procedures. The radiation-related neutropenia was observed in one patient. The median time to recurrent biliary obstruction was 367 days (interquartile range 79–472 days).

Conclusion: This pilot study shows the feasibility and preliminary efficacy of this irradiation stent in the treatment of malignant hilar biliary obstruction, with a tolerable complication rate.

1506.3

Medium- and long-term follow-up of benign biliary strictures treated with a biodegradable biliary stent: analysis of 32 patients at a single center

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Purpose: To determine the feasibility and efficacy of a biodegradable biliary stent in the treatment of benign strictures of the biliary tract by implanting ELLA-type stent using medium- and long-term follow-up of patients at a single center.

Material and methods: The study was approved by the Ethics Committee of Aragon. Thirty-two patients (females, 48.4%; mean age, 61.45 ± 13.64 years) were treated. The most frequent cause was surgical complications of the biliary branches and bile duct in 41.9% of patients. In all patients, ELLA-DV biliary stents, which were custom built with different sizes and lengths using polydioxanone for each patient, were implanted. Stent patency, clinical symptoms, relevant laboratory data, and complications were analyzed during follow-up. The mean follow-up period was 17.09 ± 25.04 months.

Results: Clinical success was 100%, and in only 1 patient, the stent migrated distally and could be replaced using an angioplasty balloon. The mean stent patency was 84.55 months (range, 60.29–108.80 months; 95% CI), and 70.96% of stents were patent. GGT, bilirubin, and alkaline phosphatase levels decreased in 33.41%, 59.26%, and 16.01% of patients, respectively. The most common immediate complication was hemobilia (6.5%), which did not require complementary measures. Nine patients (29.03%) with restenosis or obstruction required new drainage and/or surgical intervention.

Conclusion: The implantation of ELLA absorbable stents is feasible, safe, and effective for benign biliary strictures refractory to standard treatments.

1506.4

The when and how of biodegradable biliary stents in a paediatric group: is it better than what is used currently

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Purpose:

- To review the indications of biodegradable biliary stents (SX-ELLA) in paediatric patients in our centre.
- To evaluate the safety and efficiency of SX-ELLA.
- To compare the evolution between patients treated with and without SX-ELLA.

Material and methods: We included paediatric patients diagnosed with biliary stricture by US or MR and treated percutaneously by our interventional (IR) team between 2008 and 2017. We conducted a retrospective observational study on the cause of strictures and the reason for SX-ELLA placement and a descriptive comparison of the clinical evolution and stricture recurrence between patients with and without SX-ELLA placement using clinical, analytical and radiological parameters.

Results: Twenty-three patients (11 males and 22 females; mean age 6.2 years); group A (n=10) treated with bilioplasty, drainage catheters and permanent stents and group B (n=13) treated with additional placement of SX-ELLA. Mean follow-up since first IR procedure (group A)=47 months and since SX-ELLA placement (group B)=13 months.

Group A: average number of bilioplasties=2.2, drainage catheters=2.3 and permanent stents=0.2. Average time with a biliary tutor=9 months. Average stricture recurrence=7.6.

Group B: average bilioplasties prior to SX-ELLA placement=1.2 and drainage catheters=1.4. None of the above after SX-ELLA placement. Average time with a biliary tutor=2.1 months. No stricture recurrence has been diagnosed after SX-ELLA placement.

The average number of documented cholangitis episodes: group A=1.7 and group B=0.2. Current radiological, analytical and clinical resolution in group A was 80%, 50% and 80%, respectively, with 30% patients requiring surgical treatment, and in group B was 54%, 46% and 85%, respectively, with no patient requiring surgical treatment.

Conclusion: SX-ELLA is a safe and clinically efficient tool for biliary stricture treatment, avoiding surgical intervention and reducing stricture recurrence as well as repetitive cholangitis. Better understanding of the radiological, analytical and clinical dissociation in patients with SX-ELLA will require further follow-up.

1506.5

Endoluminal irreversible electroporation in the perihilar region

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Purpose: To evaluate the safety and efficacy of endoluminal irreversible electroporation (IRE) in the biliary tract performed within the perihilar region.

Material and methods: Endoluminal IRE of the common bile duct (CBD) was performed on 20 porcine models using an endoluminal device inserted during laparotomy. The IRE device consists of 3 electrodes that are 1 cm in length, attached at 120° around the expander. The procedure was conducted with the following parameters: number of pulses 50–90 and a voltage of 1200–2000 V between each couple of electrodes. All pigs were euthanized 1–22 days after the procedure. Both MRI and histopathological evaluations were employed for follow-up.

Results: The IRE treatment was successful in all porcine models. All animals survived over the defined study period. Peri-ablation edema within the hepatoduodenal ligament and adjacent liver tissue measured from 2.5–42.0 ml on post-procedural volumetric MRI analysis on day 0. Edema showed a tendency of diminishing on imaging studies over the follow-up period by 7%–27% per day. The measured depth of necrosis on histopathological specimens ranged between 3 and 6 mm. Perforation of CBD and hematoma of the hepatoduodenal ligament developed in two models with an applied electric field strength of more than 1800V/cm. One coincidental case

of partial deficiency of elastin fibres in CBD did not lead to the development of clinically significant perforation.

Conclusion: This novel endoluminal modality used within the perihilar region on porcine models is a feasible and well predictable procedure according to our experience. The safety of the method depends on selecting the ablation protocol with optimal parameters, primarily the electric field strength.

1506.6

Endoluminal radiofrequency ablation using the monopolar approach for the treatment of an occluded metal biliary stent in malignancy

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Purpose: To prove the efficacy and safety of endoluminal radiofrequency ablation using the monopolar approach for the treatment of an occluded metal biliary stent in malignancy.

Material and methods: The study includes 11 patients with metal biliary stents implanted for treating malignant biliary obstruction. All patients were selected according to our hospital's indication criteria for occluded metal biliary stent recanalisation. The stent recanalisation was performed under fluoroscopic control with radiofrequency ablation catheter EndoHPB 8F connected to the generator 1500X RF using a monopolar approach. The effect of radiofrequency ablation in the treatment of occluded metal biliary stents was evaluated by biliary tract fluoroscopy. Enrolled patients were prospectively followed-up.

Results: In all 11 cases, radiofrequency ablation using the monopolar approach was successful for stent recanalisation. The average period of stent patency before recanalisation was 6.9 months (3–12, median 5.5 months) and stent patency after recanalisation was an additional 4.8 months (1.5–12, median 5 months). Eight of 11 patients died during the follow-up within an average of 15 months (9.5–25, median 12 months) after stent placement, respectively, in 15.3 months (Kaplan–Meier analysis). No complications were observed during and after the procedure. Three patients are still alive; two of them surviving for 10 months and one surviving for 25 months after stent placement.

Conclusion: The monopolar approach for using the endoluminal radiofrequency catheter for occluded metal biliary stent recanalisation seems to be a precise and efficient technique for treating tissue ingrowth. However, the natural course of oncological disease and disadvantages of the catheter-based technique for recanalisation may lead to early procedural failure.

Free Paper Session IR in gynaecology

1507.1

Chemoembolization of uterine arteries for treatment of non-tubal ectopic pregnancy with positive fetal cardiac activity

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Purpose: To prove the efficacy and safety of combined endovascular–pharmacological treatment of advanced non-tubal ectopic pregnancy with positive fetal cardiac activity.

Material and methods: We conducted a retrospective study on all cases of non-tubal ectopic pregnancy with positive fetal cardiac activity treated with uterine artery embolization and intra-arterial methotrexate (MTX) injection combined with intramuscular MTX therapy. The cohort included 14 women with non-tubal ectopic pregnancy and positive fetal cardiac activity. Mean maternal age was 36.2±6.2 years. Non-tubal ectopic pregnancy was diagnosed based on the location: 5 (36%) cervical, 6 (43%) interstitial/cornual, and 3 (21%) cesarean scar. Mean gestational age was 78.2±19 days with beta-human chorionic gonadotropin (β-hCG) levels ranging from 2932 to 61596 IU/L (mean 18400 IU/L). Treatment success was determined by cessation of cardiac activity, drop of serum β-hCG levels by at least 15% within the hospitalization period, and undetectable serum β-hCG levels within the follow-up period.

Results: Treatment was successful in 13/14 (93%) cases with β-hCG returning to undetectable levels within 14–147 days (mean 54.5 days). In one woman with cervical pregnancy, fetal cardiac activity remained 2 days after protocol completion. Only mild adverse events (SIR class A and B) were observed. Among 8 women who stated that they were interested in becoming pregnant, 6 (75%) had a subsequent pregnancy, although 2 (30%) had spontaneous abortions.

Conclusion: Intra-arterial MTX followed by temporary bilateral uterine artery embolization combined with systemic MTX treatment is a safe, effective, and presumably fertility preserving technique in the management of advanced non-tubal ectopic pregnancy with positive fetal cardiac activity.

1507.2

Predelivery uterine artery embolization in patients affected by placental implant anomalies: feasibility, safety, and clinical–radiological outcomes

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Purpose: To assess safety and clinical–radiological outcomes of uterine artery embolization (UAE) before delivery in patients with placental implant anomalies at high risk for postpartum hemorrhage.

Material and methods: Fifty patients with diagnosed placental implant anomalies at 35–36 weeks of pregnancy were treated. Superselective UAE by injecting reabsorbable pledgets immediately before the delivery was performed in the gynecological operating room using a mobile arch and according to CIRSE guidelines for the

use of radiation during pregnancy. Five dosimeters were applied to patients' backs for measuring the uterine radiation dose, which was considered to be the same radiation dose that the fetus received. Newborns' conditions were assessed immediately after birth and at the 6-month follow-up. Uterine conditions were monitored at the 6–12-month follow-up by MR imaging.

Results: All procedures were technically successful. Overall, 64% of patients did not require transfusions. Mean blood units transfused was 0.7 U. No patient was transferred to the intensive care unit. Hysterectomy was performed in 26% patients. Mean uterine radiation dose was 15.61 mGy. One- and five-minute Apgar scores were 8–9 in all newborns. Eight newborns were lost to follow-up; normal cognitive outcome was evident in all 42 children studied at 6 months. In the 10 patients recruited for pelvic MR follow-up at 6–12 months, no uterine necrotic area was detected and the vascularization of the uterine wall was preserved.

Conclusion: UAE before delivery appeared to be a safe approach to reduce bleeding during cesarean sections in this sample of patients with placental implant anomalies. Radiation dose to the fetus was minimal. Uterus vascularization was preserved at the MR follow-up.

1507.3

Magnetic resonance-guided focused ultrasound surgery (MRgFUS) treatment for submucosal uterine fibroids

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Purpose: The objective of this study was to determine the safety and clinical efficacy of magnetic resonance-guided focused ultrasound (MRgFUS) in the treatment of submucosal uterine fibroids.

Material and methods: A total of 18 patients affected by submucosal uterine leiomyomas underwent MRgFUS (age range 24–52 years) in our department from January 2014 to January 2016; they were studied with MRI and classified with the FIGO staging system. Non-perfused volumes (NPVs) were measured immediately after MRgFUS to calculate the treated area on c.e. T1-weighted sequences (MRI). The Uterine Fibroid Symptoms and Quality of Life questionnaire (UFS-QOL) was used to determine the patients' symptom severity scores (SSS) before and 1 year post-treatment.

Results: After MRgFUS treatment, a mean NPV extension of 91.5% was observed. At follow-up studies up to 1 years, 8 out of 18 patients showed progressive reduction of the uterine volume with regularization of the uterine wall and 10 out of 18 patients showed significant reduction of fibroid volume (about 87%). Each patient was treated in one session alone. All the patients reported improvement in the UFS-QOL SSS when compared with the pretreatment score. No severe adverse events were observed.

Conclusion: The results obtained from this study demonstrated that MRgFUS can be safely and effectively used to ablate submucosal uterine fibroids for improving clinical symptomatology and the morphology of uterus.

1507.4

Robot-assisted uterine fibroid embolization using the Magellan system: a single-center experience comparing different steerable robotic catheter

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Purpose: To compare outcomes of percutaneous robot-assisted uterine fibroid embolization (UFE) using two different endovascular robotic catheters.

Material and methods: Twenty-one patients with symptomatic uterine fibroids were prospectively enrolled in a single-center study to be treated with percutaneous robot-assisted embolization using the Magellan system. Fourteen patients were treated using a first generation steerable robotic catheter, version 1.0 (group 1) and seven were treated using the new version 1.1 (group 2). Demographic, pathologic, and procedural variables were recorded. Dose area product (DAP) and effective physician doses were registered for each procedure. Procedure-related complications and clinical midterm outcomes were also evaluated.

Results: Successful robot-assisted UFE was obtained in 8 patients (57.1%) in group 1 and 7 patients (100%) in group 2 ($p=0.01$). A successful robot-assisted catheterization of the internal iliac artery anterior branch was performed in all patients of both groups. The median selective target vessel catheterization time was 21.0 ± 12.8 min vs 13.4 ± 7 min ($p=0.04$) and the total fluoroscopy time was 30.3 ± 11.2 min vs 19.3 ± 5.9 min, respectively, in groups 1 and 2. The mean DAP decreased from 18472.6 ± 15622 cGy.cm² to 5469.1 ± 4461.0 cGy.cm² ($p=0.04$). All patients obtained symptom relief at the 6-month follow-up.

Conclusion: Robot-assisted UFE is safe and effective. A new version of the steerable robotic catheter facilitates a faster procedure without related adverse events compared with the old version.

1507.5

Clinical outcome and complications using prophylactic occlusion balloons in patients with morbidly adherent placenta

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Purpose: To evaluate the outcomes of occlusion balloon technique (POB) in assisting the uterine conserving surgery, reduced postpartum haemorrhage, and maternal morbidity in patients with a morbidly adherent placenta.

Material and methods: Patients were treated at our tertiary specialised referral hospital. All patients underwent a uterine preserving surgery facilitated by the placement of POB catheters into the internal iliac arteries. Standardised protocol was followed until POB catheters were deflated and removed. Clinical outcomes such as need of hysterectomy, blood loss, transfusion requirements, hospital recovery, as well as the time to balloon deflation and catheter removal were recorded. Furthermore, complications and requirements for further management were analysed.

Results: A 5-year retrospective review was conducted. Fifty patients were diagnosed with MAP and treated with POB (23 percreta, 16 increta, 6 accreta, and 3 not confirmed). Successful inflation of POB catheters was achieved in all cases. All patients retained their uterus. Full data were collected from 48 patients. Successful bleeding control was achieved in 43 patients (89.6%), 4 patients were successfully treated with embolization (8.3%), and 1 underwent partial hysterectomy (2.1%). The average time of hospitalization was 4.7 days (3–12).

The average blood loss was 2180 ml, wherein 28 patients received blood products (58.3%). The most common complication was arterial thrombosis, present in 9 patients (18.7%), of which 8 patients did not require any intervention (16.7%) and 2 were treated with successful catheter aspiration (4.2%). Other complications included 1 groin hematoma and 1 arterial dissection.

Conclusion: Prophylactic occlusion balloon placement is a safe and effective method, allowing uterine conserving surgery to be performed with few maternal complications.

1507.6

UAE vs MRgFUS: comparative efficacy for the treatment of symptomatic uterine fibroids at the 1-year follow-up

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Purpose: Uterine fibroids (UF) are the most common benign uterine neoplasms. There is a strong tendency to look for minimally invasive solutions; however, when fibroids are numerous and extensive, a uterus-sparing surgical treatment may be associated with significant morbidities. Uterine artery embolization (UAE) and MRgFUS have been demonstrated to be safe and effective as uterus-sparing therapeutic alternatives. Our purpose is to demonstrate the efficacy of MRgFUS and UAE in the treatment of symptomatic UF as a minimally-invasive approach.

Material and methods: We retrospectively analyzed 105 women who were consecutively treated at our hospital for the indication of UF from January 2014 to January 2016. Overall, 58/105 were treated with MRgFUS and 47/105 were treated with UAE. The treatment selection criteria were established according to patient age, their wish to conceive, fibroid vascularization, and accessibility. They were screened by magnetic resonance imaging (MRI) to evaluate non-perfused volume (NPV) and reabsorption time of UF. The UFs questionnaire (UFS-QOL) was used in order to assess clinical symptom severity before and 1 year after the procedure.

Results: After 1 year, the NPV mean value was 96% using UAE and 92% using MRgFUS. We observed 68% reabsorption of the necrotic area in both techniques. The post-treatment UFS-QOL showed a reduction of about 65% when compared with the pre-treatment QOL.

Conclusion: UAE and MRgFUS significantly improved the quality of life of women with symptomatic UF. UAE is more radical compared to MRgFUS, but it is necessary to consider the age of patients and their wish to conceive.

Free Paper Session Venous and IVC intervention

1508.1

Optimum duration and dose of r-tPA with the acoustic pulse thrombolysis procedure for intermediate-risk (submassive) pulmonary embolism (OPTALYSE PE)

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Purpose: To explore optimal duration/dose of EkoSonic® endovascular system ultrasound-facilitated, catheter-directed thrombolysis (USCDT) in submassive pulmonary embolism (PE).

Material and methods: Subjects had acute (≤ 14 days) proximal PE in at least one main or proximal lobar pulmonary artery and a right to left ventricular end-diastolic diameter ratio (RV/LV) ≥ 0.9 on computed tomographic angiography (CTA). Subjects received USCDT with tissue-type plasminogen activator (tPA) per randomization to one of four treatments. Primary efficacy endpoint was reduction of RV/LV by >0.2 on CTA 48 hours (h) after starting treatment. Primary safety endpoint was major bleeding within 72 h after initiating treatment.

Results: Eighty-three subjects at 17 centers were treated with USCDT bilaterally per randomized dose/duration. All four treatment groups showed significant reductions in the primary efficacy endpoint of reduction in RV/LV 48 h after starting treatment (Table). Major bleeding rate was 2.4%; one was bleeding from a splenic artery pseudoaneurysm treated with transfusion and coil embolization and the other was an intracranial hemorrhage in a patient with platelet dysfunction and labile hypertension.

Ultrasound (h); Total tPA	Mean RV/LV Change (%); 1-Sided p Value Compared to 0.20; N	Major Bleeding Pts (%); N
2; 8 mg	-0.46 (27); 0.0030; 21	0 (0); 22
4; 8 mg	-0.40 (25); 0.0014; 21	0 (0); 21
6; 12 mg	-0.44 (27); 0.0006; 24	0 (0); 24
6; 24 mg	-0.52 (27); 0.0145; 16	2 (12.5); 16

Conclusion: Lower dose and duration USCDT minimizes the risk of major bleeding while improving measures of RV function. These findings have important implications for shortening procedure time, minimizing tPA exposure, and increasing cost effectiveness.

1508.2

Cancer and venous access (CAVA): a randomised controlled trial with associated qualitative research of venous access devices for delivering long-term chemotherapy

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Purpose: The primary objective was to compare the clinical and cost effectiveness of the following three central venous access devices in routine use for delivering chemotherapy: peripherally inserted central catheters (PICCs), Hickman-type devices and chest wall ports.

Material and methods: This was an open multicentre (15 U.K. sites) randomised controlled trial (RCT) involving 1500 patients who

received chemotherapy for ≥ 3 months. Four randomisation options were available for eligible patients (PICC vs Port, PICC vs Hickman, Hickman vs Port, and PICC vs Port vs Hickman). The third option was the preferred if the others were available and if the patient was not suitable for or refused one of the devices. The PICC vs Hickman arm was a non-inferiority comparison, and the other options were a superiority comparison. The primary outcome measure was complications. Secondary endpoints included venous thrombosis (superficial or deep), re-intervention rates (device removal and replacement), interruptions to chemotherapy delivery, time to first complication and quality of life. Health-related quality of life and a full health economic analysis outcomes, including cost effectiveness, were performed. Total sample size is 1500 with 12-month follow-up. The trial was funded by the National Institute of Health Research.

Results: To date, 950 patients have been randomised, and the Hickman vs Port comparison has been closed. Baseline data will be presented as the trial is still ongoing.

Conclusion: This is the world's largest RCT that compares these 3 devices and should provide definitive results in terms of their relative efficacy and cost effectiveness.

1508.3

Percutaneous mechanical thrombectomy for acute symptomatic iliofemoral deep vein thrombosis using the Aspirex®S catheter

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Purpose: To report our experience with percutaneous mechanical thrombectomy (PMT) for acute symptomatic iliofemoral deep vein thrombosis (DVT) using the Aspirex®S catheter.

Material and methods: Twelve patients (10 females, 2 males) with a mean age of 34.5 years (range: 17–59 years) who presented with acute symptomatic iliofemoral DVT were treated by PMT using the 10-F Aspirex®S system (Straub Medical AG, Wangs, Switzerland). Procedures were performed under local anesthesia by the popliteal and/or jugular approach. Insertion of a temporary caval filter was required in 3 cases.

Results: Successful thromboaspiration and recanalization were achieved in all patients (100%). Complete removal of the free thrombus was noted in all patients. Overall, the amount of blood/thrombus removed ranged between 150 and 360 ml. Complementary intervention, including proximal angioplasty and stenting, was necessary in all cases. Mean PMT and total procedure duration were 13 and 71 minutes, respectively. No complication occurred. The patient's postprocedural course was uneventful in all cases, with hospital discharge within 2 days. One patient required reintervention by thrombectomy using the Aspirex®S catheter within 1 month for early in-stent rethrombosis. Follow-up was continued for a mean of 7 months. All patients were asymptomatic with no sequelae. Secondary stent patency was 100% as assessed by Doppler ultrasound and CT.

Conclusion: PMT using the Aspirex®S catheter is a safe, fast, and effective therapeutic option in patients with acute symptomatic iliofemoral DVT.

1508.4

Endovascular stent placement for chronic post-thrombotic symptomatic ilio-femoral venous obstructive lesions: a single-center study on safety, efficacy, and quality of life improvement

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Purpose: To report our single-center experience with the use of endovascular treatment for chronic post-thrombotic symptomatic ilio-femoral venous obstructive lesions.

Material and methods: A prospective single-center observational cohort study of patients with post-thrombotic syndrome (PTS) and chronic symptomatic ilio-femoral venous obstructive lesions referred for endovascular treatment was conducted from March 2012 to April 2016. The procedure included recanalization, pre-dilation, and self-expandable stenting of stenotic or occluded iliac and/or femoral veins. The severity of PTS, quality of life, and treatment outcomes were assessed using Villalta scale and Chronic Venous Insufficiency Questionnaire (CIVIQ-20) at baseline and 3 months after the procedure.

Results: Twenty-one patients (11 females, 10 males; median age, 41 years; range, 32–60 years) were included. Recanalization and stenting was successfully accomplished in all prime procedures. The immediate technical success rate was 96% considering 25 procedures that were performed without any complications. The median follow-up was 18 months (range, 6–30 months) with a 90.5% stent patency rate. The Villalta score significantly decreased from the baseline at 3 months after the procedure [14 (range, 11–22) and 5 (range, 1–10), respectively, $P < 0.0001$], showing a significant decrease in the severity of PTS. The CIVIQ-20 score significantly decreased from the baseline at 3 months after the procedure [48.5 (range, 39–73) and 26.5 (range, 21–45), respectively, $P < 0.0001$], thus showing a significant improvement in quality of life.

Conclusion: Our results confirm the high clinical success rate and safety of endovascular PTS treatment and highlight the significant impact of stenting on the quality of life of patients with chronic post-thrombotic symptomatic ilio-femoral venous obstructive lesions.

1508.5

A comparative study of ALN, Cook Celect and Cook Celect platinum vena cava filters

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Purpose: To examine the effectiveness, safety and complication rates of IVC filters and to compare the ALN, Cook Celect and Cook Celect Platinum vena cava filters.

Material and methods: A retrospective review of hospital medical records of patients receiving an IVC filter in a level 1 trauma centre was performed between November 2011 and June 2016. Each filter episode had available angiography and CT images examined by 2 Interventional Radiologists. The patients' medical notes were examined for each admission and relevant data was extracted.

Results: 476 filters were placed; 161 ALN, 153 Cook Celect and 162 Cook Celect Platinum filters. Any minor or major complication was 51.6% for ALN, 45.1% Celect and 27.2% Celect Platinum. Of the filters with follow-up imaging limb penetration was the highest minor complication 64.2% for ALN, 64.9% Celect and 35.3% Celect Platinum filters. Major complications (including breakthrough PE, migration, fracture, IVC strictures and pericaval haematoma) were

5.6% ALN, 2.6% Celect and 1.2% Celect Platinum filters where breakthrough PEs constituted the largest major complication at 3.7% ALN, 2.0% Celect and 0.6% Celect Platinum filters. Excluding breakthrough PE, the rates of other major complications rates were low. Where retrieval was attempted it was successful in 96.3% ALN, 94.6% Celect and 95.2% Celect Platinum filters.

Conclusion: All 3 filters studied demonstrated safety and high rates of retrievability. The incidence of minor complications was higher than other studies in the current literature with limb penetration being the most common. As far as the authors are aware there is no published data on the Celect Platinum.

1508.6

Comparison of the results of blood sampling from the left central adrenal vein and the common trunk of the left adrenal vein in adrenal venous sampling

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Purpose: We aimed to evaluate whether venous sampling from the central adrenal vein (CAV) and common trunk vein (CTV) above and below the confluence of the left inferior phrenic and left adrenal veins, respectively, results in the same decision for the aldosterone-overproducing side in adrenal venous sampling (AVS).

Material and methods: We retrospectively selected 111 patients (52 men, 59 women; mean age 50.8 years) who had been diagnosed with primary aldosteronism and had undergone AVS. Left adrenal venous sampling was performed from CAV and CTV and from right adrenal vein and inferior vena cava (IVC) after adrenocorticotrophic hormone stimulation. Aldosterone and cortisol concentrations (AC and CC, respectively) were measured in each sample, and we calculated the lateralized ratio [LR; AC/CC ratio (ACR) on the higher-value side/ACR on the lower-value side] and the contralateral ratio (CR; ACR on the lower-value side/ACR on IVC) using samples from CAV and CTV. We compared AC, CC, ACR, LR, and CR between these two groups using paired t-tests. Decision concordances for the aldosterone-overproducing side based on LR or CR between CAV and CTV were evaluated by kappa statistics.

Results: AC and CC were significantly higher in the CAV group ($p < 0.001$). However, ACR, LR, and CR showed no significant differences between the CAV and CTV groups ($p > 0.06$). Decision concordances for the aldosterone-overproducing side were excellent in both LR and CR ($\kappa = 0.80$ and 0.93 , respectively).

Conclusion: Blood sampling from the CTV may be useful in AVS, which could contribute to reducing the cost and shortening the examination time.

News on Stage Session Scientific News on Stage

2005.1

Does chronic outward force of nitinol stents in SFA trigger restenosis? Interim report of the BIOFLEX-COF study

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Purpose: Self-expanding nitinol stents exert a chronic outward force (COF) on the vessel wall, depending on stent oversizing (ratio of vessel diameter/stent diameter) and stent material ("stiffness" of the stent). In animals and humans, high COF has been linked to neointimal hyperplasia and lumen loss. The BIOFLEX-COF study is the first randomized study to address the influence of COF on neointimal hyperplasia and restenosis.

Material and methods: De novo SFA lesions were treated with nitinol stent implantation. Eighty patients were randomized into high and low COF groups. Stent diameters were chosen after measuring the SFA diameter according to a pre-defined sizing table. To obtain low COF, a soft stent (Pulsar, Biotronic) was implanted with little oversizing. To obtain high COF, a harder stent (Lifestent, Bard) was implanted with ample oversizing. Between the two groups, a 2–3× difference in absolute COF is expected. The outcome parameter is the volume of the in-stent-neointima measured by CT angiography 1 and 2 years after the implantation.

Results: A total of 50 patients have been recruited and undergone stent implantation. The technical success rate was 100%, and no major complications occurred. All stents could be implanted with the pre-planned amount of oversizing.

Conclusion: The BIOFLEX COF study was scheduled to complete recruitment in 07 2017, and 1 year outcome data are expected in 09-2018. By measuring the actual volume of neointima at every mm along the stent axis rather than only giving a binary restenosis rate, more detailed correlation analyses of COF and neointima formation will be possible.

2005.2

Two-year results from the IN.PACT global studies and outcomes in patients with diabetes

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Purpose: To expand the clinical evidence with the IN.PACT™ Admiral™ drug-coated balloon (DCB) in the treatment of patients with symptomatic (Rutherford 2–4) femoropopliteal disease.

Material and methods: In total, 1406 subjects were treated with the IN.PACT™ Admiral™ DCB and analyzed as part of the consecutively enrolled clinical cohort. A subset of the clinical cohort, referred to as the imaging cohort, underwent duplex ultrasound imaging at 12 months and at the time of any reintervention within 12 months to assess target lesion patency. The imaging cohort consisted of three prospectively pre-specified sub-groups, and data for the subjects in each group have been presented: de novo in-stent restenosis ($n=131$), long lesion ≥ 15 cm ($n=157$), and chronic total occlusion ≥ 5 cm ($n=126$).

Results: The mean age of subjects in the clinical cohort was 68.6 ± 10.1 years and 67.8% were males. The mean lesion length was 12.09 ± 9.54 cm, including 18.0% in-stent restenosis, 35.5% total occlusions, and 68.7% calcified lesions. Freedom from CD-TLR within 12 months was 92.5%. Primary safety, defined as freedom from device- and procedure-related mortality through 30 days and freedom from major target limb amputation and clinically-driven target vessel revascularization within 12 months, was 92.1%. The rates of major target limb amputations and thrombosis within 12 months were 0.2% and 2.9%, respectively.

Conclusion: The 12-month results confirm the safety and effectiveness of the IN.PACT™ Admiral™ DCB in femoropopliteal lesions. Detailed 2-year results will be available at the time of this meeting.

2005.3

Outcomes following subintimal recanalization of chronic total occlusions: a subset analysis of the IN.PACT global CTO imaging cohort

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Purpose: To report 12-month outcomes on the impact of subintimal recanalization of chronic total occlusions (CTO) treated in the IN.PACT Global CTO Imaging Cohort.

Material and methods: To evaluate vessel patency of these CTO lesions, 126 patients with CTO lesions (127 lesions) were enrolled into the CTO Imaging Cohort and underwent duplex ultrasound imaging at 12 months and following any reintervention within the follow-up period.

Results: Mean lesion length was 22.83 ± 9.76 cm. Of the 127 CTO lesions treated, 61 were categorized as having been crossed via a sub-intimal (n=61, SI) and true lumen (n=64, TL) approach. Overall patency by Kaplan-Meier estimate was 85.3% at 12 months. When stratified by SI vs. TL, patency was 79.8% and 90.1% respectively (p=NS). Freedom from CD-TLR at 12 months by Kaplan-Meier estimate was 86.1% for the sub-intimal group and 92.0% for the true-lumen group.

Conclusion: The mean age of subjects was 67.5 years. Mean lesion length was 22.83 ± 9.76 cm. Of the 127 CTO lesions treated, 61 were categorized as having been crossed via a sub-intimal (n=61, SI) and true lumen (n=64, TL) approach. Overall patency by Kaplan-Meier estimate was 85.3% at 12 months. When stratified by SI vs. TL, patency was 79.8% and 90.1% respectively (p=NS). Freedom from CD-TLR at 12 months by Kaplan-Meier estimate was 86.1% for the sub-intimal group and 92.0% for the true-lumen group. The primary safety composite endpoint was achieved by 88.7% of subjects. There were no device- or procedure-related deaths through 30 days or major target limb amputations through 12 months.

2005.4

Stellarex drug coated balloon: science insights and evidence updates

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Purpose: To review the rationale and data supporting 2nd generation low dose DCB.

Material and methods: Modern DCBs utilize several technical components to exert their mode of action including differing drug formulations, drug doses, excipients, and coating methodologies. Stellarex is a low dose (2 ug/mm²) DCB with a hybrid paclitaxel formulation and a unique Polyethylene Glycol excipient (PEG). Lowering drug dose represents a design goal of modern DCBs in that, when combined with high transfer efficiency, limits potential drug embolization. The Stellarex DCB hybrid drug formulation balances crystalline and amorphous paclitaxel to combine sustained and prompt drug release and increase coating uniformity and integrity particularly in the dry state. Polyethylene Glycol, due to its high molecular weight (8000 g/mol) confers superior mechanical properties and high coating adaptability to balloon deformations. In addition, PEG operates as a slow dissolving carrier thus limiting drug dispersion during balloon tracking in the bloodstream and offering sustained release while in tissue. Finally PEG affinity to hydroxyl apatite (the primary component of calcified atherosclerotic lesions) may confer limited wash out in presence of calcium.

Results: Bench and preclinical evidence with the Stellarex DCB demonstrate high transfer efficiency translating into a desired drug tissue uptake and retention at 30 days and limited drug loss compared to alternative DCB technologies with higher drug doses. Level 1 evidence from 2 randomized trials and 628 patients with common to complex profiles support these findings with highest reported 1-year primary patency of 89%.

Conclusion: Stellarex is a clinically proven, 2nd generation, low dose, drug coated balloon.

2005.5

Radioembolization practices in Europe in 2017 – a survey among CIRSE members

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Purpose: Radioembolization of liver tumors is not a uniform therapy, many choices need to be made from planning treatment until follow-up with a lot of variation between centers. In addition, there have been several developments in the field of radioembolization over the last decade, that seem not to have found their way into routine practice everywhere. We conducted a survey among CIRSE members to investigate how radioembolization is performed across Europe.

Material and methods: An online questionnaire consisting of 25 questions was distributed among all members of the Cardiovascular and Interventional Radiology Society of Europe (CIRSE). The questions were in part based on a European survey performed in 2011 (Powerski et al, Eur J Radiol 2012) and were divided into the following categories: 1) patient work-up, 2) patient treatment, 3) patient aftercare, and 4) future developments. Results were compared with results of the previous survey.

Results: The survey was completed by 63 European centers spread over 17 countries. Most responses came from Germany (n=13), followed by Italy (n=9), and Turkey (n=7). Hepatocellular carcinoma and colorectal carcinoma metastasis were the most frequently treated tumor types. 43% of centers used exclusively resin microspheres (vs. 68% in 2011), 23% used glass microspheres (7% in 2011), and 33% used both (25% in 2011). There is a trend towards less coiling of non-target vessels (gastroduodenal artery is always coiled by 8% of centers vs. 71% in 2011) and more sequential treatment of the left and right liver lobe (53% vs. 33% in 2011). Cone-beam CT is used during work-up by 77% of centers.

Conclusion: This survey provides insight into the current state of radioembolization practices across Europe. The way radioembolization is performed has changed in many aspects over the last six years.

2005.6

The Lutonix AV trial: Interim 18 month results of a randomized trial of drug coated balloons in hemodialysis arteriovenous fistulae

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Purpose: Introduction: This multicenter trial was designed to explore the role of a drug-coated balloon in hemodialysis arteriovenous fistulae (AVF). Paclitaxel has been shown in prior small randomized trials and in early and mid-term results of this trial to yield better target lesion primary patency (TLPP) in AV fistulae compared with conventional balloon angioplasty. This trial is ongoing up to 2 years follow-up and given the propensity for recurrence of stenosis in AVF, late results are of considerable interest.

Material and methods: 285 patients with failing AVF at 23 centers were enrolled in this randomized trial. All patients received vessel preparation (high pressure PTA) of the lesion responsible for access dysfunction; a secondary lesion was allowed. After successful (<30% residual stenosis) PTA, either a paclitaxel-coated balloon (DCB) or an uncoated control balloon (C) of similar semi-compliant design was deployed at the treatment site. The treatment and control balloons were the same diameter as the pre-treatment balloon. Central venous and stent-associated stenoses were excluded. Follow-up was clinically driven; no scheduled US or fistulography was performed. Endpoints included 3, 6, 9, 12, 18 and 24 month target lesion primary patency (TLPP), number of interventions required to maintain target lesion patency, and safety endpoints.

Results: Lesion location, access type and other demographic variables did not differ between groups. The 30-day safety endpoint was met ($P < 0.001$). Interim 18 month results will be reported.

Conclusion: The ongoing Lutonix AV trial is the first large multicenter trial of DCB in AVF, and the first such trial to show a benefit of DCB.

Free Paper Session Radiation protection

2207.1

Occupational radiation exposure to the lens of the eye in interventional radiology

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Purpose: To measure the radiation exposure to the lens of the eyes of interventional radiologists (IRs) and the staff and to compare against the yearly dose limits set by the International Common on Radiation Protection (ICRP) standards in 2013. In addition, to calculate the estimated lifetime accumulated dose to the lens of the eye and measure the effectiveness of lead glasses.

Material and methods: This 12-month prospective study included 5 pairs of radiation protective lead glasses with thermoluminescent dosimeters (TLD) placed outside and behind the lead glasses worn by various interventional radiology staff. Radiation exposure (Hp3) was measured over a 12-month period with a control TLD placed in the storage area of the glasses when not being utilised. Radiation levels were compared against ICRP recommendations and a 'working lifetime' accumulated dose was calculated.

Results: At 6 months, the extrapolated yearly dose for IRs was between 12.1 and 30.7mSv on the outside of the glasses. The extrapolated yearly dose behind the lead glasses was 2.3–7.6mSv. The average reduction in radiation dose using lead glasses (0.035mm Pb equivalent) was 83%. Splash incidents were found for all glasses. Further analysis according to dose per days of intervention performed, lifetime cumulative radiation dose and protection against splash incidents were recorded. 12-month results will be presented.

Conclusion: Yearly dose limits to the eyes would be exceeded in some IRs depending on working loads. Lead glasses should be worn by some IRs to reduce the radiation dose to their eyes with an added benefit of splash protection.

2207.2

Real-time radiation dosimetry during vertebral augmentation: initial experience, education, and radiation reduction

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Purpose: The growth of fluoroscopically guided interventional procedures has led to increased radiation exposure to patients and staff. This study investigates a real-time radiation dosimetry system (RTRS) during vertebral augmentation, including its effects on radiation exposure and implementation of radiation safety measures.

Material and methods: RTRS (Ray safe I2) measured real-time radiation exposure in mREM (mR) for the attending physician (IR), scrub technologist (SC), circulating technologist (CT), and anesthesiologist (A). Fluoroscopy time (FT), dose area product (DAP), and mR were displayed for staff during the procedure. Data during standard procedure (SP) (n=10) were collected. Radiation reducing measures were added in the radiation-reduced procedure group (RRP) (n=55) and monitored with RTRS.

Results: Patients' weight was higher in RRP (72 vs 67 kg) compared with that in SP. Steps to reduce mR included the following:

- increasing staff awareness due to RTRS in a room,
- using low-pulse fluoroscopy (3f/s),
- angulation of image intensifier toward IR,
- wearing protective glass lead shield for IR and A,
- purposefully increasing distance to the radiation source,

- placing a radiation-absorbing shield on patients, and
- eliminating post-procedure cone-beam CT.

Radiation exposure data table:

	SP	RRP
DAP (cGy/cm ²)	2051	1474
FT (min)	3.9	4.7
IR (mrem)	9.1	5.4
SC (mrem)	1.4	0.6
C (mrem)	1.6	0.5
A (mrem)	3.4	1.1

Exposure of SC using cone-beam CT increased mR by 5-fold.

Conclusion: Utilization of RTRS significantly reduced staff radiation exposure during vertebral augmentation. This new procedure algorithm incorporates increased radiation awareness, stringent use of radiation protective devices, and implementation of a revised workflow.

2207.3

Scatter radiation reduction with a dedicated patient shield in interventional radiology examinations

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Purpose: A substantial amount of the medical staff's radiation exposure is generated by patients themselves due to scatter radiation. This study investigates the shielding efficiency of a dedicated patient apron using an anthropomorphological phantom.

Material and methods: We used a clinical angiography system (ArtisZee, Siemens Healthineers, Germany) with a thorax phantom (Alderson RANDO Phantom, Alderson Research Laboratories Inc., USA) as a scattering object. For radiation measurement, an ionization chamber (UMo, Berthold Technologies, Germany) was used. All measurements were performed at four different heights in order to evaluate the radiation exposure for different body parts of an examiner [165 cm (eye lense), 150 cm (thyroid), 130 cm (thorax), 100 cm (gonads)]. For each height, we additionally recorded the radiation exposure for three different tube angles (0°, 30°-right, and 30°-left). Each setup was measured with and without phantom shielding (femoral notch for intervention, lead equivalent: 0.25 mm, AMT Medical GmbH, Germany).

Results: At the eye's position, we measured a radiation reduction at the angle 30°-right, 0°, and 30°-left of 33%, 80%, and 41%, respectively. Similarly, at the thyroid level, the radiation reduction was found to be 53%, 79%, and 54%, respectively. The corresponding values of radiation reduction at the thorax were 69%, 77%, and 75%. The gonads were additionally protected by 25%, 16%, and 6%, respectively, using the lead shield. Each measurement is highly significant by $p < 0.01$ using a t-test.

Conclusion: Our study shows significant reductions of scatter radiation using a dedicated patient shielding apron on top of a phantom.

2207.4

Effective implementation of fluoroscopic and angiographic dose reduction in image guided procedures

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Purpose: To evaluate the effects of the Clarity radiation dose reduction program on patient and operator dose during interventional procedures. The impact on image quality of neurointerventional procedures will also be assessed.

Material and methods: We retrospectively compared radiation dose measurements of three commonly performed procedures obtained before and after the implementation of a dose reduction program. All procedures were performed by operators with between 12-25 years of experience. We modeled operator dose in an interventional suite by using an anthropomorphic mannequin to represent a patient and comparing dose measurements in a room modified and not modified by the dose reduction program. Operator dose was measured at the level of the eye and waist. The effects of dose reduction on image quality of neurointerventional procedures is still in progress. To do so, our evaluators are comparing images obtained with and without dose reduction side-by-side in a blinded fashion and completing a questionnaire pertaining to comparative image quality.

Results: After the dose reduction program was implemented patient dose was reduced by 65% for fistula interventions, 60% for visceral angiograms and 56% for chest ports. Operator dose reductions at the level of the eye and waist were 9%-22% and 30%-40%, respectively, depending on body region examined. The impact on image quality is currently being investigated. Preliminary findings suggest no significant difference in image quality.

Conclusion: The Clarity dose reduction program significantly reduces patient and operator dose. The impact on image quality as related to neurointerventional procedures is currently in progress.

2207.5

Effectivity of brain protection by lead X-ray attenuating head caps in phantom experiments and clinical practice

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Purpose: Interventional radiologists are exposed to scatter radiation during X-ray-guided procedures. Although the body and thyroid are usually protected by a customized apron, most interventional radiologists do not wear head protection caps. Occupational head exposure to radiation may cause radiation-induced cataracts and an increased risk of brain neoplasia. The aim of this study was to evaluate the X-ray protection effect of X-ray attenuating head caps with and without lead glasses.

Material and methods: Phantom measurements mimicking a clinical setting for an interventional radiologist were performed. X-ray exposure of the phantom head (Rando-man) with and without a 0.35-mm lead-equivalent head protection cap with and without lead glasses was measured using thermoluminescent dosimeters (TLD-100s) attached above and under the cap and glasses at predefined landmarks. Additionally, the X-ray protection effect was measured in two clinical procedures.

Results: We present the results from our phantom study and interim data from our ongoing prospective clinical analysis. In phantom measurements, the X-ray exposure reduction at the frontal head and left parietal lobe were a factor of 4.7 ± 0.3 and 3.8 ± 0.6 , respectively, for the lead cap and a factor of 5.1 ± 0.2 and 2.2 ± 0.7 , respectively, for the cap and glasses. These results were paralleled in the clinical setting (frontal head reduction factor of 2.5–6.0 and left parietal lobe reduction factor of 1.3–2.1). In contrast, an exposure increase was observed in the right parietal lobe (reduction factor of 0.4–0.6).

Conclusion: The X-ray protection effect of radiation attenuating head caps was a reduction in head exposure by a factor of 2.5–6 for the frontal head. This reduction is hardly influenced by wearing additional lead glasses.

2207.6

Evaluation of reduction in time and radiation exposure using a robotic tracking system for CT-guided percutaneous lung and renal biopsy

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Purpose: To evaluate the advantages of using a robotic tracking system for CT-guided percutaneous lung and renal biopsy in terms of technical success, procedure time, perfect centering of the lesion, and radiation dose exposure to interventional radiology (IR) and patients.

Material and methods: Between July 2015 and December 2016, we performed 26 CT-guided percutaneous biopsies in 26 patients (16 lung biopsy and 10 renal biopsy). Thirteen biopsies (8 lung and 5 renal) were performed using the "freehand" standard technique, whereas 13 procedures (8 lung and 5 renal) were performed using the robotic tracking system. For both procedures, the final positioning of the needle was confirmed with fluoro-CT. The parameters for CT were as follows: 125mAs and slice thickness of 2mm.

Results: Fluoro-CT confirmed the correct position of the needle using the robotic tracking system with a single entry in 12/13 (92%) patients. Technical success for both procedures was 100%. The mean execution time was 10 minutes for the assisted procedure and 16 minutes for the "freehand" procedure. The mean radiation dose for the patients after the first CT used for the visualization of the lesion was 2.5mSv in the standard procedure and 0.56mSv in the procedure using the robotic tracking system. The radiation dose for IRs was 0.

Conclusion: The robotic tracking system is an innovative medical device that allows centering lesions with an high degree of accuracy and following needle trajectory in real-time to avoid sensitive structures. Furthermore, reducing the procedure time and number of CTs facilitates reduction in the radiation dose in the patients and IRs.

Free Paper Session Drug-coated balloons

2208.1

Low-dose drug-coated balloon outcome for peripheral arterial disease treatment in females and patients with diabetes mellitus: 12-month sub-group analyses from the ILLUMENATE European randomized clinical trial

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Purpose: This randomized trial was designed to assess the safety and effectiveness of Stellarex drug-coated angioplasty balloon (DCB), a low-dose (2 µg/mm² surface dose of paclitaxel) DCB, in treating peripheral arterial disease (PAD) of the superficial femoral and/or popliteal artery.

Material and methods: This was a prospective, randomized, multi-center trial with blinded core lab adjudicated endpoints. Patients were randomized following successful predilatation to treatment with DCB (222 patients, 254 lesions) or uncoated PTA balloon (72 patients, 79 lesions). The primary effectiveness endpoint was

primary patency at 12 months. Post-hoc subgroup analyses were conducted to assess effectiveness of DCB in females and patients with diabetes.

Results: Within the cohort, the primary effectiveness endpoint was met and DCB was superior to PTA [83.9% (188/224) vs. 60.6% (40/66), $p < 0.001$]. Primary patency was significantly higher in females treated with Stellarex than in those treated with PTA [85.3% vs 61.0% ($p = 0.0168$)], and there was no significant difference in primary patency rates between males and females in the cohort treated with DCB (90.4% vs 85.3%, $p = 0.3064$). Patients with diabetes had a significantly higher patency rate when treated with Stellarex [82.9% vs 71.3% ($p = 0.0043$)] and patients in the Stellarex cohort with or without diabetes had similar patency rates (89.2% vs 88.8% $p = 0.4724$).

Conclusion: Superiority of Stellarex over PTA was demonstrated in females and in patients with diabetes. Patency rates were not statistically significantly different when comparing females to males or patients with diabetes to those without diabetes. Stellarex is an effective DCB solution for females and patients with diabetes.

2208.2

Twelve-month results of the RANGER SFA randomized study of the Ranger paclitaxel-coated balloon catheter: diabetic subgroup

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Purpose: The purpose of this randomized clinical study, performed in humans for the first time, was to evaluate the performance of the Ranger paclitaxel-coated balloon catheter (Boston Scientific Corporation, Marlborough, MA, USA; Hemoteq AG, Würselen, Germany) vs uncoated balloons for angioplasty of femoropopliteal artery lesions.

Material and methods: This prospective, randomized (2:1, Ranger paclitaxel-coated balloon:uncoated balloon) study included patients with symptomatic leg ischemia requiring treatment (i.e., Rutherford classification 2–4) and de novo or restenotic lesions in the native non-stented femoropopliteal segment. Approximately 38% of the study patients had diabetes ($n = 40$). The primary endpoint was 6-month angiographic late lumen loss, and efficacy and safety assessments continued at 12 months.

Results: Patients with diabetes treated with Ranger paclitaxel-coated balloon catheter ($n = 28$) had a mean lesion length of 70 ± 40 mm, 36% had occlusions, and 46% had severe calcifications, whereas patients in the control group ($n = 12$) had a mean lesion length of 47 ± 34 mm, 27% had occlusions, and 18% had severe calcifications. Late lumen loss at 6 months among patients with diabetes was significantly less for the Ranger DCB group (0.036 ± 1.0 mm vs 0.93 ± 1.3 mm; $P = .040$). The 12-month follow-up and analysis, including patency, TLR, and safety assessments, will be complete by the time of presentation.

Conclusion: The lumen loss analysis suggests that restenosis was inhibited in patients with diabetes treated with Ranger paclitaxel-coated balloon catheter, and 12-month results will show whether this inhibition translates into favorable patency and reintervention rates.

2208.3

Impact of calcium on drug-coated balloon: analysis of the long lesion (>15 cm) and CTO imaging cohorts of the IN.PACT Global study

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Purpose: The objective of the IN.PACT Global study was to assess the safety and effectiveness of the IN.PACT™ Admiral™ drug-coated balloon in the treatment of real-world patients with femoropopliteal disease. Here we report outcomes based on calcification in the long lesion and chronic total occlusion (CTO) imaging cohorts.

Material and methods: The IN.PACT Global study enrolled 1535 subjects, 1406 of whom were analyzed as part of the consecutively enrolled clinical cohort. A subset of the clinical cohort, the imaging cohort, underwent duplex ultrasound imaging at 12 months and during any reintervention within 12 months to assess target lesion patency. The imaging cohort comprised the following three prospectively predefined subgroups: de novo in-stent restenosis, long lesion of ≥ 15 cm, and CTO of ≥ 5 cm. This analysis focuses on the impact of calcium on patency, clinically driven TLR, and other outcomes in the long lesion and CTO cohorts only.

Results: In total, 321 subjects from the long lesion and CTO cohorts were stratified into two groups: group 1, none, mild, or moderate calcium (n=249) and group 2, moderately severe and severe calcium (n=72). The groups were well-matched at baseline. Mean age was 67.6% in group 1 and 73.6% in group 2. The mean length of the treated lesion was 22.9 $\pm$ 9.68 cm in group 1, and the treated lesions included 73.7% of the total occlusions. The mean length of the treated lesion was 24.73 $\pm$ 9.68 cm in group 2, and the treated lesions included 60.3% of the total occlusions.

Conclusion: Detailed results will be available at the time of this meeting.

2208.4

Twelve-month clinical outcomes after treatment of femoropopliteal lesions with a novel paclitaxel-matrix coated balloon catheter

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Purpose: This randomised controlled multicentre trial assessed the safety and efficacy of the paclitaxel-coated balloon catheter SeQuent® Please OTW (B.Braun Melsungen AG, Germany) in comparison with those of conventional pressure-only balloon angioplasty (POBA) in the treatment of steno-occlusive lesions of the femoropopliteal artery.

Material and methods: One hundred fifty-three patients with steno-occlusive lesions of the superficial femoral and the proximal two segments of the popliteal artery were randomised 1:1 for treatment with a drug-coated balloon (DCB) angioplasty or POBA. Inclusion criteria were Rutherford stages II–IV, >70% stenosis, lesion length 4–27cm and at least one patent run-off vessel. Clinical follow-up was performed at 12 months.

Results: The censored walking distance increase was significantly higher in patients who underwent DCB angioplasty. Furthermore, at 12 months, TLR rate in the DCB group was significantly lower than that in the POBA group, whereas the Rutherford category improvement was also significantly better in the DCB group.

Conclusion: Compared with POBA, the use of paclitaxel-resveratrol matrix-coated peripheral balloon angioplasty was associated with significantly reduced TLR rates and an improved walking distance at 12 months.

2208.5

EffPac Trial: Effectiveness of paclitaxel-coated Luminor® balloon catheter versus uncoated balloon catheter in the femoropopliteal artery to prevent vessel restenosis or reocclusion: Primary endpoint and 6 months follow-up

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Purpose: The aim of this investigator-initiated trial is to evaluate the safety and efficacy of the novel Luminor® Paclitaxel-coated drug-eluting balloon (DEB) (iVascular, S.L.U., Barcelona, Spain) in inhibiting restenosis and in ensuring long-term patency.

Material and methods: Multicenter randomized-controlled trial to evaluate Luminor® Paclitaxel-coated DEB catheter of stenotic or occlusive lesions (length: ≤15 cm) in the superficial femoral artery (SFA) and popliteal artery (PA) up to the P1 segment compared to non-coated plain old angioplasty balloon (POBA) catheter. In total 172 subjects will be treated with either DEB or POBA in 11 German study centers in a 1:1 randomization study design. Primary endpoint is late lumen loss (LLL) at 6 months. Secondary endpoints are patency rate, target lesion/vessel revascularization, quality of life (assessed with Walking Impairment Questionnaire (WIQ) and EQ5D), change of Rutherford stage and ankle-brachial index, major and minor amputation rate at index limb, number of bailouts and all-cause mortality.

Results: The primary endpoint (LLL) and 6 months follow-up results will be presented.

Conclusion: EffPac represents a randomized controlled trial that will provide evidence on the effectiveness of Luminor® Paclitaxel-coated DEB catheter for the reduction of restenosis compared to POBA of SFA and PA. The results of EffPac will allow direct comparison to other already-completed RCTs applying Paclitaxel-coated DEB from different manufactures in the same target vessel.

Trial registration: NCT02540018. Registered 17 August 2015

2208.6

Twelve-month outcomes of standard vs. extended usage of DCB: analysis of the IN.PACT Global study

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Purpose: The IN.PACT Global study was designed to evaluate the safety and effectiveness of the IN.PACT™ Admiral™ DCB for the treatment of symptomatic femoropopliteal artery lesions across a wider range of patients treated in real-world clinical practice.

Material and methods: IN.PACT Global is an independently adjudicated prospective, nonrandomized, multicenter study that enrolled >1500 patients. A large number of patients treated with clinical and lesion characteristics that did not fit the standard use (SU) criteria

of previously conducted pivotal trials (such as IN.PACT SFA Trial) were included in an extended-use group. The extended-use group is defined as patients with lesions >18cm in length and moderate/severe calcification. Endpoints included primary safety, defined as freedom from device- and procedure-related mortality through 30 days; freedom from major target limb amputation and clinically-driven target vessel revascularization within 12 months; and freedom from clinically-driven target lesion revascularization, major adverse event rate, major target limb amputation and thrombosis rates at 12 months. Outcomes will be compared between patients in the SU and EU groups.

Results: Among the patients characterized as standard use, mean age was 67.4 years, 62.7% were male, 76.6% were hypertensive, and 36.5% were diabetic. Mean lesion length was 7.70 ± 4.48 cm. Among the extended-use group, the mean age was 68.4 years, 70.8% male, 84.7% were hypertensive, and 40.4% were diabetic. The mean lesion length treated for this group was 17.02 cm.

Conclusion: Twelve-month results will be compared between the SU and EU groups. These data will be available at the time of this meeting.

Free Paper Session

Peripheral arterial disease

2306.1

Thirty-six-month results from the MAJESTIC trial of the Eluvia drug-eluting vascular stent system

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Purpose: The purpose of the MAJESTIC clinical study was to evaluate the performance of the Eluvia drug-eluting vascular stent system (Boston Scientific Corporation, Marlborough, MA, USA) in treating femoropopliteal artery lesions.

Material and methods: MAJESTIC is a prospective, single-arm, multicenter clinical study of patients with chronic lower limb ischemia and de novo or restenotic lesions in the native superficial femoral artery and/or proximal popliteal artery. Long-term follow-up includes safety monitoring (i.e., adverse events and target lesion revascularization) over 3 years.

Results: Mean age (±SD) of the patients (N=57) was 69±3 years, 83% were male, and 35% had diabetes. Baseline Rutherford category was 2 for 35%, 3 for 61%, and 4 for 4% of patients. Mean lesion length was 70.8±28.1 mm, and 65% had severe calcification. Percent diameter stenosis was 86.3%±16.2%, and 46% had total occlusions. At 24 months, freedom from TLR was 91.3% and primary patency was 78.2% (Kaplan–Meier estimates). No stent fractures were identified over 24 months. Thirty-six-month safety assessments will be available by the time of presentation. At 36 months, freedom from TLR was 85.3%. No target limb amputations occurred and no stent fractures were identified.

Conclusion: MAJESTIC results show that patients treated with the Eluvia stent had a high patency and low MAE rate through long-term follow-up.

2306.2

The randomized Freeway Stent Study completed the 12-month follow-up and favored the use of drug-eluting balloons over plain balloons for the postdilatation of nitinol stents in the SFA and PI segments to lower restenosis rate

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Purpose: Stents are needed in up to 50% of all peripheral interventions where PTA with plain or drug-eluting balloons alone will not reopen the vessel sufficiently. Nevertheless, the restenosis rate of stents is still a major limitation of peripheral arterial interventions. Drug-eluting balloons potentially overcome the problem of in-stent restenosis when used for postdilatation after primary nitinol stenting in the SFA and PI segments.

Material and methods: The Freeway Stent Study is a prospective, randomized, international trial conducted in 13 centers of Germany and Austria. Overall, 204 patients were enrolled and randomized to primary stenting, followed by either DEB (FREEWAY™) or POBA postdilatation. Primary endpoint was clinically driven target lesion revascularization (TLR) at 6 months; secondary endpoints included patency rate, shift in Rutherford classification, and ABI and MAE at 6 and 12 months.

Results: The 12-month follow-up has been completed and the final study results highly favor the use of FREEWAY™ DEB over POBA. In clinically driven TLR, the primary patency rate and in clinical outcomes for patients, the FREEWAY™ DEB clearly show superior results over the use of a standard balloon.

Conclusion: The use of DEB as a postdilatation device is investigated through a new approach to decrease the restenosis rate after nitinol stenting in the SFA and PI segments. The Freeway Stent Study shows that the use of DEB as a restenosis prophylaxis seems to be safe and feasible. The 12-month follow-up results give a clear sign that all parameters favor DEB.

2306.3

Treatment of calcified iliac stenosis using the shockwave medical Lithoplasty® system to facilitate percutaneous aortic intervention

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Purpose: Endovascular aneurysm repair (EVAR) with stentgrafts has become the standard of care; however, many patients are not candidates because of calcified iliac access arteries. Percutaneous treatment of calcified iliac stenosis is associated with high rates of complications including dissection and perforation which require urgent percutaneous or surgical intervention and associated comorbidities. Lithoplasty is a novel balloon-based therapy utilizing lithotripsy specifically designed to disrupt calcium prior to low-pressure balloon expansion. This study aimed to investigate the safety and performance of the peripheral lithoplasty catheter system (Shockwave Medical, Fremont CA), a lithotripsy-enhanced, low-pressure balloon catheter, for the treatment of calcified, stenotic, iliac arteries.

Material and methods: This is a prospective, single-center, single-arm study of 10 patients with calcified iliac artery disease. Patients will be screened for severely calcified iliac arteries (stenosis > 50%)

using CTA. Patients will undergo procedural angiography and intravascular imaging at baseline and following lithoplasty. The primary safety endpoint is major adverse events through 30 days including death, target limb loss, or target limb revascularization. The primary performance endpoint is acute reduction in percent diameter stenosis of the target lesion.

Results: Baseline and 30-day results will be available at the time of presentation.

Conclusion: Lithoplasty is a novel therapy for the treatment of calcified, stenotic peripheral arteries. This is the first prospective study for evaluating the safety and performance of the shockwave medical peripheral lithoplasty system to treat calcified, stenotic, iliac arteries using a familiar balloon-based approach.

2306.4

Full cohort 12-month outcomes of the BIOLUX 4EVER trial: treatment options backed by evidence

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Purpose: The BIOLUX 4EVER trial was designed to investigate the efficacy of combined endovascular treatment of fempop arterial stenotic disease using the Paseo-18 Lux drug-releasing balloon and Pulsar-18 stent

Material and methods: The BIOLUX 4EVER is a prospective, multicenter trial that enrolled 120 patients with fempop arterial stenotic disease. In this trial, the combination therapy of the Paseo 18 Lux DCB with the low-strut profiled Pulsar 18 stent was investigated and finally compared with the 4EVER trial where the same stent was used but without the DCB vessel. In addition, benchmarking the outcomes of the more versatile combination therapy of DCB and BMS with the results of several DES trials was included in this investigation. The primary endpoint of the BIOLUX 4EVER was primary patency on DUS in lesions <19 cm and freedom from clinically-driven target lesion revascularization at 12 months.

Results: In total, 120 patients with a mean age of 70.8 years were included (65.83% male patients; 19.17% were with diabetes). The mean lesion length that was treated in the full cohort was 83.33 mm. A total of 33.33% occlusions and 50% moderate-to-severe calcified lesions were treated. Preliminary 12-month primary patency (105/120 patients) was 89.3% and freedom from clinically-driven target lesion revascularization (105/120 patients) was 93.7%.

Conclusion: Full cohort 12-month results will be available at the time of the CIRSE meeting.

2306.5

Primary stenting of the superficial femoral artery in intermittent claudication improves health-related quality of life, ABI, and walking distance: 12-month results of a randomized controlled multicenter trial

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Purpose: Invasive treatment of intermittent claudication (IC) due to severe atherosclerotic stenosis or occlusion in the superficial femoral artery (SFA) is controversial. This prospective randomized trial was performed to assess the impact of primary stenting with nitinol self-expanding stents compared with that of the best medical

treatment alone in patients suffering from stable IC due to SFA disease on the health-related quality of life (HRQoL).

Material and methods: One hundred patients with stable IC due to SFA disease from seven Swedish hospitals treated with the best medical treatment (BMT) were randomized to either the stent (n=48) or the control (n=52) group. Change in HRQoL assessed by Short Form36 Health Survey (SF-36) and EuroQoL 5-dimensions (EQ5D) 12 months after treatment was the primary outcome measure. Improvement in the walking impairment questionnaire (WIQ), ankle-brachial index (ABI), and walking distance were the secondary outcomes.

Results: HRQoL improved significantly; the SF-36 domain physical function improved 19 points ($P<0.001$), bodily pain 14 points ($P=0.001$), general health 6 points ($P=0.019$), vitality 10 points ($P=0.004$), physical component summary 6.5 points ($P<0.001$), EQ5D 0.14 points ($P=0.008$), and WIQ 22 points ($P<0.001$) in the stent group but was unchanged in the control group. Both ABI and walking distance improved significantly in both groups, but at 12 months, both ABI ($P<0.001$) and walking distance ($P=0.001$) were higher in the stent group.

Conclusion: In patients with IC caused by lesions in the SFA, addition of primary stenting to BMT was associated with significant improvement in HRQoL, ABI, and walking distance after 12 months of follow-up compared with BMT alone.

2306.6

BioMimics 3D helical stent imparts curvature in calcified vessels and creates swirling flow

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Purpose: The BioMimics 3D stent is a self-expanding nitinol stent with a three-dimensional helical centreline geometry indicated for use in the femoropopliteal artery. The purpose of the helical centreline geometry is to generate swirling blood flow within the stented segment. Preclinical studies have indicated that the introduction of swirling blood flow reduces neointimal formation. This clinical study aimed to answer the question whether non-planar curvature can be imparted to a diseased, calcified artery and whether this leads to a swirling flow.

Material and methods: The Mimics study randomized 76 patients with symptomatic peripheral arterial disease: 2:1 to either BioMimics 3D or Lifestent. In the helical and straight stent groups, 52% (26/50) and 58% (15/26) ($P=0.47$), respectively, had moderate-severe calcification (core lab data). Using biplanar X-ray images (AP and lateral projections), the stent centreline curvature was quantified for each device. The presence or otherwise of swirling flow within the stents was confirmed by transluminal color Doppler.

Results: For lesions with none-mild calcium burden, there is a significant increase in stent curvature when the BioMimics 3D and control stents are compared ($P=0.05$) and there is no drop-off in the level of curvature in the BioMimics 3D device when the none-mild and moderate-severe groups are compared ($P=0.14$). Primary patency was observed to be independent of the degree of calcification in the BioMimics 3D group. This supports the rationale for BioMimics 3D use within heavily diseased femoropopliteal segments.

Conclusion: The BioMimics 3D stent is as effective at imparting three-dimensional helical curvature in calcified vessels as it is in non-calcified vessels.

Free Paper Session GI tract intervention

2307.1

Spectrum of fluoroscopy-guided percutaneous diagnostic and treatment procedures via the pancreatic duct percutaneous drainage tract: feasibility and technique

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Purpose: To present the percutaneous procedures that might be performed after pancreatic duct (PD) percutaneous drainage.

Material and methods: Twenty-one patients underwent image-guided percutaneous procedures via the PD percutaneous drainage tract, including endoluminal RFA with subsequent stenting in 9, balloon-assisted percutaneous descending litholapaxy (BAPDL) in 6, endoluminal biopsy in 3, balloon dilatation in 2, and stenting in 1 patient. The obligatory first step for all procedures was conduction of the wire into the duodenum performed using a 5-Fr-diameter Advantage catheter. RFA was performed using a 5-Fr-diameter novel bipolar RF device (15 watts of energy applied for 2 minutes), positioned in the strictured segment over the wire and BAPDL was performed by pushing down action using a partially inflated balloon after papilla dilatation. Endoluminal biopsy was performed using an endobiliary forceps biopsy set. Balloon dilatation and stenting was performed using the conventional technique.

Results: In 18 (85.7%) of 21 cases, the procedures were completed, achieving PD patency restoration or adequate tissue sample; in 3 (14.3%) cases (all pancreatic head cancers), procedure completion was impossible because of failure of guidewire conduction across the strictured segment of PD. All patients tolerated the procedure well and there was no 30-day or hospital mortality; no technique specific complications were observed.

Conclusion: Percutaneous fluoroscopy-guided percutaneous diagnostic and treatment procedures via the PD percutaneous drainage tract are safe and effective; these procedures should be routinely suggested as treatment options for selected patients.

2307.2

Percutaneous image-guided main pancreatic duct drainage: indications, technique, and results

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Purpose: To present percutaneous image-guided pancreatic duct (PD) drainage.

Material and methods: Thirty-seven patients underwent percutaneous image-guided PD drainage. In 36 of them, the indication was PD obstruction-related clinical symptoms (pancreatic irritation or recently revealed diabetes); in one case of pancreatic fistula, non-dilated PD was drained. PD drainage was performed under combined image guidance: US and fluoroscopy (17) or CT and fluoroscopy (20 cases). After US- or CT-guided PD puncture using 22-18-G needles, the drainage catheter was placed under real-time fluoroscopy guidance over the wire.

Results: Drainage was successful in all cases including the case with non-dilated PD with post-biopsy pancreatic fistula. Clinical improvement was documented and pancreatic fluid discharge varied

between 300 and 900 ml/day. Three patients with recent onset of diabetes showed a dramatic improvement in glycemic control.

Conclusion: Percutaneous PD drainage appears to be a safe and effective procedure and should be considered in patients with obstructed PD, particularly in failed endoscopic retrograde cannulation or impracticable cases.

2307.3

Introduction of a new low-profile gastrostomy tube for percutaneous radiological gastrostomies: experiences in 115 procedures over a 3-year period

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Purpose: Analysis of the primary success, procedural complications, and material-related complications of a new low-profile gastrostomy tube for percutaneous radiological gastrostomies (prg).

Material and methods: Since the introduction of the new low-profile gastrostomy tube 3 years ago, 115 prg have been performed. Queries on the radiological and hospital information systems were performed and data were analyzed for primary technical success, complication rate, and material-related complications during follow-up. All prgs have been performed using the push gastrostomy technique with a tube of 16 Fr. The low-profile gastrostomy tube is a balloon-retained device in which the balloon is not mounted onto but placed in profile with the tube. Because of this construction, only a 2-Fr bigger peel-away sheath is necessary. Older systems with non-low-profile tubes needed a 4-Fr overdilatation.

Results: In total, 115 prg have been performed. The primary success was higher than 99%. There have been 15.8% minor complications (local infection or mild spilling) and 2.6% major complications (2× spilling and 1× leakage into the peritoneal cavity). In total, 24.1% had dislocated tubes or other material-related problems during the follow-up.

Conclusion: With the new low-profile gastrostomy tube, a high rate of success with low complications can be achieved. The small diameter of the tube through the low profile reduces the risk of overdilatation of the tract. A 16-Fr tube has a sufficient diameter without the risk of clogging because of the feed or applied drugs. Balloon-retained tubes have a higher risk for tube dislocation.

2307.4

Y-90 radioembolization with Occlusafe catheter infusion system in patients with unresectable hepatic metastasis

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Purpose: Yttrium-90 (Y-90) radioembolization is a well-established treatment option for patients with unresectable liver tumors. Coil embolization of extrahepatic vessels is usually mandatory to avoid extrahepatic nontargeted implantation of Y-90 microspheres. To test the Occlusafe microcatheter (Terumo, Japan) as a new balloon antireflux microcatheter (2.7 F) for Y-90 microspheres infusion.

Material and methods: Nine patients with unresectable liver metastasis [6 colorectal cancer (CRC) and 3 breast cancer (BC)] underwent Y-90 radioembolization. In all cases the Occlusafe catheter was used for microsphere infusion. Embolization of the gastroduodenal artery was not performed in all patients. In all cases infusion was started after Dyna CT scan. The liver distribution of microspheres was assessed by Y-90 PET/CT on the same day of the procedure.

Results: The procedure was performed in all patients without any complications. The Occlusafe microcatheter allowed catheterization of the hepatic arteries even in difficult anatomical variants. Y-90 PET/

CT confirmed the intrahepatic distribution of the microspheres and no extrahepatic nontargeted implantation in the gastroduodenal territories.

Conclusion: The Occlusafe catheter is a valuable device for preventing reflux of Y-90 microspheres during radioembolization. The system may expand the indications of radioembolization in those patients previously deemed unfit because of the high risk of extrahepatic microsphere implantation.

2307.5

A novel technique using transhepatic retrograde duodenal stent placement in treating duodenal obstruction

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Purpose: Case series reviewing a technique allowing duodenal stent placement across the ampulla of Vater via a transhepatic approach. Endoscopy is most commonly used to place duodenal stents across neoplastic gastric outlet obstructions. However, if the obstruction is severe, an endoscopic approach can fail. Percutaneous transhepatic duodenal stent placement has been used in patients with malignancies not involving the ampulla of Vater. To this date, such an approach has not been considered an option when the stent must be deployed across the ampulla.

Material and methods: The technique resides in establishing a through-and-through wire going from the liver toward the jejunum, and then, curving back on itself retrogradely through the duodenum and stomach and out of the mouth. The stent is advanced over the wire via the transhepatic route until it crosses the ampulla where it is deployed. After stenting the duodenum, the biliary system can also be stented into the duodenal stent.

Results: Case series of 10 patients (7 male and 3 female) with a mean age of 78 years. The main indication for stenting was pancreatic carcinoma. Average time from stent placement to discharge was 47 days. Overall, 55% showed marked improvement in bilirubin levels post-stenting. Placement failed in only one patient due to tumor perforation while trying to cross it with a wire. None of the nine patients developed pancreatitis or peritonitis. There were no mortalities in the first 30 days.

Conclusion: The retrograde transhepatic technique is an effective alternative with a high success rate and few complications.

2307.6

Fluoroscopy-guided dilation of oesophageal strictures in patients with dystrophic epidermolysis bullosa: long-term results

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Purpose: To investigate the immediate and long-term outcomes of fluoroscopy-guided balloon dilation of oesophageal strictures in a series of patients with dystrophic epidermolysis bullosa (DEB).

Material and methods: Retrospective review and analysis of prospectively maintained medical records of all patients with DEB who underwent fluoroscopy-guided balloon dilation of oesophageal strictures between 2003 and 2016 was performed. The main indication for treatment was dysphagia attributed to at least one

radiologically confirmed oesophageal stricture. The primary end-points of the study included technical success; clinical improvement, measured using a 0–4 dysphagia score system; and mean intervention rate and interval. The secondary endpoint was the complications rate.

Results: Forty-five consecutive patients with DEB and dysphagia due to oesophageal strictures were treated with fluoroscopy-guided balloon dilation. The mean frequency of dilatation per patient was 5 (ranging between 1 and 29). The balloon diameter ranged from 8 to 18 mm. The mean follow-up time was 87.50 ± 27.42 months. The technical success rate was 98.7%. There were no major complications. There was significant immediate relief of symptoms in almost all patients with postprocedural dysphagia score significantly lower than the baseline ($p < 0.001$).

Conclusion: Repeated fluoroscopy-guided balloon dilation is safe and effective for the management of dysphagia caused by oesophageal strictures in DEB. This procedure was safe with no major complications and associated with significant improvement in the dysphagia score and satisfactory long-term reintervention rates.

Free Paper Session Dialysis access

2308.1

Near-infrared fluorescence imaging of MMP-2 activity as a biomarker of stenosis in AV fistulae

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Purpose: To establish the capability of near-infrared optical imaging in detecting matrix metalloproteinase-2 (MMP-2) activity as a biomarker of vascular remodeling in arteriovenous fistulae (AVF) *in vivo*.

Material and methods: AVF were surgically created in the right groin of Wistar rats ($n=10$), while sham procedures were performed in the contralateral (left) groin of each rat. Following intravascular administration of the fluorescent probe, near-infrared imaging was performed both *in vivo* as well as *ex vivo* in AVF- and sham-treated animals. Histologic analyses of AVF- and sham-treated vessels were performed to corroborate imaging findings.

Results: AVF were successfully created in all animals at the time of surgery. Fistulography confirmed AVF with $>50\%$ peri-anastomotic stenosis in all animals imaged 4 weeks post-AVF creation ($n=5$). In two animals, AVFs were thrombosed at 4 weeks post-AVF creation. The mean normalized MMP-activated NIRF signal was 45.5 in AVFs compared with 16.2 in the contralateral control vessels. The mean increase in total radiant efficiency of AVFs over the control vessels was 2.6-fold ($SD=0.98$, $p=0.012$). Increased levels of MMP-2 were identified in the neointimal layer of the peri-anastomotic venous stenosis. On average, the thickness of intimal staining for MMP-2 measured 171.3 ± 58.9 compared with 70.4 ± 34 in sham vessels ($p=0.0072$).

Conclusion: NIRF imaging can detect increased MMP-2 activity in stenotic AVF compared with contralateral normal vessels. This finding was confirmed by an increase in the MMP-2 signal in the neointimal layer of stenotic AVF. These findings indicate that NIRF imaging of MMP-2 may be used as a biomarker for the vascular remodeling of the underlying stenosis.

2308.2

Percutaneous creation of an endovascular arteriovenous fistula (endoAVF): 12-month follow-up and outcome data

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Purpose: The newly developed endovascular approach for ulnar-ulnar fistula creation (endoAVF) may be an alternative to the surgical upper-arm dialysis fistula. The feasibility, early complication rates, and short-term outcome data of this novel treatment option have been described previously by our working group and showed promising results. Here we describe the 12-month follow-up analysis in terms of clinical and functional outcomes.

Material and methods: Between July 2015 and February 2016, 8 patients were included in this observational study. Indications for endoAVF were confirmed by a multidisciplinary vascular board upon contraindication for Cimino fistula creation. Patients were included after a pretherapeutic ultrasound. Time to maturation of endoAVF and clinical and functional outcomes at the 12-month follow-up are reported here.

Results: Of the 8 patients included in the study, creation of endoAVF was successful in all cases. Median time to endoAVF maturation was 63 days (range: 26–137 days). Hemodialysis was started without problems in all 8 patients. Patency after 4, 6, and 8 months was 100%. At the 10-month follow-up examination, a closure of fistula was observed in 1 patient. After the 12-month follow-up period, hemodialysis via endoAVF was performed in the remaining 7 patients (88%).

Conclusion: At the 12-month follow-up, endoAVF showed good clinical and functional outcomes. Bigger sample sizes and longer follow-ups are needed to prove the comparability to surgical dialysis access creation.

2308.3

Patient perspectives on central venous access devices (CVADs) in chemotherapy: a qualitative investigation in the context of a large-scale RCT

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Purpose: The purpose of this research is to develop a quality of life measure for patients with CVADs and to inform the education of clinicians caring for these patients. To this end, we aim to investigate patients' experiences of three CVADs for the long-term delivery of chemotherapy (Hickman-type device, PICC and implantable chest wall ports) and their experiences of participation in a randomised controlled trial of CVADs.

Material and methods: Focus groups were conducted at six clinical sites across the UK. Participants were patients with port, Hickman or PICC devices for the long-term delivery of chemotherapy. A range of experiences with different devices were sampled. Focus group discussions were audio recorded and transcribed, and data were analysed using thematic analysis.

Results: The key themes identified in the data include (i) practical difficulties and patient adaptations regarding the day-to-day device management of CVADs, (ii) the social and psychological aspects of CVADs, (iii) the importance of patient interactions with clinical staff concerning CVADs and (iv) patients' informational needs regarding decisions about CVADs and various aspects of self-care.

Conclusion: This research identifies a number of challenges faced by patients who need a CVAD for the administration of chemotherapy. It suggests a number of ways in which clinical teams might

improve patient experiences of CVADs. Finally, this research offers novel insights regarding some potential benefits of port devices over other CVADs.

2308.4

Vascular access rescue with endovascular angioplasty using paclitaxel drug-eluting balloons

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Purpose: The leading cause of haemodialysis vascular access failure is thrombosis due to insufficient maturation of the arteriovenous anastomosis or stenosis of the prosthetic venous anastomosis. We present a single-centre 25-month experience with a paclitaxel-releasing high-pressure drug-eluting balloon employed on native and prosthetic vascular accesses.

Material and methods: We prospectively evaluated 81 patients (50 M). The overall mean age was 67±12 years (range 30–87). In total, 151 stenoses were treated. Twenty-two (27.2%) patients were treated for different stenoses: two (n=15, 68.2%), three (n=5, 22.8%), four (n=1, 4.5%) or five times (n=1, 4.5%). A successful angioplasty was defined as a procedure free from complication and with a residual stenosis < 30%. All patients underwent monthly clinical and radiological follow-up.

Results: Angioplasty was technically successful in 95.5% cases. Intraoperative complications occurred in six (4.5%) cases: 5 thrombosis and 1 PSA. No in-hospital mortality or major local or systemic morbidity was observed. No patient was lost to follow-up and the mean follow-up was 300 days (range 30–771 days). In 25 cases, a significant restenosis was documented; of these, restenosis was documented in 20 (80%) cases during follow-up or as a result of haemodynamic changes during haemodialysis and was documented in five cases (20%) after access thrombosis. In all cases restenosis was treated with four stentgrafts. Restenosis rate was 0%, 2.2% 15.1% and 33.9% at 30, 180, 360 and 720 days, respectively.

Conclusion: In our experience, the paclitaxel-releasing high-pressure drug-eluting balloon has proven to be safe and effective.

2308.5

Poor man's thrombectomy is a novel technique for the treatment of thrombosed arteriovenous grafts: 5-year results of 241 cases

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Purpose: This was a single-center retrospective analysis investigating the results of a hybrid thrombolysis-thrombectomy method for the treatment of thrombosed dialysis arteriovenous grafts (AVG).

Material and methods: From January 2012 to December 2016 (5 years), 291 declotting procedures were performed in our department for the treatment of thrombosed dialysis arteriovenous fistulas or AVGs. Data were available for 129 patients (75 men, 58.1%) with AVG undergoing 241 procedures [1.87 procedures/patient (1–10)]. The procedure includes initial thrombolysis with 5mg tPA followed

by thrombectomy with high-pressure balloons for thrombus maceration using "facing sheaths" technique. Sixty-one patients underwent ≥2 declotting procedures. In 80 cases (80/241; 33.2%), a stent-graft (SG) was used for thrombus apposition or treatment of persistent stenosis. The primary outcome measure was circuit survival. Secondary outcome measures included procedural complications and investigation of independent factors that could influence survival.

Results: The median survival was 434 days according to Kaplan-Meier survival analysis. In 6 cases (6/241, 2.49%), declotting failed and a catheter was placed. There were 16 minor (16/241, 6.64%) and no major complications. There was no significant difference regarding circuit survival when SG was placed (no SG 406 days vs. SG 349 days; p=0.24). There was a significant difference with the 2nd declotting compared with that with the 1st declotting procedure in 61 patients (1st: 162 days vs. 2nd: 447 days; p<0.0001).

Conclusion: The hybrid declotting method performed in our department has high survival rates with increased technical success and minimum complications without the use of thrombectomy devices.

2308.6

Prospective single-center observational study investigating angioplasty with paclitaxel-coated balloons for the treatment of failing native arteriovenous fistulae and prosthetic arteriovenous grafts

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Purpose: To report the results of a large prospective single-center observational study investigating angioplasty with paclitaxel-coated balloons (PCBs) for the treatment of failing native arteriovenous fistulae (AVFs) or prosthetic arteriovenous grafts (AVGs).

Material and methods: The enrollment criteria for this clinical study included the clinical signs of failing dialysis access with the angiographic documentation of a significant stenotic lesion in patients with AVF or AVG circuits. From April 2015 to September 2016, 76 patients [mean age, 60 (range, 19–84) years] were treated with the PCB dilation of a stenosed venous outflow lesion. Regular duplex ultrasound follow-up was performed. Study outcome measures included device success (<30% residual stenosis), procedural success (<30% residual stenosis), and the primary and secondary patencies of the treated lesion (no need for any interim repeat procedures).

Results: Demographics: dialysis patients, 74/76 (97%); males, 47/76 (63%); BMI, 28.8 (range, 21.6–37.0); diabetes, 48/76 (63%); and hypertension, 67/76 (88%). Procedural success was obtained in 74/76 (97.3%) patients after high-pressure pre-dilation. The PCB device success was obtained in 74/74 (100%) patients. No major or minor complication was noted. At 6 months, cumulative target lesion primary patency was at the juxta-anastomotic site, 9/17 (53%); venous outflow site, 12/16 (75%); central venous site, 7/14 (50%); and protheto-venous site, 2/27 (7%).

Conclusion: PCB angioplasty improved patency after angioplasty of venous stenoses of the failing vascular access used for dialysis mostly in the juxta-anastomotic and native av-outflow tract. No improvement was observed at the prosthetic-venous anastomotic site.

News on Stage Session Interventional Oncology News on Stage

2804.1

Proof of concept of a gene-directed enzyme prodrug therapy with intra-arterial delivery of mesenchymal stem cells in a rabbit VX2 hepatic tumor model

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Purpose: Gene-directed enzyme prodrug therapy (GDEPT) is a cancer gene therapy using a gene (optimized by mutations) encoding for an enzyme delivered to tumor cells and followed by the administration of a prodrug, which is converted locally into a cytotoxic by the mutated enzyme. The goal of our study was to assess the feasibility and efficacy of a suicide gene therapy using transduced mesenchymal stem cells intra-arterially delivered in a rabbit VX2 hepatic tumor model.

Material and methods: Eleven rabbits with a VX2 hepatic tumor were randomly assigned to 3 groups. Control group A (1 rabbit) was free of any treatment, Control group B (2 rabbits) received intravenous injection of 80mg/kg cyclophosphamide at days 3 and 9, and group C (8 rabbits) received the GDEPT treatment consisting of an intra-arterial injection of transduced MSCs successively at days 0 and 11, followed by a CPA injection at days 3 and 14. Animals were followed until sacrifice (day 25) by ultrasound scan and blood examination. An all-organ pathological examination was performed after sacrifice.

Results: A significant tumor volume difference between control groups and group C was observed at day 7 ($p=0.024$), day 11 ($p=0.024$), and day 25 ($p=0.048$). Tumor necrosis was significantly higher in rabbits who received GDEPT (78% of total tumor surface) compared with control animals (22% of total tumor surface) ($p=0.006$).

Conclusion: Intra-arterial delivery of transduced MSCs with a suicide gene is feasible and induces significant tumor necrosis in a rabbit VX2 hepatic tumor model.

2804.2

Idarubicin-loaded DC Bead® for chemoembolization of HCC: interim analysis of IDASPHERE II (FFCD 1307) multicenter single-arm phase II trial

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Purpose: The primary endpoint was to assess the objective response (OR) rate at 6 months after trans-arterial chemoembolization (TACE) for HCC using the idarubicin-loaded DC Bead®.

Material and methods: TACE sessions (1–4) were performed using 10mg of idarubicin loaded in the 100–300- μ DC Bead®. Toxicity assessed according to NCI-CTCAE v4.0. or evaluated by MRI centralized review using mRECIST criteria was the primary endpoint. The study involved a 2-step Fleming design (H0: OR at 25% at 6 months vs H1: 40%, power=90%, one-sided: $\alpha=5\%$). Forty-six patients (pts) were included for the interim analysis (91 pts initially planned), and 44 pts were evaluable.

Results: Forty-six pts (median age: 71 years range: 44–89 years; male: 87%; Child A: 80%) were enrolled in 7 centers. Performance status was 0 in 83%, 1 in 15%, and 3 in 2%. BCLC status was A in 10.9%, B in 76.1%, and C in 13%. Bilobar disease was reported in 51%, with >3 HCC nodules in 53.5% pts. Complete response, partial response, and stable disease were observed in 6 (13.6%), 16 (36.4%), and 4 (9.1%) pts, respectively. OR rate at 6 months was 50% (90% CI: 36.8%–63.2%). The trial was stopped at interim analysis because of efficacy: OR was achieved in 22 pts (19 pts or more were expected). In term of toxicities, 72% of the patients had at least one grade 3–4 toxicity, mainly transaminase increase.

Conclusion: TACE of HCC using the idarubicin-loaded DC Bead® is well-tolerated and provides a 50% objective response rate at 6 months. A randomized phase 3 trial is warranted.

2804.3

Prospective clinical and pharmacological evaluation of the Delcath System's second generation (GEN2) hemofiltration system in patients undergoing percutaneous hepatic perfusion with melphalan

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Purpose: To analyze the pharmacokinetics and toxicity of percutaneous hepatic perfusion (PHP) with melphalan using a new Delcath System's second generation (GEN2) filter in patients with hepatic metastases and compare this with first generation filters.

Material and methods: From February 2014, two prospective phase II studies were initiated in patients with hepatic metastases from ocular melanoma or colorectal cancer. In 10 PHP procedures performed in the first 7 enrolled patients, blood samples were obtained to determine filter efficiency and systemic drug exposure. PHP was performed with melphalan 3 mg/kg with a maximum dose of 220 mg. Complications were assessed according to CTCAE v4.03. Response was assessed according to RECIST 1.1.

Results: Pharmacokinetic analysis of blood samples showed an overall filter efficiency of 86% (range 71.1%–95.5%). The mean filter efficiency decreased from 95.4% 10 minutes after the start of melphalan infusion to 77.5% at the end of the procedure ($p=0.051$). Bone marrow depression was observed after up to 80.0% in 10 procedures, but was self-limiting and mostly asymptomatic. No hypotension-related complications or procedure-related mortality occurred.

Conclusion: The GEN2 filter had a higher melphalan filter efficiency than the first-generation filter and a more consistent performance. PHP with the GEN2 filter appears to have an acceptable safety profile, but this needs further validation in larger studies.

2804.4

Chemoembolization adopting polyethylene glycol drug-eluting embolics loaded with doxorubicin for the treatment of hepatocellular carcinoma

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Purpose: To study the efficacy and tolerability of transarterial chemoembolization (TACE) using polyethylene glycol (PEG) drug-elutable microspheres loaded with doxorubicin for the treatment of hepatocellular carcinoma (HCC).

Material and methods: Eighty-four patients with unresectable HCC by tumor board were assigned to TACE and treated with polyethylene glycol drug-elutable (PEG) embolics loaded with doxorubicin. Patients were prospectively enrolled and included 32 (76%) males and 10 (24%) females. Median sample age was 65 years (range 42–83). Patients were treated with 50 mg of doxorubicin loaded in 2 ml of PEG embolics (diameter 100±25 µm) that were infused via the chemoembolization method. Data collected included previous cancer therapy, tumor size, number of lesions and TACE, tumor response (1, 3, and 6 months), type and intensity of adverse events, and quality of life (QoL).

Results: One month following TACE, tumor response rate was 79% [complete response (CR)=50%, partial response (PR)=29%, stable disease (SD)=17%, and progressive disease (PD)=5%]. At 3 months, CR=48%, PR=24%, SD=24%, and PD=3%. At 6 months, CR, PR, SD, and PD were 43%, 19%, 29%, and 10%, respectively. TACE was well-tolerated by all patients with evidences of no procedure complications or systemic drug-related side effects. Fever (33%), transaminase rise (17%), and pain (35%) were the most frequent side effects, with a mostly mild intensity (G1-2). QoL was 80 at 1 month after TACE and 81 and 82 at 3- and 6-month time points, respectively.

Conclusion: Data suggest that PEG embolics are efficacious and safe for the treatment of HCC, as indicated by the good tolerability, QoL, and high tumor response.

2804.5

Pharmacokinetic profile of irinotecan in patients with liver metastases from colorectal cancer treated with unilobar or bilobar drug-eluting microsphere chemoembolization

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Purpose: To evaluate the pharmacokinetic (PK) profile, treatment safety, and efficacy of LifePearl® microspheres loaded with irinotecan in the treatment of liver predominant metastatic colorectal cancer (mCRC) by transarterial chemoembolization (TACE).

Material and methods: LifePearl® microspheres loaded with irinotecan is a prospective, single-arm, multicenter PK study enrolling up to 20 patients with CRC with liver predominant unresectable metastatic disease, without portal vein involvement, with ECOG performance status 0 or 1, life expectancy ≥ 3 months, and adequate hematologic function. The primary endpoint of the study is the PK profile of LifePearl® microspheres loaded with irinotecan. The secondary endpoints were as follows: adverse events (grade ≥ 3 according to CTCAE v4) up to 30 days post-initial treatment, overall survival, progression-free survival, response rate (mRECIST criteria) 3 months after the first treatment assessed by a core laboratory, and technical success (ability to deliver ≥ 75% of the planned dose during the first chemoembolization).

Results: Treatment involved infusion of LifePearl® microspheres loaded with 100 (unilobar) or 200 mg (bilobar) of irinotecan with treatment repetition after 2 or 4 weeks, respectively. Blood samples were collected for PK analysis of irinotecan and metabolite SN-38 during the first TACE and analyzed by a central laboratory. Of the 10 patients enrolled thus far, one died and four experienced grade 3 treatment-related adverse events in up to 30 days.

Conclusion: Full PK profiling, including peak plasma concentration, area under curve, and plasma half-life; procedural success; toxicity; and adverse events occurring up to 30 days post-procedure will be available at the time of presentation.

2804.6

Transarterial chemoembolization of hepatocellular carcinoma with 100±25-µm and 200±25-µm Lifepearl microspheres: short-term follow-up and safety profile

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Purpose: To evaluate short-term response and safety profile of doxorubicin-preloaded 100±25-µm and 200±25-µm Lifepearl microspheres in the treatment of hypervascular hepatocellular carcinoma (HCC).

Material and methods: Forty-nine typical hypervascular HCC (mean size, 25.5 mm; range, 59–11 mm) in 37 patients [26 males; mean age, 63.2±13.3 years; BCLC-A (n=17) and BCLC-B (n=20)] were prospectively enrolled. TACE procedure was highly standardized as follows: dual-phase CBCT-assisted procedure; superselective microcatheterization (2.7 Fr); embolic agent: 100 mg of doxorubicin divided in vials of 100±25-µm and 200±25-µm particles; embolization protocol: 100±25-µm particles were injected first, and if arterial flow arrest was not achieved, 200±25-µm particles were injected till stasis. Procedures were scored by the degree of achieved superselective microcatheterization. Results were evaluated according to mRECIST criteria using MDCT/MRI at 1-month follow-up. Toxicity evaluation was based on the comparison of pre- and post-procedural laboratory tests (with a cut-off of 50% of increase); the onset of major or minor complications was recorded.

Results: In 19 patients, the score was 0 (no non-target sub-segmental artery embolization), whereas in 30 patients who underwent TACE, the score was 1 (one non-target sub-segmental artery embolization). At 1-month follow-up, complete response was observed in

65.3% of patients, partial response in 18.3%, and stable disease in 14.2%, with an objective response rate of 83.6% and disease control rate of 97.8%. In 12/49 patients, a significant increase was noticed in hepatic laboratory tests, but only 4 patients developed symptoms requiring specific medical treatment. One patient developed a hepatic abscess in the treated area.

Conclusion: TACE with Lifepearl microspheres provides excellent short-term control of HCC burden with a favorable toxicity profile.

Free Paper Session Super Tuesday

3006.1

Bariatric embolization of arteries for treatment of obesity (BEAT obesity): mid-to-long-term safety and efficacy data

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Purpose: BEAT obesity is an investigator-initiated FDA-approved investigational device exemption designed to assess the safety and efficacy of bariatric embolization in the treatment of morbidly obese patients using 300–500- μ m embospheres. We present our 6–12-month safety and efficacy data.

Material and methods: Morbidly obese [body mass index (BMI) of 40–60] adult patients without comorbid conditions (n=20, 4 male) were enrolled. Primary endpoints were weight loss and 30-day adverse events (AEs). Secondary endpoints (12-month follow-up) were blood pressure, lipid profile, serum obesity hormones, hunger/satiety assessments, quality of life (QOL) surveys, and endoscopy and gastric emptying results.

Results: Mean age/BMI were 44.5 $\pm$ 10.7 years and 45.1 $\pm$ 4.1 kg/m², respectively. The left gastric artery (LGA) alone was embolized in 5 patients, and the LGA and gastroepiploic arteries were embolized in 15 patients. No major AE occurred. Small ulcers were seen in 7 patients at the 2-week endoscopy; all resolved at the 3-month endoscopy. There was 1 case of transient subclinical pancreatitis. One patient demonstrated delayed gastric emptying at 1 month postprocedure. There was 8.2 $\pm$ 3.9% (n=20), 11.9 $\pm$ 5.5% (n=17), 14.9 $\pm$ 7.7% (n=10), and 15.1 $\pm$ 14.6% (n=4) excessive weight loss at 1, 3, 6, and 12 months, respectively. There was a trend toward improvement in QOL parameters and significant decreases in hunger/appetite scores. Full hormonal profiles will be presented once all patients have reached the 12-month follow-up.

Conclusion: Bariatric embolization is well-tolerated in severely obese patients. Bariatric embolization appears to have sustained weight loss both 6 and probably 12 months postprocedure. As BEAT obesity continues, more insight into the long-term efficacy of the procedure will be obtained.

3006.2

Efficacy and safety of PAE: results from the UK-ROPE registry

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Purpose: Prostate artery embolisation (PAE) is an emerging treatment for lower urinary tract symptoms secondary to benign prostatic enlargement. It involves injection of small particles directly into the prostatic arteries bilaterally, leading to devascularisation of hyper vascular nodules.

Material and methods: Multicentre registry in UK with a 12-month follow-up. Before-after analysis of IPSS scores, IIEF-5, and urological measurements such as Qmax, residual void volume and prostatic volume.

Results: We present findings on the efficacy of PAE from the multicentre UK ROPE registry database. We collected baseline data from 216 individuals undergoing this procedure at 17 sites. The median baseline score for IPSS was 22.0. 117 subjects completed 12-month follow-up, with a median unadjusted IPSS score of 10.4 (change = -10.9, p= 0.000). The median baseline IPSS-QOL score was 5.0. 126 subjects completed an IPSS-QOL at 12 months, with a median unadjusted score of 2.0 (change = -3.0, p = 0.000). PAE did not negatively affect the subjects' erectile function, as measured by IIEF up to 12 months post-procedure. We also present improvements in Qmax and prostatic volume reduction in this patient cohort. Full multivariate analysis, adjusting for confounders and allowing for missing data, is currently underway and will be presented at the conference.

There were 2 minor non-target embolisations (0.9%). These resulted in small penile ulcers which had a self-limiting course and resolved in both patients within 6 weeks.

Conclusion: Our findings support other emerging evidence that PAE for BPH is an efficacious procedure for LUTS BPE with a very acceptable safety profile.

3006.3

Four-year results of the IN. PACT SFA trial comparing a drug-coated balloon catheter with an uncoated balloon catheter in femoropopliteal lesions

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Purpose: To evaluate long-term safety and efficacy of the IN. PACT™ Admiral™ paclitaxel-eluting balloon catheter (DCB) compared with those of the standard percutaneous angioplasty (PTA) when used to treat *de novo* and non-stented restenotic lesions in SFA and PPA.

Material and methods: IN.PACT SFA is an independently adjudicated, prospective, multicenter, randomized single-blinded trial, which enrolled 331 patients with symptomatic (Rutherford 2–4) femoropopliteal lesions. Patients were randomly assigned in a 2:1 ratio to treatment with the IN.PACT™ Admiral™ DCB or PTA. At 4-years, study assessments included major adverse events (MAE) defined as all-cause mortality, clinically-driven target vessel revascularization (CD-TVR), major target limb amputation, and thrombosis at the target lesion site and time to first CD-TLR.

Results: Patients were randomized to treatment with DCB (n=220) and PTA (n=111). Baseline characteristics were similar between groups. Among patients treated with DCB, 65.0% were male, 40.5% were diabetic, and 38.6% were current smokers. In the PTA arm, 67.6% were male, 48.6% were diabetic, and 36.0% were current smokers. At 3 years, patients treated with DCB demonstrated

significantly superior primary patency compared to PTA (69.5% vs. 45.1%, $p < 0.001$). The rates of CD-TLR were 15.2% for DCB and 31.1% for PTA ($p = 0.002$), with time to first event significantly longer for the DCB group (542.9 ± 278.2 vs. 302.9 ± 213.0 days; $p < 0.001$). Duplex ultrasound was not mandated after the third year; thus, patency will not be evaluated.

Conclusion: Four-year results, including MAE, time to first CD-TLR, and freedom from TLR, will be available at the time of this presentation.

3006.4

BATTLE trial: 6-month outcomes in a multi-center randomized trial comparing MISAGO with ZILVER PTX for the treatment of intermediate length femoropopliteal lesions

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Purpose: Our aim was to demonstrate the clinical superiority of primary stenting using the Zilver PTX stent system versus bare metal self-expandable stenting for the treatment of intermediate length femoropopliteal lesions in patients with symptomatic peripheral arterial disease.

Material and methods: BATTLE trial is a French multi-centric, randomized clinical trial. In total, 186 patients were enrolled and assigned to treatment with MISAGO or ZILVER-PTX in a 1:1 ratio. The primary endpoint was freedom from in-stent restenosis at 1 year defined by restenosis of $>50\%$ and by a peak systolic velocity index >2.4 at the target lesion assessed by an independent core laboratory. Independent clinical event committee adjudicated adverse events.

Results: At baseline, no significant differences were observed in patient characteristics between the MISAGO and Zilver-PTX groups. The mean lesion length in groups A and B was 70 and 65 mm, respectively (NS). The mean stent length in groups A and B was 91 and 72 mm, respectively, (NS) at 1 month. The cumulative rate of major events in groups A and B was 17% and 14%, respectively, with no significant difference in death (0.7% vs 0%), target lesion revascularization (0.7% vs. 0.7%), and local complication (7% vs. 7%). No early amputation was observed in both groups; group B showed a trend for increased early in-stent thrombosis compared with group A ($n=5$ vs. $n=1$).

Conclusion: The follow-up of patients is currently ongoing and final 6 months data, including clinical and duplex scan results, will be available at the time of the presentation.

3006.5

Safety and performance of the Shockwave Medical Lithoplasty® System in treating calcified, stenotic, infrapopliteal arteries

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Purpose: Critical limb ischemia results in marked reductions in blood flow and is associated with increased morbidity and mortality. The revascularization of below-the-knee lesions with percutaneous transluminal angioplasty is very common despite high restenosis rates. The calcification of infrapopliteal arteries is common in patients with diabetes and renal dysfunction. The treatment of calcified lesions is associated with reduced procedural success, greater procedural complications, and very poor long-term outcomes.

Lithoplasty is a novel balloon-based therapy that utilizes lithotripsy specifically designed to disrupt calcium prior to low-pressure balloon expansion. This study sought to investigate the safety and performance of the Peripheral Lithoplasty Catheter System (Shockwave Medical, Fremont, CA), a lithotripsy-enhanced, low-pressure balloon catheter in treating calcified, stenotic, infrapopliteal arteries.

Material and methods: This was a prospective, multi-center, single-arm study involving 20 patients with calcified infrapopliteal artery disease. The primary safety endpoint was major adverse events, including death, myocardial infarction, emergency revascularization, or target limb amputation, over 30 days. The primary performance endpoint was acute reduction in the percent diameter stenosis of the target lesion, as assessed by angiographic core lab. The secondary endpoint was the ability of the Peripheral Lithoplasty Catheter System to achieve residual stenosis of $<50\%$.

Results: Baseline and 30-day results will be available at the time of presentation.

Conclusion: Lithoplasty is a novel therapy for treating calcified peripheral artery lesions. This is the first prospective study that evaluated the safety and performance of the Shockwave Medical Peripheral Lithoplasty System in treating calcified, stenotic, infrapopliteal lesions using a familiar balloon-based approach.

3006.6

Randomized, prospective comparison of radial versus femoral access in transarterial liver embolization: BEST liver access trial

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Purpose: It is unknown whether radial or femoral access provides better outcomes in patients with liver cancer who underwent transarterial liver embolization.

Material and methods: A randomized, prospective, single institutional, intra- and inter-patient controlled trial comparing radial and femoral access in patients with primary or metastatic liver cancer who underwent chemo- or bland embolizations. Randomly and sequentially, all patients underwent at least two interventions: 1 transradial and 1 transfemoral. If a third one was needed, the patient selected the access type. The primary endpoint was patient access preference, and secondary endpoints were access-related complications. All patients were assessed next day and at 30 days post-intervention. Assessment included a questionnaire and physical exam followed by ultrasound.

Results: Fifty-five patients with liver cancer (31 hepatocellular carcinoma and 24 metastatic disease) were initially randomly assigned to radial or femoral access. Thirty-six patients had completed the trial. A total of 124 transarterial liver embolizations were performed. After undergoing treatment via both accesses, 29/36 (81%) patients preferred radial and 7 (19%) preferred femoral (ratio 4:1) access. No major adverse events occurred in either access type. Twenty-five patients had minor complications: 16/71 (22%) transradial procedures and 8/53 (15%) transfemoral procedures (NS). Minor complications were mainly bruising and local pain. There was no clinically evident stroke at 30 days.

Conclusion: Both radial and femoral accesses were safe and effective for transarterial liver embolization. It is clear that the patients prefer radial access.

Free Paper Session Neuro and carotid intervention

3104.1

Achievable aspiration flow rates using a large balloon guide catheter during carotid artery stenting

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Purpose: Emergency carotid stenting is a frequent endovascular procedure, especially for tandem lesions during endovascular stroke. Protection systems are not generally applied in emergency procedures. However, a balloon guide catheter is frequently used. We evaluated whether sufficiently high aspiration flow rates using a balloon guide catheter during common carotid artery occlusion can be achieved to reverse ICA flow during these procedures.

Material and methods: Aspiration experiments were conducted using a commercially available aspiration pump. Aspiration with 6 different types of carotid stents inserted in a 9-F balloon guide catheter was performed. Volumetric flow rates in the ICA and ECA in 10 healthy volunteers were measured using 4D flow MRI to determine a relationship among the achieved aspiration rates. Lastly, a simple DSA method to estimate ECA-ICA collateralization under CCA occlusion was proposed in an animal model.

Results: Aspiration rates ranged from 25 to 78 ml/min. Mean volumetric flow rate was 210.4 ml/min in the ICA and 100.9 ml/min in the ECA. The DSA experiment showed a clear differentiation between the antegrade and retrograde flow in the ICA and ECA branches.

Conclusion: An approximation of ICA flow volume under CCA occlusion based on MRI and existing literature revealed a value of 27 ml/min. A flow reversal in the ICA with the evaluated setup during emergent carotid stenting could be achieved in majority of the patients using the stent with the smallest diameter and the stent with the shortest outer stent sheath. The proposed DSA method might be helpful in device selection.

3104.2

Tandem therapy in bilateral intraocular retinoblastoma

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Purpose: To assess efficacy of tandem therapy in bilateral intraocular retinoblastoma.

Material and methods: Retrospective analysis of 6 patients with bilateral intraocular retinoblastoma who received ophthalmic artery chemoinfusion with either melphalan alone or melphalan+carboplatin [melphalan 0.3–0.4mg/kg (max 7.5mg), carboplatin 15–30mg]. Cycle repeated after 3weeks as per tumor response. Investigations performed pre- and post-procedure comprised CBC, coagulation profile, biochemistry, B-scan, MRI, evaluation under anesthesia, and electroretinogram.

Results: We have treated 12 eyes in 6 patients with 47 separate sessions of OAC (23 in right eyes, 24 in left eyes). Technical success rate was 100% (catheterization successful in 47/47 sessions). Mean session of OAC per eye was 3.91 (range 3–4 sessions per eye), with a mean follow-up period of 18.5 months (range 9–28 months). Out of these, 9 eyes showed complete response, 2 eyes received focal consolidative therapy after downsizing the tumor, and 1 eye was enucleated due to disease progression. Globe salvage rate was 91.66% (11/12 eyes saved). No major complications during the procedure were noted.

Conclusion: Bilateral SOAC (tandem therapy) in bilateral intraocular retinoblastoma is safe and effective novel technique for achieving a good tumor response. It offers means to salvage the globe while preserving useful vision in patients with bilateral intraocular retinoblastoma. When used, globe salvage rate achieved was 91.66% for bilateral intraocular retinoblastoma.

3104.3

Investigation of plaque protrusion during carotid artery stenting on intravascular ultrasound

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Purpose: The projection of plaque into the stent lumen during coronary artery stenting on intravascular ultrasound (IVUS) is referred to as plaque protrusion (PP); it occurs at an incidence of 11%–22.5%. PP is not associated with periprocedural ischemic events, but it has similarly been recognized during carotid artery stenting (CAS), although PP during CAS is unclear. The objective was to clarify the incidence and association of ischemic events with PP during CAS.

Material and methods: A total of 362 consecutive carotid atherosclerotic stenoses in 328 patients [314 males, age range, 51–97 years (mean, 73.6 years); 158 symptomatic cases; stenosis rate, 50%–99% (mean, 81.0%)] who underwent CAS under IVUS between October 2007 and December 2016 were retrospectively analyzed. PP was defined as plaque seen inside the stent lumen on IVUS and classified as crescent type and convex type. The incidences of PP and associated ischemic events within 30 days after procedure were investigated.

Results: PP was observed in 30 cases (8.3%); in 28 cases (7.7%), immediately post-procedure, and in 2 cases (0.6%), more than 24 hours post-procedure. Nineteen cases (63.3%) were classified as crescent type and 11 cases (36.7%) as convex type. Ischemic events occurred in 8 of the 30 PP cases (26.7%) (1 major, 5 minor, and 2 TIA). All 8 cases were classified as convex type. Convex type was strongly associated with ischemic events.

Conclusion: The incidence of PP in CAS was 8.3%, and convex type among PP was strongly associated with periprocedural ischemic events.

3104.4

PulseRider stent-assisted coiling of very wide-neck cerebral aneurysms: a preliminary single-center experience

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Purpose: To evaluate the efficacy and safety of a novel endovascular device designed to treat bifurcation intracranial aneurysms with very wide necks.

Material and methods: Over an 18-month period, we used the PulseRider device (Codman) for stent-assisted coiling in 7 patients (4F and 3M, mean age 53 years) presenting with a extremely broad-based unruptured cerebral aneurysm (median dome size 6.4 mm and median neck size 5.9 mm). The PulseRider device has a unique frame configuration specifically designed with concentrated coverage at the neck and open architecture in the branch vessels allowing preservation of the parent artery patency and flow through the bifurcation while securely retaining coils within the aneurysmal sac and minimizing exposed metal. Main advantages of this device are the lower risk of stent-induced platelet aggregation and ability to reposition even after complete deployment before detachment.

Results: Optimal PulseRider deployment followed by complete aneurysm coiling was obtained in 6 patients. Detachment of the device at the end of the coiling was uneventful. Failure of PulseRider treatment occurred in one case due to angulation of the aneurysmal neck related to the parent vessel axis. No intraprocedural thromboembolic complication was observed. There was no mortality or permanent neurologic morbidity at discharge and at the 3–6 months follow-up. The immediate angiographic outcome showed 4 complete occlusions and 2 small neck remnants. Follow-up at 6 months demonstrated persistent complete occlusions in 3, stable remnants in 2, and growing neck in 1 patient.

Conclusion: PulseRider stent-assisted coiling of wide-neck cerebral aneurysms is feasible with low procedural complication rate and promising initial results.

3104.5

Intraprocedural vessel damage during mechanical thrombectomy for acute ischemic stroke: technical details and clinical significance in a multi-center study

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Purpose: Mechanical thrombectomy has revolutionized the management of acute ischemic stroke. Iatrogenic complications due to arterial rupture and dissection have not been formally described. This study aimed to report our intraprocedural vessel damage and discuss its technical details and clinical significance.

Material and methods: We prospectively studied patients included in SONIA registry (2011–2015), a mandatory, externally

audited registry that monitors the quality of reperfusion therapies in Catalonia during practice. Iatrogenic complications, successful recanalization (TICI grade $\geq 2b$), procedural time, symptomatic intracranial haemorrhage (SICH), dramatic neurological improvement (≥ 10 points decrease in NIHSS score at 24 hours), and independent functional outcome (mRS ≤ 2) at 3 months were recorded.

Results: Among the 1640 patients included, iatrogenic complications occurred in 3.6% patients (2.0% patients with dissection, 1.6% with perforation, 40% with middle cerebral artery occlusion, 52.1% with left-sided occlusion, and 21.7% with posterior circulation). The median NIHSS score was 17 (12–21) on arrival and 9 (3–18) at 24 hours. Complications were not related to general anaesthesia: 26.7% patients had complications vs. 73.3% had no complications (RR, 1.7; 95% CI, 1.0–3.0; $p=0.061$). Complications were associated with less successful recanalization [36.7% vs. 79.3% (RR, 6.0; 95% CI, 3.6–10.1; $p=0.000$)] and longer procedural time [108.1 $\pm$ 55.2 min vs. 87.4 $\pm$ 73.32 min ($p=0.031$)]. SICH [18.3% (81.8% perforation vs. 18.2% dissection, $p=0.002$) vs. 2.5% ($p=0.000$)], good early response [15.1% vs. 71.0% ($p=0.000$)], functional independence [18.4% vs. 48.9% ($p=0.000$)], and mortality [60.0% vs. 17.4% ($p=0.000$)].

Conclusion: Iatrogenic complications were rare, but when they occurred, they were associated with high unfavourable outcome. However, 18.4% had functional independence, suggesting that in some patients with complications, good neurological recovery is achievable.

3104.6

Carotid artery stenting: results and analysis of a single-center experience after 20 years

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Purpose: Report on the 20-year experience in carotid artery stenting (CAS) with cerebral protection devices evaluating the technical aspects, results, and outcomes.

Material and methods: In total, 1636 patients who underwent CAS with a minimum follow-up of 12 months were retrospectively analyzed. Indications for CAS were in accordance with the NASCET criteria. A bilateral CAS was performed in two sessions in 147 patients. A cerebral protection device (CPD) was used in 94.7% patients, whereas no CPDs were employed in 136 patients (8.3%) for anatomical complexity. Pre- and post-CAS medication was administered according to standard protocols. Results were analyzed correlating neurological complications with the operator's experience, plaque morphology, and patient age.

Results: Technical success was achieved in all cases. After a mean follow-up of 76 $\pm$ 32.4 months, 1236 patients (75.5%) were alive, with a 30-day mortality of 1.9%. In-stent restenosis occurred in 18/1636 patients (1.1%) and was solved with angioplasty in 5/18 patients (27.7%) or re-stenting in 13/18 patients (72.2%). Primary patency was 98.7%; the secondary patency rate 100%. Neurological events occurred in 3.2% patients. Results were analyzed correlating neurological complications with the operator's experience, plaque morphology, and patient age. Neurological disorders were 1.9% in asymptomatic patients and 4.5% in symptomatic ones ($p=0.001$) and they proved to be higher in older patients (>80 years) than in those <80 years (6.4% vs 2.7%; $p<0.05$). The overall neurological adverse events were 6.1% in patients with complex plaques and 1.0% in those with stable plaques ($p<0.001$).

Conclusion: CAS can be considered as a valid method for the treatment of carotid pathology; nevertheless, accurate evaluation of the patient is mandatory.

Free Paper Session Oncology 2

3105.1

No-touch multi-bipolar radiofrequency ablation of superficial subcapsular hepatocellular carcinoma within Milan criteria: effectiveness and tolerance

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Purpose: The percutaneous ablation of superficial subcapsular hepatocellular carcinoma (SSHCC) remains controversial because of a high risk of complications, such as hemorrhage and tumor seeding along the needle path. These complications are mainly related to the direct tumoral puncture needed when using mono-applicator ablation devices. No-touch multi-bipolar radiofrequency ablation (NTMBP-RFA) allows the treatment of SSHCC without tumoral puncture. The purpose of this study was to assess the effectiveness and tolerance of NTMBP-RFA in SSHCC.

Material and methods: Between 2007 and 2014, 58 patients [median age: 63 (range: 46–86) years] with 59 SSHCCs [median diameter: 25 (range: 10–50) mm] were treated with NTMBP-RFA. The assessment of response and follow-up relied on CT or MRI performed at 1 month after treatment and every 3 months thereafter. Complications were graded according to the Society of Interventional Radiology (SIR) classification. Effectiveness in terms of local tumor progression (LTP) was assessed using Kaplan–Meier method. Signs of peritoneal or parietal tumor seeding were examined in follow-up imaging studies.

Results: NTMBP-RFA achieved complete response in 58/59 (98.3%) SSHCCs after 1 (n=52) or 2 (n=6) procedures, and 1 patient was transplanted after the first NTMBP-RFA failure. One patient (1.7%) developed a major complication (septicemia with liver failure; SIR D). Eighteen patients (31%) exhibited imaging anomalies without clinical impact (SIR A) 1 month after NTMBP-RFA. After a median follow-up of 25 (range: 1–93) months, LTP occurred in 5/58 patients with 1-, 2-, and 3-year LTP-free survival rates of 98.3%, 94.8%, and 91.3%, respectively. No patient exhibited signs of tumor seeding.

Conclusion: NTMBP-RFA is an effective and safe treatment option for SSHCC within Milan criteria.

3105.2

CT-guided high-dose rate brachytherapy in combination with previous transarterial chemoembolization in patients with unresectable hepatocellular carcinoma

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Purpose: To investigate the combination of embolization followed by CT-guided high-dose rate brachytherapy (CT-HDRBT) in patients with HCC.

Material and methods: Forty-seven patients were enrolled in this study. Two groups were assessed: transarterial chemoembolization before CT-HDRBT vs. bland transarterial embolization (TAE) before CT-HDRBT. Primary endpoint was overall survival (OS), and secondary endpoints were local progression rate and time to progression (TTP).

Results: Altogether, 78 lesions with a median tumor size of 35.5 mm (7–144 mm, mean 41.2 mm) were treated. Four patients were BCLC Stage A, 30 patients BCLC B, and 13 patients BCLC C. After a median follow-up of 25.1 months, 26 of the patients had died, 2

patients underwent liver transplantation, and 5 patients were lost to follow-up. Median OS was 32.3 months, with no significant difference between TACE and TAE. Median OS of patients in BCLC Stage A was 32.3 months, in BCLC B 36.9 months, and in BCLC C 27.6 months. Local progression rate was 9%, with no significant difference between TACE and TAE. Median PFS was 11.7 months in TACE patients and 10.3 months in TAE patients (p=0.466).

Conclusion: Combination of transarterial embolization before CT-HDRBT provides a very promising survival. Patients with large tumors (BCLC B or portal venous invasion, BCLC C) benefit most as published survival of patients in BCLC B stage is 16.9 months and BCLC C is 10.7 months, which exceeded by 20 and 17 months, respectively.

3105.3

Fusion imaging guidance to improve conspicuity of small hepatocellular carcinoma: proposal of a new feasibility score

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Purpose: To evaluate and prospectively apply a feasibility score for liver ablation using fusion imaging guidance.

Material and methods: Between January 2016 and December 2016, 145 patients (mean age 66.4 ± 8.2 years) with 183 HCCs ≤ 3 cm referred for RFA with fusion imaging guidance were prospectively enrolled. Prior to ablation, the operators scored the visibility of tumors, and in case of poor conspicuity (0) or no conspicuity (1), the nodule was classified according to its vascularization (presence = 0, absence = 1) at CEUS (wash-in or wash-out = 0, absence = 1) and the presence of anatomical landmarks (presence = 0, absence = 1). Based on the sum of the scores, nodules were divided into three groups (G1: 0-1, G2: 2, G3: 3); significance was assessed using Wilcoxon test.

Results: On the whole, 36/183 tumors (mean size 15 ± 4 mm) were scored poorly (11/36) or were not visible (25/36) at ultrasound examination, 11/36 had CEUS positivity, and 13/36 showed anatomical landmarks. CA was obtained in 12/13 (92%) nodules in G1, 7/9 (78%) nodules in G2, and 3/14 nodules (21%) in G3. In G3, 4 cases were completely missed at the first attempt. CA was significantly better in G1-G2 than in G3 (p = 0.01); no statistical differences were found between G1-G2 and the group with good visibility (135/147 nodules, mean size 18 ± 6 mm, CA 92%, p > 0.05).

Conclusion: Fusion imaging is an effective tool to increase the number of ablated tumors; however, obtaining CA in completely invisible nodules with no anatomical landmarks still remains challenging. A feasibility score of >2 predicts poor technical results.

3105.4

Ablation of colorectal liver metastases by irreversible electroporation: final results of the COLDIRE-2 trial

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Purpose: To investigate the safety and efficacy of irreversible electroporation (IRE) of colorectal liver metastases (CRLMs) considered unsuitable for surgical resection and thermal ablation because of the proximity of vital structures.

Material and methods: In this prospective, single-arm, phase II trial, 30 patients with CRLMs ≤ 3.5 cm were treated with IRE. Adverse events (AEs) were graded according to the Common Terminology Criteria for Adverse Events (CTCAE). Three-monthly ¹⁸F-FDG PET-CT,

contrast-enhanced CTs, and MRIs were performed to detect disease progression. Kaplan–Meier estimates were used for survival analysis.

Results: IRE was successfully performed in all 30 patients (39 CRLMs). No IRE-related deaths occurred. Ten minor and 4 major AEs (all grade 3) were noted: portal vein thrombosis (n=2), biliary obstruction (n=1), and hemorrhage (n=1). After a median follow-up period of 11.0 (range, 2–33) months, 6 lesions showed an ablation site recurrence, 3 of which were successfully retreated (primary efficacy rate, 84.6%; assisted efficacy rate, 92.3%). Median EFS was 7.0 months; the first site of disease recurrence was liver (n=11), lung (n=7), liver and lung (n=2), brain (n=1), bone (n=1), and peritoneal deposits (n=2). Median OS was not reached; 1-year OS was 86.7%.

Conclusion: IRE represents a safe and effective technique for small CRLMs that are unsuitable for surgical resection and thermal ablation. The outcome appears promising with regards to local tumor control, although the relatively high number of early distant site recurrences should keep us wary. The results mandate the setup of a trial comparing IRE to stereotactic ablative radiotherapy for CRLMs unsuitable for surgical resection and thermal ablation.

3105.5

The effects of irreversible electroporation therapy (IRE) on embolisation materials using validated vegetal model: an experimental study

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Purpose: Irreversible electroporation (IRE) is a non-thermal tumour ablation technique by inducing cell apoptosis while preserving extracellular architecture. Surgical clips and embolic agents may lie adjacent to or within the target lesion, especially in previously treated liver lesions. It is unknown to date if IRE causes degradation of the embolic agents or surgical clips. We aim to examine the 1) effects of IRE on the morphology of various embolic agents and 2) effects of these agents on the ablation field using a previously validated vegetal model, the potato tuber.

Material and methods: Metallic surgical clips and various metallic and non-metallic embolic agents were inserted within the centre of the tuber ablation field using a needle guide. Additionally, surgical clips were inserted on the edge and outside the ablation field. One tuber without material was ablated as a control. Ablation settings were based on previously published experiments. Tubers were imaged with magnetic resonance imaging (MRI) 18–24 hours after ablation, and the dimensions of the ablated fields were measured. Structure of the non-metallic embolic agents was examined microscopically by the pathologist.

Results: Non-metallic agents did not affect the ablation pattern when compared with the control group. Metallic implants, however, did affect the ablation pattern compared with the control group. There was no microscopic physical alteration or degradation of all agents after IRE.

Conclusion: IRE does not affect embolic agents or surgical clips in this experimental study, although there is alteration to the field pattern with metallic material. Further animal model experiments are warranted to confirm these findings.

3105.6

Microwave ablation in the proximity of surgical clips: does it influence the ablation zone?

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Purpose: During microwave ablation (MWA), titanium surgical clips can generate unwanted heat due to the induced electric current in the ablation zone. We evaluated the possible influences of surgical clips within the ablation zone on the resulting temperature and shape of the ablation volume.

Material and methods: Thirty-two MWAs (60 W, 3 minutes) were performed ex vivo in the bovine liver tissue. Temperature was measured every second at 4 points of interest (POIs): at 7.5-mm distance from the antenna on the side of the clip (adjacent to clip), at 7.5-mm distance on the opposite side, and at 15-mm distance on both sides. We calculated the mean temperature curve at the 4 POIs over time. After MWA, the liver was dissected to measure the ablation zone.

Results: MWA could be successfully performed in all 32 experiments. Temperature was significantly higher at the position of the clip than at the same distance on the opposite side of the probe, with a maximum difference of 12.9 (p=0.011). Temperature was significantly higher at 15-mm distance on both sides of the microwave antenna than on the side of the clip, with a maximum difference of 9.8 (p=0.004). No significant change in the size and shape of the ablation zone was ascertained.

Conclusion: Surgical clips within the target volume of MWA resulted in a significant increase in the local temperature. Therefore, surgical clips near the ablation zone pose a risk of thermal damage to adjacent vulnerable structures.

Free Paper Session TEVAR

3106.1

Initial experience with the transapical access for TEVAR

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Purpose: The endovascular approach evolved as a mainstay in the treatment of aortic aneurysms. Arterial access is a key parameter for success; the transfemoral approach is often inaccessible due to vascular pathologies such as vessel kinking or occlusion. The transapical access may be an alternative approach. The goal of this study is to report the feasibility of the transapical approach for the endovascular repair of thoracic aortic aneurysms (TEVAR).

Material and methods: Three patients with thoracic aortic aneurysms with inaccessible femoral arteries (2 × chronic Leriche's syndrome, 1 × massive kinking) underwent TEVAR via the transapical approach. For access, the apex of the left ventricle was exposed by a minithoracotomy. After left ventricular puncture, a guidewire was placed through the aortic valve into the descending thoracic aorta. All stentgrafts were delivered under fluoroscopic guidance.

Results: All three procedures were technically successful with complete exclusion of the aneurysm without endoleak. One patient suffered spinal ischemia with subsequent paraplegia on day 4 after the procedure. The same patient died on day 43 after the procedure due

to esophageal rupture. Routine follow-up at 6 months after treatment showed normal post-procedural findings in the two remaining patients.

Conclusion: Transapical access is a feasible and safe alternative to transfemoral access in selected cases scheduled for TEVAR.

3106.2

Mid-term results of endovascular total arch repair using in-situ fenestration TEVAR for arch TAA and chronic type A aortic dissection

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Purpose: Total arch replacement is the gold standard treatment for aortic arch aneurysm and possible treatment strategy for chronic type A dissection with good reported outcomes. However, because total arch replacement is extremely invasive, it can be difficult to perform in some patients. We designed an endovascular total arch repair procedure with the use of in situ fenestration, and we present our mid-term results.

Material and methods: Twelve patients (chronic type A aortic dissection, $n = 4$ and aortic arch aneurysm, $n = 8$) who underwent endovascular total arch repair with the use of in situ fenestration TEVAR from a zone 0 landing were retrospectively analyzed. All procedures were performed under general anesthesia and cardiopulmonary bypass. The triple branches were manually punctured in a retrograde manner, and all branches were reconstructed with the use of stentgrafts.

Results: The procedure was successful in 11 of the 12 patients; the remaining 1 patient additionally underwent axillary-axillary artery bypass during the operation because his left subclavian artery was difficult to puncture. All patients had an acceptable postoperative course, with no 30-day and in-hospital deaths. One of the patient had endoleakage; however, all patients exhibited a reduction in the aneurysm diameter or thrombosed false lumen during a mean follow-up of 15 (2–41) months.

Conclusion: Endovascular total arch repair with the use of in situ fenestration TEVAR is a valuable option for aortic arch aneurysm and chronic type A dissection with acceptable mid-term results.

3106.3

Quality of life in patients with Stanford type B aortic dissection after endovascular repair

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Purpose: Acute aortic dissection is a severe and life-threatening disease; more and more patients with Stanford type B aortic dissection choose endovascular repair due to its mini-invasiveness and quick recovery. This study aims to focus on the quality of life (QoL) of patients with Stanford type B aortic dissection after endovascular repair.

Material and methods: From January 2014 to July 2016, 40 patients with Stanford type B acute aortic dissection received an endovascular repair. Of the total number of patients, 35 were males (87.5%) and 5 females (12.5%), mean age 50.9 ± 14.1 years. The Medical Outcomes Study Short Form-36 (MOS SF-36) was used to assess the QoL preoperatively and after endovascular repair. The first follow-up (FU) of the SF-36 questionnaire (FU1) was obtained within 3.9 ± 0.3 months after repair and the second (FU2) 10.9 ± 1.2 months thereafter.

Results: None of patient died during the observational period, and one patient was lost to FU. SF-36 observation showed that the best-scoring domain was "role emotion," and "vitality" and "mental health" also scored well preoperatively. Except for "role emotion" and "mental health," all remaining domains showed a significant improvement at both FU1 and FU2.

Conclusion: Endovascular repair in patients with Stanford type B aortic dissection has excellent clinical outcomes and improves QoL; further research is required to assess whether this improvement in QOL persists over the long term.

3106.4

Long-term surveillance and indications for secondary interventions after primary TEVAR in patients with complicated type B aortic dissection (TBAD)

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Purpose: To evaluate indications and results of secondary endovascular repair after TEVAR in complicated type B aortic dissection (TBAD) in a cohort of patients treated between January 2009 and December 2016.

Material and methods: Between January 2009 and December 2016, 139 patients underwent TEVAR for complicated TBAD. Primary success rates and the need for additional primary and secondary interventions were analyzed during follow-up.

Results: In 95/139 patients who underwent TEVAR of the primary entry tear, an additional intervention was needed as part of the primary procedure (30-day period); thus, 61 stents or stent grafts (compromised visceral or peripheral artery perfusion), 23 embolizations (mostly coiling) of false lumen reperforations, and 11 EVARs were performed. Thirty-day mortality rate in this subgroup was 7.9%, and that in the 44 patients who underwent TEVAR alone was 2.5%. No persistent paraplegia occurred in the entire cohort. One-year survival rate in the surviving patients was 81%. Among these surviving patients, further (secondary) interventions were required in 46% of patients at 1-year intervals and in 71% of patients at 5-year intervals. These interventions included additional TEVAR reaching the celiac trunk, EVAR, F-EVAR, and organ artery stenting for delayed malperfusion syndrome. The specific procedure-related mortality rate associated with these secondary interventions was 3.4%.

Conclusion: Complicated TABD can be treated primarily by TEVAR alone in approximately one-third of the patients. Two-thirds of the patients require further interventions parallel to or directly related to the primary procedure. Thus, maintaining a strict surveillance program in all patients is mandatory for the early detection of delayed secondary complications, which then require further interventions. In a 5-year follow-up, this might be expected as high as 70%.

3106.5

The need for further endovascular repair after surgical arch replacement for type A aortic dissections

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Purpose: To evaluate the need for further endovascular repair and completion procedures after open surgical arch replacement and to analyze the outcome of such interventions.

Material and methods: Between January 2009 and December 2016, 138 patients underwent aortic arch replacement with (77) or without a frozen elephant technique (61) for symptomatic type A aortic dissection. In total, 110 patients survived the operation, and they represent the cohort of this analysis.

Results: During follow-up (median, 31 months), 36/110 survivors underwent 57 secondary interventions. The indication for these interventions was either a persistent or newly developed malperfusion syndrome (41) or a critically increasing false lumen diameter (16). Twenty-one patients needed more than one intervention. In 31 patients, a persistent malperfusion syndrome resulted from inadequate reperfusion of the true lumen, which was treated with TEVAR. Eleven of these patients underwent additional visceral artery stenting. Ten patients presented a delayed malperfusion syndrome, which was mostly caused by secondary onset of organ failure or reduced perfusion of the legs and was accordingly treated with stentgrafts. Sixteen patients with late critical enlargement of the false lumen underwent TEVAR (11) or F-EVAR (5) (mean interval, 37 months). One patient developed incomplete paraplegia. Procedure-related 30-day mortality rate was 1.8% (2/57).

Conclusion: Type A aortic dissection is a life-threatening emergency that requires open repair, which is associated with significant primary mortality. In approximately 1/3 of the survivors, further complex aortic or visceral side branch interventions are required to improve survival.

were observed. The re-intervention rate was 21.4% (9/42). CTAs showed a sac shrinkage/stable diameter in 85.7% patients.

Conclusion: Custom-made endografts represent a robust alternative for patients unsuitable for surgery with thoraco-abdominal aneurysm and type B dissection. Long-term follow-up demonstrates a low re-intervention rate.

3106.6

Long-term follow-up with custom-made endografts (b-EVAR/f-EVAR) for endovascular repair of thoraco-abdominal aneurysm and type B dissection: a single-centre experience

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Purpose: To report a single-centre long-term follow-up with custom-made endografts for thoraco-abdominal aneurysm and type B dissection.

Material and methods: Between 2011 and 2016, 42 patients (71.6±9.2 years; 12 females) were treated. The indications were Crawford aneurysm type 4 (n=21; 50%), type 3 (n=13; 30.9%), type 2 (n=4; 9.5%), and type 1 (n=2; 4.8%) and Stanford type B dissection (n=2; 4.8%). All patients were unfit for open surgery. The mean aneurysm diameter was 58.5±8.3 mm (range 50–78). The employed custom-made endografts were fenestrated (n=15; 35.7%), multibranched (n=22; 52.4%), and mixed (n=5; 11.9%). CTAs were followed up yearly.

Results: Endografts were deployed successfully in all patients in a single session. Two patients with dissections underwent endovascular fenestration prior b-EVAR. Catheterization of the fenestration/branch was successful in 98.25% (169/172) patients. One case was solved with the chimney technique and the two remaining cases were not stented; no late endoleak occurred. The mean fluoroscopy time was 84.8±33.6 minutes, mean contrast media volume was 338.6±129.6 ml, and mean intervention duration was 348.8±1115.5 minutes. The 30-day mortality was 9.5% and the 180-day mortality was 14.3%. The 30-day complication rate was 21.4%. Four cases of paraplegia (9.5%) were observed, 2 of which healed by spinal cord drainage.

The follow-up was conducted for 21±18 months (4–34; 25th–75th). No surgical explantation or renal insufficiency occurred. Fenestration/branch primary patency at 6 months and 1, 2, 3, and 4 years were 99.4% and 98.8%, 97.7%, 97.1%, and 96.5%, respectively, and secondary patency at 72 months was 100%. The endoleak rate was 28.5%: 5 type III, 1 type I, and 6 type II without aneurysmal sac enlargement

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PART 3

**Abstracts of
Posters**
sorted by presentation
numbers

Aortic Intervention

P-1

Incomplete abdominal aorta block with a small balloon in patients with dangerous placenta previa

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Purpose

The clinical result of a small balloon in abdominal aorta block in patients with dangerous placenta previa were retrospectively analyzed.

Material and methods

Overall, 274 patients with dangerous placenta previa were analyzed retrospectively. Prophylactic abdominal aorta balloon was inserted to avoid metrorrhagia. The diameter of the balloon was selected to be 2mm less than that of the abdominal aorta. The percentage of hysterectomy, amount of bleeding, and right iliac artery injury were evaluated in this group and compared with those in the large balloon group (212 patients).

Results

No hysterectomy occurred. The amount of bleeding had no statistical significance ($p>0.05$). Right iliac artery injury was observed in 3 cases in the small balloon group and 12 in the large balloon group, showing a statistical significance ($p<0.05$).

Conclusion

Incomplete abdominal aorta block with a small balloon in patients with dangerous placenta previa is effective and leads to lesser complications compared with that with a large balloon.

P-2

Posterior circulation evaluation before and after TEVAR using ultra-low-dose whole-brain computed tomography perfusion

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Purpose

To investigate posterior circulation evaluation using ultra-low-dose whole-brain computed tomography perfusion (CTP) in patients with aortic dissection treated with TEVAR.

Material and methods

From March 2016 to April 2016, TEVAR was performed in 11 consecutive patients with Stanford type B aortic dissection. The left subclavian arteries (LSAs) of all 11 patients were intentionally covered by stent grafts. Before and after TEVAR, ultra-low-dose whole-brain CTPs (70 kV, 70 mAs) were performed for evaluating cerebral blood volume (CBV) and cerebral blood flow (CBF) in the posterior circulation. CTDI and DLP (979.7 mGycm) were collected for radiation dose monitoring. Paired t-test was used to compare CTP parameters of the posterior circulation.

Results

The mean interval time between ultra-low-dose whole-brain CTP was 8 days (7–10 days). Compared with those before TEVAR, CBV (1.8 vs. 3.3, $P<0.05$) and CBF (42.7 vs. 59.8, $P<0.05$) of the posterior circulation was decreased after TEVAR. The difference was greater in the right-half posterior circulation, with CBV (1.4 vs. 3.1, $P<0.05$) and CBF (35.7 vs. 56.3, $P<0.05$).

Conclusion

Ultra-low-dose whole-brain CTP could indicate decreased perfusion of posterior circulation in aortic dissection treated with TEVAR because of LSA coverage.

P-3

Transcatheter closure of mitral paravalvular leak by the ante-grade approach with an arteriovenous loop in patients with and without mechanical aortic valve prostheses

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WITHDRAWN

P-4

Treatment of type II endoleaks with a novel agent, precipitating hydrophilic injectable liquid (PHIL)

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WITHDRAWN

P-5

Embolization of type I endoleaks after EVAS: technical considerations, success rates, and outcomes

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Purpose

To review the transcatheter embolization technique used for management of type I endoleaks (ELIs) after Nellix endografts and report the outcomes.

Material and methods

A single-center retrospective review from 2010 to 2016 of all ELIs identified 12 patients with Nellix endografts who underwent embolization for an ELI. CFA access and angiographic confirmation of the endoleaks was attained. Coils, Onyx, or a combination were used for embolization. Technical success was considered as resolution of the endoleak at completion angiography. Follow-up imaging surveillance was based on CT angiography and Duplex US. Immediate technical success, complications, and outcomes were assessed.

Results

Fifteen cases of ELI embolization were performed in 12 patients with Nellix grafts. Immediate technical success was achieved in all cases. Average time from endoleak diagnosis to embolization was 24 days (range, 2–58 days). Three patients demonstrated late recurrent endoleaks and required additional embolization. Detachable coils in addition to Onyx were used in 11 cases, Onyx was used in 3 cases, and coils were solely used in 1 case. Three adverse events with Onyx reflux into the Nellix graft and a groin hematoma were observed. None of the complications had long-term sequelae. At the average post-embolization follow-up time of 496 days, freedom from endoleak recurrence and sac growth was 92%.

Conclusion

Transarterial embolization is a viable option in the management of ELIs after EVAS. Careful case selection is necessary to ensure optimum outcomes.

P-6

Mid-term outcomes of type I endoleak embolizations

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Purpose

To report the technical success and mid-term outcomes of transcatheter embolization of type I endoleaks (ELI) in 29 patients after endovascular aortic repair (EVAR).

Material and methods

Twenty-nine patients with ELI (24 men, 5 women; mean age 80 years) underwent embolization of abdominal ELI (26 proximal, 3 distal endoleaks) after EVAR. The average aneurysm sac size was 7.7 cm. The average time between EVAR and endoleak diagnosis was 663 days and from endoleak diagnosis to embolization was 27 days. Onyx alone or with detachable coils was used for embolization. Immediate technical success, complications, and outcomes were assessed.

Results

A total of 33 embolization procedures were performed in 29 patients. Onyx alone was used in 18 cases, Onyx and coils were used in 14 cases, and only coils were used in 1 case. Immediate technical success with complete isolation of the endoleak on completion angiography was achieved in all procedures. Seven procedural complications occurred, with none showing long-term sequelae. During the follow-up period, 11 patients developed endoleak recurrence. Of these, 8 had been treated with Onyx alone and 3 with Onyx and coils. Four patients underwent a second embolization procedure. At the average follow-up time of 494 days, freedom from endoleak recurrence was 71% and freedom from sac growth was 75%.

Conclusion

Transcatheter embolization of ELI offers a safe, feasible, and sustainable treatment option for selected patients who are unsuitable for standard methods of ELI treatment. The combined use of coils with Onyx embolization seems to result in a better outcome.

P-7

Treatment of cervical ectopic pregnancy using uterine artery embolization along with the administration of methotrexate

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Purpose

Our objective was to evaluate the safety and effectiveness of conservative management of cervical ectopic pregnancies with vaginal bleeding using uterine artery embolization (UAE) along with the administration of methotrexate (MTX) as an alternative nonsurgical treatment for controlling bleeding and preserving fertility.

Material and methods

Our study includes 16 women diagnosed with cervical ectopic pregnancy with a median age of 32 years. Two third of them were nulliparous. Fetal cardiac activity was present in 11 pregnancies. Vaginal bleeding was the most common presentation occurring in 14 cases. Six women presented with acute life-threatening hemorrhage. All cases were successfully treated using UAE with gelatin sponge particles. In half of the patients, administration of MTX was performed before and after UAE. The follow-up periods after UAE ranged from 1 to 12 months. We evaluated the UAE technique, complications, clinical outcomes, and fertility.

Results

In all patients, UAE could control active vaginal bleeding on gynecologic examination. The rebleeding was successfully controlled by a second UAE procedure in 2 patients. No major complication related to UAE was detected. The uterus could be preserved in all patients. Normal menses resumed within 2 months after UAE in 9 patients. Five patients had successful natural births.

Conclusion

Cervical ectopic pregnancy is a rare occurrence with a risk of life-threatening maternal haemorrhage. Systemic administration of MTX alone or along with UAE is a minimally invasive intervention option for treating cervical ectopic pregnancy with vaginal bleeding while allowing the preservation of fertility.

P-8

Mitral paravalvular leak closure by the antegrade percutaneous approach with an arteriovenous wire loop through a mechanical aortic valve prosthesis

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Purpose

To evaluate the feasibility and safety of transcatheter closure of a mitral paravalvular leak (MPVL) using the antegrade approach requiring a trans-septal puncture and an arteriovenous wire loop across the mechanical aortic valve.

Material and methods

From March 2016 to October 2016, three patients with double mechanical mitral and aortic valve prostheses were referred for a symptomatic MPVL. The location of the leaks was at 9, 10, and 12 o'clock positions in the surgical view and the largest diameter of each leaks was 7 mm, 8 mm, and 8.5 mm as per TEE measurement, respectively. Two vascular plugs and one ductal occluder were implanted from the right femoral vein via the trans-septal antegrade approach using an arteriovenous wire loop established through the mechanical aortic valve. Follow-up was performed at 1, 3, 6, and 12 months and annually thereafter.

Results

Technical success was achieved in all three patients. The hemodynamic situation was relatively stable during the procedure. Instant angiography and TTE imaging after the devices being implanted showed that the leaks were totally closed in two cases and trivial residual leak existed in one case. During the follow-up, the devices were stable and noninterference of the occluders with the mitral disc movements was observed. No new leak and increased residual leak were detected. The improvement in congestive heart failure by at least 1 New York Heart Association grade occurred in all patients.

Conclusion

The presence of a mechanical aortic valve should not be a contraindication to percutaneous closure of MPVL. Despite the complexity of our technique, the procedure seems to be safe and effective.

P-9

Percutaneous aortic fenestration: why, when, and how to do it

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Background

The management of complicated type B aortic dissection can be challenging. These patients cannot be managed medically. Aortic fenestration is one of the methods for decompressing the hypertensive false lumen by creating a hole in the distal part of the dissection flap. This procedure allows outflow from the false lumen, thereby reducing intraluminal pressure, relieving branch vessel obstruction, and reducing the risk of extension of the dissection. Generally, this procedure is performed in urgent cases.

Clinical Findings/Procedure

The aim of this poster is to describe the i) history, ii) rationale (with special emphasis on clinical indications and patient selection), and iii) technique of percutaneous aortic fenestration.

Conclusion

In type B aortic dissection patients with branch vessel obstruction caused by a hypertensive false lumen and extension of the dissection, an urgent decompression of the false lumen is required. Percutaneous aortic fenestration, in selected patients, can be used for branch vessel reperfusion and for stopping the possible extension of the dissection.

P-10

Diagnosis and treatment of aorto-esophageal fistula due to foreign body ingestion: a single-center experience

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Learning Objectives

Aorto-esophageal fistula (AEF) caused by a foreign body is a rare but life-threatening situation that requires urgent treatment. The main objective of this study was to analyze imaging findings, treatment, and outcomes of aorto-esophageal fistula and provide an update on our experience at the Second Xiangya Hospital.

Background

Although life-threatening, the clinical manifestations of AEF can be very subtle and nonspecific.

Clinical Findings/Procedure

A total of 7 patients with AEF had been recorded in the Second Xiangya Hospital since 2011, and all of them underwent computed angiotomography examination. The authors analyzed the clinical data and compared the outcomes with previously published cases. All 7 patients complained of retrosternal pain; 3 of them had a sentinel episode of minor hemorrhage. There were mainly 3 types of imaging manifestations. Type 1 was foreign body directly penetrating into the aorta with or without surrounding inflammation (3 cases). Type 2 appeared as an ulcer of the aorta with surrounding inflammation (3 cases). Type 3 showed pseudoaneurysm of aorta (1 case). The foreign body of types 2 and 3 can be invisible or away from the aorta. Patients with type 1 imaging were treated with open thoracic surgery. Patients with type 2 received thoracic endovascular aortic repair (EVAR), and 1 of them received a secondary open thoracic surgery due to mediastinal infection 4 months later. Compared with previous studies, our cases showed a relatively better outcome, that is, except for the patient with type 3 imaging who had conservative treatment and died during hospitalization, the other 6 patients recovered after a follow-up of 5–36 months.

Conclusion

Imaging findings may be related to treatment selection and outcome of the aorto-esophageal fistula.

P-11

Cutaneous fistulization of an ascending aortic pseudoaneurysm after Bentall surgery: endovascular repair using the Amplatzer muscular septal occluder device

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We would like to report our experience of an endovascular repair using the Amplatzer muscular ventricular septal defect occluder device for an ascending aorta pseudoaneurysm after Bentall surgery complicated with a cutaneous fistula.

P-12

Visceral and lower extremity malperfusion treated by endovascular fenestration and stenting in a Marfan syndrome patient with type A dissection

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A Marfan syndrome patient presented with type A dissection complicated by visceral and lower extremity malperfusions. Endovascular management of static and dynamic branch vessel obstructions was treated with supraceliac and infrarenal aortic fenestration and aortoiliac true lumen stenting.

P-13

Abdominal aortic thrombosis: an unusual cause of renal failure in a baby

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A 12-month-old baby presented with severe acute kidney injury and abdominal distension. Catheter angiography confirmed acute thrombosis of the suprarenal abdominal aorta, including both renal arteries. Twelve hours of 3-Fr catheter thrombolysis successfully restored the renal function.

P-14

Celiac artery embolization originating from false lumen and aortic stent grafting in type A dissection after total arch replacement with elephant trunk

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A 70-year-old woman developed type A dissection after arch replacement with elephant trunk. False lumen enlargement from retrograde flow was treated by celiac artery embolization starting at the false lumen via the re-entry point and by aortic stent grafting.

P-15

Interventional management of perforated aortic root replacement conduit

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A 78-year-old female presented with chest pain 10 months following aortic root replacement. CT aortogram showed a large mediastinal pseudoaneurysm and extravasation jet from graft perforation (cardioplegia cannulation site) with a turbulent helical flow in arch/descending aorta. Angioembolisation was successful using the Amplatzer II plug.

Biliary intervention

P-16

Risk factors for biliary infection after percutaneous transhepatic biliary stenting in malignant biliary obstruction

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Purpose

We aim to evaluate the risk factors of biliary infection after percutaneous transhepatic biliary stent placement in malignant biliary obstruction.

Material and methods

Between January 2012 and January 2016, patients who were treated with biliary stent placement for malignant biliary obstruction in three medical centers were retrospectively enrolled. Based on the follow-up within 30 days after stenting, we divided these patients into two groups, the infection group and the non-infection group. The main outcome measures were demographics, clinical features, preoperative imaging characteristics, and procedural details. The independent risk factors for biliary infection after biliary stent placement were identified by multivariate logistic regression analysis based on the risk factors selected by univariate analysis using the χ^2 test for classification variables.

Results

Overall, 151 patients were included in this study, of which, 33 were in the infection group and 118 were in the non-infection group. There was no significant statistical difference in age, sex, and laboratory results between these two groups. Univariate analysis for potential risk factors showed that the length of obstruction, preoperative PS score, diabetes, gallstones, pancreatic carcinoma, obstruction type (low/high), preoperative PTCD, and stenting across the major duodenal papilla were associated with biliary infection after biliary stent placement. Logistic regression analysis showed that the length of obstruction, diabetes, obstruction type (low/high), and presence/absence of preoperative PTCD were independent risk factors of biliary infection after biliary stent placement.

Conclusion

The length of obstruction, diabetes, high-level biliary obstruction, and absence of preoperative PTCD were independent risk factors of biliary infection after percutaneous transhepatic biliary stent placement in malignant biliary obstruction.

P-17

Efficacy of double stenting of biliary tree in patients with Klatskin tumor using the stent-in-stent (SIS) technique: single vs. double access

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Purpose

To evaluate the efficacy of double stenting of biliary tree in patients with Klatskin tumor using the stent-in-stent (SIS) technique with a single or a double percutaneous access.

Material and methods

A research was performed on the database of our institution from January 2013 to April 2016, and all patients who underwent biliary percutaneous stenting for the malignant occlusion of the biliary tree were evaluated. Demographical, histological, and interventional data as well as data on follow-up were collected.

Results

SIS placement was performed in 16 patients. All of them had Klatskin tumor; 8 (50%) were classified as type IV, 1 (6%) as type IIIa, 1 (6%) as type IIIb, 1 (6%) as type II, and 5 (32%) as type I according to the Bismuth classification. Eleven out of 16 (69%) patients underwent single-access stenting with a "T" configuration of the SIS system, whereas 5 patients (31%) underwent double-access stenting with a "Y" configuration. In all cases, the procedure was performed with no major complications. Short-term follow-up (median: 9 days after the stenting procedure, IQR: 5–15) was performed with diagnostic cholangiography in 13 cases (81%), showing patency of the stenting system in all cases.

Conclusion

SIS is technically feasible, with good short-term clinical results. We did not identify clinical or technical advantages in performing double-access stenting instead of single-access stenting. Therefore, single access could be preferred to guarantee a better tolerability by the patient.

P-18

Percutaneous intraductal radiofrequency ablation plus metal stent implantation in the management of malignant bilioenteric anastomosis stricture post-choledochojejunostomy

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Purpose

To assess the feasibility and safety of percutaneous intraductal radiofrequency ablation (RFA) plus metal stent implantation in the management of malignant bilioenteric anastomosis stricture post-choledochojejunostomy.

Material and methods

From January 2014 to December 2016, 15 patients with malignant bilioenteric anastomosis strictures post-choledochojejunostomy treated by percutaneous intraductal RFA plus metal stent implantation were included for retrospective analysis. Procedure-related complications, stent patency, and survival after the treatment were investigated.

Results

There were 5 cases of type IIIa, 2 cases of type IIIb, and 2 cases of type IV hilar cholangiocarcinomas; 1 case of hepatocellular carcinoma; and 5 cases of pancreatic carcinomas. Deployment of percutaneous RFA plus metal stent implantation was technically successful in all patients. Fifteen stents had been implanted successfully. No acute pancreatitis, hemobilia and perforation, bile leakage, or other severe complications occurred. There were 7 cases of procedure-related cholangitis and 4 cases of postoperative abdominal pain. The serum direct bilirubin levels decreased 1 week after the procedure. The median stent patency was 125 days (95% CI 92–147). The survival was 6.3 months (95% CI 4.5–12.5). Two patients undertook a second RFA at 156 and 167 days because of stent restenosis. Six patients died during the follow-up.

Conclusion

Percutaneous RFA plus metal stent implantation is a safe and feasible therapeutic option for the palliative treatment of malignant bilioenteric anastomosis stricture post-choledochojejunostomy. Its long-term efficacy and safety are promising but need to be proven with random clinical trials.

P-19

Percutaneous metallic stent placement for palliative management of malignant biliary hilar obstruction

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Purpose

To investigate the technical and clinical outcomes of percutaneous metallic stent placement in patients with malignant biliary hilar obstruction (MBHO).

Material and methods

From 2007 to 2014, 415 patients (men, 261; women, 154; mean age, 65 years; range, 29–92 years) with MBHO were included in this retrospective study. All patients were treated with unilateral or bilateral stent placement in a T, Y, or X configuration using covered or uncovered stents.

Results

A total of 784 stents were successfully placed in 415 patients. Fifty-five patients had major or minor complications, including hemobilia (n = 19), cholangitis (n = 13), cholecystitis (n = 11), bilomas (n = 10), peritonitis (n = 1), and hepatic vein-biliary fistula (n = 1). Removal of temporary drainage catheter was achieved in 370 patients (89.1%). Ninety-seven patients were lost to follow-up. Stent dysfunction occurred in 154 of 318 patients: tumor ingrowth with/without overgrowth (n = 107), sludge incrustation (n = 44), and other causes (n = 3). The median patient survival and stent patency were 212 days [95% confidence interval (CI), 186–237 days] and 141 days (95% CI, 126–156 days), respectively. In terms of stent patency, there were no statistical differences in age, sex, underlying disease, Bismuth type, stent type, or stent configuration. Stent type and configuration did not significantly affect technical success, complications, successful internal drainage, patient survival, or stent patency.

Conclusion

Percutaneous stent placement is technically safe and effective for internal drainage in patients with MBHO. In addition, stent type and configuration did not significantly affect technical and clinical outcomes.

P-20

Percutaneous management of benign biliary enteric anastomotic strictures after iatrogenic bile duct injuries

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Purpose

To assess the technical success, complications and reintervention rate of percutaneous transhepatic balloon dilatation (PTBD) of biliary enteric anastomotic strictures (BES).

Material and methods

A retrospective review of patients who underwent PTBD for benign resistant BES from December 2004 to January 2016 was performed. Diagnostic cholangiogram was obtained to assess the level of obstruction. Strictures were dilated using 8–12-mm-diameter balloons followed by placement of 8–10-Fr internal–external drainage catheters, which were removed 2–5 days post-PTBD cholangiography. Follow-up was performed using clinical assessment, liver function tests, and ultrasound. Fischer's exact test was used to determine the association between recurrence of strictures and PTBD sessions.

Results

Thirty-seven patients underwent PTBD, including 10 (27%) males and 27 (73%) females. Mean age was 41.3 years (range 23–70 years). Twenty-nine patients (78.4%) were treated with choledochojejunostomy and 8 (21.6%) with hepaticojejunostomy. A 100% success was achieved in all the PTBD sessions. Nineteen (51.3%) patients were treated with a single PTBD session. Mean follow-up time was 36 months (range 1–75 months). Eighteen (48.7%) patients needed reintervention; 11 (29.7%) were symptom free after the second session at the 3-year follow-up, and 3 (8.1%) were symptom free after the third session of PTBD. No significant difference in developing recurrent strictures after 1st and 2nd PTBD sessions [18 (48.7%) vs. 7 (39%); p<0.5716] was observed. Four (10.9%) patients required metallic stent placement after the third session. Three (8.1%) patients developed stones; in 2 (5.4%) patients, stones were removed percutaneously, and 1 (2.7%) patient required surgical removal.

Conclusion

PTBD is a safe treatment for BES; however, there is risk of recurrent BES after 3 years of PTBD sessions. Few patients with resistant strictures might require stent placement.

P-21

Treatment variables associated with improved long-term outcomes in patients receiving percutaneous biliary drainage for benign anastomotic biliary strictures

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Purpose

To identify associations between treatment variables and patient demographics compared to long-term outcomes in patients receiving percutaneous biliary drainage (PTBD) for benign biliary anastomotic strictures.

Material and methods

Overall, 304 adult patients receiving PTBD between 1994 and 2015 were identified using the CPT billing codes. Medical records were retrospectively reviewed, and treatment variables and patient characteristics were analyzed with respect to the incidence of surgical revision of the biliary anastomosis. Strict adherence to a structured treatment protocol involving serial upsizing to a maximum catheter

size of 18–20F was also analyzed with respect to incidence of surgical revision for patients treated following protocol implementation in 2010.

Results

Overall, 72.8% of patients avoided surgical revision. A larger maximum biliary catheter size showed a significant association with avoiding surgical revision, whereas catheter days, number of cholangioplasties, and use of a cutting balloon did not show a significant association. Males, older age at time of intervention, longer time from surgery to placement of the initial tube, and a larger maximum tube size were also associated with avoiding surgical revision. Strict adherence to the structured protocol was significantly associated with avoiding surgical revision (5.1% who followed the protocol vs 28.9% who did not undergo surgical revision).

Conclusion

Percutaneous drainage of benign post-surgical biliary anastomotic strictures prevents surgical revision in a majority of cases. A larger maximum catheter size and strict adherence to a structured protocol are important elements of treatment for benign anastomotic biliary strictures.

P-22

Investigation of percutaneous interventional treatments for biliary complications after liver transplantation

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Purpose

To investigate the technique, efficacy and safety of percutaneous interventional treatments for biliary complications (BC) after liver transplantation (LT).

Material and methods

Clinical and imaging data of 127 patients with BC after LT who underwent percutaneous interventional treatments in our hospital from January 2006 to December 2015 were analysed retrospectively. The patients were classified into the following 5 groups: biliary leakage, anastomotic biliary strictures, hilar biliary strictures, multifocal biliary strictures and biloma. The modality of interventional treatments was percutaneous transhepatic biliary drainage (PTBD), PTBD combined with balloon dilation and PTBD combined with balloon dilation and stent implantation.

Results

The first successful rate of PTBD was 97.6%. The total curative, improvement and inefficacy rates of interventional treatments were 37.8%, 44.9% and 17.3%, respectively. In the biliary leakage group, all patients were cured by PTBD and the curative rate was 100%. In the anastomotic biliary strictures group, the curative and improvement rates were 64.3% and 35.7%, respectively. The efficacy rate was 100%. In the hilar biliary strictures group, the curative, improvement and inefficacy rates were 40%, 53.3% and 6.7%, respectively. The efficacy rate was 93.3%. In the multifocal biliary strictures group, the curative, improvement and inefficacy rates were 13.7%, 54.9% and 31.4%, respectively. The efficacy rate was 68.6%. In the biloma group, 3 cases (3/7) were cured and treatment of 4 cases was ineffective. The efficacy was the best in patients with biliary leakage, and it was the worst in the patient with bilomas ($p < 0.001$).

Conclusion

PTBD combined with balloon dilation and biliary stent implantation is a safe and effective therapeutic modality for patients with BL after LT, which can improve patients' clinical symptoms and elevate patients' quality of life.

P-23

Long-term results of percutaneous biliary balloon dilatation and sequential upsizing of silastic transanastomotic stents for benign hepaticojejunostomy strictures: a tertiary care centre experience

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Purpose

Benign biliary strictures are efficiently managed by the creation of hepaticojejunostomies (HJs). Strictures at the HJ anastomotic site are common and difficult to manage.

To determine the safety, efficacy, and long-term results of percutaneous biliary balloon dilatation (PBBBD) and sequential upsizing of silastic transanastomotic stents (STS) for benign HJ strictures.

Material and methods

A total of 130 patients (53 males and 77 females) who had undergone HJ were recruited in the study between 2007 and 2014. PBBBD was performed after traversing HJ strictures under ultrasound and fluoroscopy guidance, followed by placement of STS using multiple ducts. These silastic catheters were fashioned as transanastomotic stents and were upsized sequentially over a period of 1 year at a 3-month interval. Hepatolithiasis without obvious strictures ($n=28$) were also managed similarly after balloon sweeping of calculi. The mean maximum diameter achieved at the end of 1 year was 34.5 F. The mean procedure time and fluoroscopy time were 49.5 (31–64) and 15.33 (13.6–18.2) minutes, respectively. Whitaker manometric perfusion tests were performed before removal of silastic tubes ensuring adequate decompression of strictures. The primary outcome measure was the absence of clinical biliary obstruction symptoms at 24 months.

Results

The overall technical and clinical success rates were 98.5% and 97.7%, respectively. The primary outcome measure was achieved in 97.7% patients. The mean follow-up and primary patency durations were 43.6 and 42.5 months, respectively. Procedure-related mortality and major morbidity rates were 0% and 3.8%, respectively.

Conclusion

PBBBD and sequential upsizing of STS of benign HJ strictures is a safe and effective procedure with excellent outcome measures.

P-24

Biliary percutaneous transluminal forceps biopsy using the "cross push-hold" technique: results in 50 patients with suspected malignant biliary obstruction

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Purpose

To evaluate the efficacy and safety of percutaneous transluminal forceps biopsy (PTFB) using a "cross push-hold" technique in malignant biliary obstruction.

Material and methods

Fifty patients (women, 27 and men, 23; age 66 ± 15.9 years) with obstructive jaundice, biochemical markers, MR cholangiopancreatography, and/or history of malignant disease underwent percutaneous transhepatic cholangiography by the standard method. For PTFB, a 0.035-inch hydrophilic guidewire was negotiated across the stricture and a 7-FR, 24-cm sheath when introduced just passed its limit. A 1.8-mm flexible forcep (Captura-Cook Endoscopy) was inserted alongside the guidewire, the cups were opened and pushed until maximum resistance, usually at the stricture centre. The cups were closed while holding pressure, not pushing further. Four to six specimens/patient were obtained; lesions involved the intrahepatic ducts, 18; hilum, 17; common bile duct, 5; and ampullary

segment, 10 patients. Final diagnosis was derived from surgical excision in 4, from additional histology in 16, and from clinical/radiological follow-up in 30 patients. For morbimortality, the Dindo-Clavien (D-C)-scale was used. Sensitivity, specificity, and predictive values were calculated using a 2 × 2 table.

Results

Overall, malignancy was confirmed in 47/50 (94%) patients (cholangiocarcinoma, 17; pancreas, 11; colorectal metastasis, 8; gallbladder, 3; and others, 8 patients). All PTFB specimens were reliable for diagnosis, showing malignancy, 28; false-negative, 19; and no false-positive. Sensitivity, specificity, and positive predictive value were 60%, 100%, and 100%, respectively. Morbidity (6%) occurred in 3 patients [one haemobilia (D-C-IIIb) and 2 transient pancreatitis (D-C-II)], without mortality.

Conclusion

PTFB using the “cross push-hold” technique is safe and provides moderate sensitivity, high specificity, and positive predictive values. Of note, holding the pressure, instead of continuously pushing the forceps, may prevent it from slipping forward while closing the cups.

P-25

Percutaneous transcholecystic common bile duct stone removal via percutaneous cholecystostomy and cystic duct cannulation: technical outcomes and factors influencing the result in 112 patients

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Purpose

To evaluate technical outcomes of percutaneous transcholecystic common bile duct (CBD) stone removal and identify predictors of technical failure in patients with cholangitis and/or cholecystitis.

Material and methods

From September 2009 to December 2016, 112 consecutive patients (67 men, 45 women; mean age, 73 years) with CBD stones underwent percutaneous stone removal via cholecystostomy and cystic duct cannulation. All patients had acute cholangitis and/or cholecystitis. All patients could not tolerate immediate surgery because of cardiac problems (n = 41); previous operation for cancer (n = 22); or poor medical condition, including sepsis (n = 11), pulmonary dysfunction (n = 11), diabetes mellitus (n = 18), or liver cirrhosis (n = 9). Technical success rates and complications were evaluated. Logistic regression analysis was used to identify predictive factors of technical failure.

Results

CBD stones were successfully removed in 88 of the 112 patients (78.6%). In 24 patients, stone removal failed because of failure of cystic duct cannulation (n = 14), multiple CBD stones (n = 5), proximal migration of CBD stone (n = 4), and low insertion of the cystic duct (n = 1). No procedure-related complications were observed. During the mean follow-up of 255 days, recurrence of CBD stones occurred in 4 patients. Proximal migration of CBD stone was identified as an independent predictor of technical failure (odds ratio: 12.994, 95% CI: 1.274–132.563, P = 0.030).

Conclusion

Percutaneous CBD stone removal via percutaneous cholecystostomy is safe and technically feasible. Proximal migration of CBD stones was the only independent predictor of technical failure.

P-26

Percutaneous cholecystostomy for acute acalculous cholecystitis: clinical outcomes of 271 patients

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Purpose

To evaluate the clinical efficacy of percutaneous cholecystostomy (PC) for the treatment of acute acalculous cholecystitis (AAC).

Material and methods

From March 2007 to February 2014, a total of 271 AAC patients (men, 169; women, 102; mean age, 72 years; age range, 22–97 years) who underwent PC were retrospectively evaluated.

Results

PC was successfully performed in all 271 patients. Symptom resolution and significant improvement of laboratory values were achieved in 235 patients (86.7%) within 4 days after PC. Overall complication occurred in six patients (2.2%). Interval elective cholecystectomy was performed in 127 (46.8%) of 271 patients. In-hospital mortality rate was 8.4% (23 of 271 patients). Among the remaining 121 patients, successful removal of PC catheter was achieved in 88 (72.7%) patients at a mean of 30 days (range, 4–365 days), following a successful trial of catheter clamping. In the remaining 33 patients, the catheters could not be removed due to late stage of their underlying diseases. During the mean follow-up period of 1227 days (range, 42–3188 days), 72 patients died, whereas 49 remained alive. Of the 88 patients in the catheter-removal group, 86 (97.7%) were successfully treated with initial PC, whereas two (2.3%) experienced recurrence of cholecystitis. Cumulative recurrence rates were 1.1%, 2.7%, and 2.7% at 1, 2, and 8 years, respectively.

Conclusion

The good therapeutic outcomes of PC and lower recurrence rate suggest that PC itself is a definite treatment option not requiring subsequent cholecystectomy in majority of AAC patients.

P-27

Percutaneous extraluminal recanalization of bile duct anastomosis obstruction after liver transplantation

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Purpose

Bile duct anastomosis obstruction is an important complication, which can develop after liver transplantation. Although the obstruction can be treated with endoscopy, percutaneous procedure, or surgical revision, including retransplantation, surgical management is very rarely performed due to postsurgical adhesion or lack of donor livers. We retrospectively evaluated the feasibility of the percutaneous extraluminal recanalization of bile duct anastomosis obstruction after living donor transplantation.

Material and methods

We extraluminally recanalized bile duct anastomosis obstruction in 5 patients, who had undergone failed endoscopic and percutaneous intraluminal recanalizations. We punctured from the proximal bile duct via the PTBD tract to the distal segment using the hard tip of a hydrophilic guidewire, which was bended onsite. To facilitate the distal duct puncture, we used an endoscopic nasobiliary drainage catheter (n=3), a metallic stent (n=1), or a drainage catheter via the other segmental duct (n=1) in the distal duct as a target. After recanalization, PTBD catheters were placed in the recanalized tracts.

Results

All patients showed technical and clinical success and no major complications. One or two plastic stents were endoscopically placed by the rendezvous technique, 3–439 days after recanalization. In 3

patients, the plastic stents were removed 11.7–60.8 months after placement and recanalized tracts remained patent for 17.5–26.3 months after removal of the stents. In 2 of these patients, however, stent removal and placement was repeated 2 and 3 times during those periods because of recurrent obstruction. The remaining 2 patients maintained plastic stents in the tracts for 26.3 and 93.5 months.

Conclusion

Percutaneous extraluminal recanalization of anastomosis obstruction after liver transplantation is feasible, but further investigation is necessary to maintain patency.

P-28

Diagnostic yield of percutaneous transhepatic biliary biopsy forceps in the diagnosis of obstructive jaundice

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Purpose

To determine the safety and efficacy of our initial experience of introducing the technique of biliary biopsy forceps (Cook Medical) during percutaneous transhepatic biliary drainage (PTBD) for obtaining diagnostic tissue.

Material and methods

A retrospective audit of all biliary biopsy cases during an 18-month period (June 2015–November 2016) when this technique was introduced at our centre. Patient demographics, site of obstruction, operator, complications, and histopathology result were analysed on the hospital's electronic patient record. Follow-up surgery, clinical outcome, and/or imaging was also documented (median follow-up 12 months).

Results

Twenty-six patients underwent a biliary biopsy procedure (14 male). All 26 procedures were technically successful with no complications related to the biopsy. A mean of 2.8 (2–4) samples were acquired. Seventeen hilar and 9 distal CBD lesions were targeted. Fifteen (58%) specimens yielded a diagnosis of malignancy or "highly suspicious" of malignancy. Three samples had non-malignant tissue, 1 had "atypia," and 7 (27%) were non-diagnostic (insufficient or crushed sample). Distal CBD lesions (3 out of 9) were more likely to be non-diagnostic. Of the 3 non-malignant tissue samples, one patient had proven adenocarcinoma on subsequent endoscopic ultrasound biopsy and the other 2 patients had images indicating malignancy (one patient died). Non-diagnostic samples were evenly spread through the 18-month period, but may be operator dependent.

Conclusion

Our initial experience with biliary biopsy forceps demonstrates acceptable diagnostic yield with a high procedural success rate and no associated complications.

P-29

Biodegradable biliary stent implantation in the treatment of hepatobiliary disease in the pediatric age: experience at a single center

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Purpose

To evaluate the safety and results of the treatments at our center using biodegradable biliary stents for hepatobiliary disease in the pediatric age group.

Material and methods

Between January and December 2016, a total of 6 patients were treated with resorbable biliary stents (4 male, 2 female, with an average age of 65 months, range 16–180 months). The base disease comprised 4 cases of atresia of the bile ducts, 1 case of sclerosing cholangitis, and 1 case of sarcoma of the liver. The patients were followed clinically and with ultrasound at 1, 3, and 6 months after the placement of the resorbable biliary stent.

Results

The stent implant was feasible in all cases. In none of the cases, major or minor complications were observed. In all patients, we performed a control with cholangiography for 24 hours that showed an optimal control of the placement of the stent and the resolution of the biliary stricture. The mean follow-up time was 7.5 months (range 5–12 months); any invasive treatment in the follow-up period was not necessary. The stent was visible for 3 months on average during the follow-up using ultrasound.

Conclusion

Percutaneous placement of biliary biodegradable stents represents an excellent option in the treatment of biliary stricture in the pediatric age group. In all cases, the treatment has been effective and free of complications. More research is needed to confirm our results.

P-30

Interventional radiology in liver transplantation

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Learning Objectives

1. To review common complications of liver transplant patients (arterial, venous, and biliary) and their diagnostic imaging modalities.
2. To review most common interventional procedures applied to resolve these complications.

Background

Liver transplant is used to treat hepatocarcinoma and acute or chronic end-stage liver failure in pediatrics and adults.

In transplant patients, current prognosis consists of an extended survival. However, some complications occur, which may cause significant morbidity, increase the risk of surgery or even retransplantation. Imaging may be required to diagnose, and interventional procedures may be indicated in their treatment.

Clinical Findings/Procedure

Liver transplant complications may be divided into vascular (arterial, portal venous, or hepatic venous) or biliary complications. Vascular complications reduce flow by obstructing (thrombosis or stenosis), leaking, or "stealing" flow. Angioplasty with or without stenting and thrombolysis is a valid option for treatment, and its use is described in the setting of liver transplantation. Flow physiology may also be changed by embolizing vessels causing "stealing" from the hepatic artery (namely splenic vessel) as well as by embolizing portosystemic collaterals. Biliary complications may also require drainage (of bilomas or intrahepatic ducts) or dilation of a stenotic biliary duct. We will review the most common complications focusing on the imaging modalities used to diagnose them, the interventional procedures available, and their expected successes as well as demonstrate some cases treated at our institution.

Conclusion

Diagnostic and interventional radiology may contribute to extended liver transplant graft survival, providing an early diagnosis of complications and a reasonable alternative to surgical treatment.

P-31

Novel delivery of avitene via transhepatic introducer sheath for track embolization following transhepatic interventions

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Learning Objectives

We describe a novel technique for transhepatic track embolization using avitene (Bard, US) through the usual transhepatic introducer sheath.

Background

Post-procedural hemorrhage is one of the major causes of morbidity and mortality following hepatobiliary interventions. These procedures are also often associated with substantial levels of post-procedural pain because of bile leak and subsequent peritoneal irritation. Previous studies have confirmed that track embolization can substantially reduce hemorrhage and bile leak risks.

Clinical Findings/Procedure

Prepare avitene by mixing a 1 g sachet with a desirable amount of diluted contrast (we often use a solution of 3.5 ml normal saline mixed with 4.5 ml Omnipaque 240 mg I/ml). Withdraw the sheath a few millimeters under fluoroscopy to a position just proximal to the level of entry point to a portal vein branch or biliary duct. Gradually, inject the avitene solution through the side-arm of the introducer sheath under fluoroscopy filling the sheath while avoiding overflow of the solution beyond the tip of the sheath. Cut the tapered part of the sheath dilator and advance it a few millimeters through the hemostatic seal of the introduced sheath valve. Withdraw the sheath back over the dilator while holding the dilator in a fixed position and monitor the formation of a continuous cast of track embolization under fluoroscopy.

Conclusion

In our experience, using this technique produces a continuous cast of track embolization, with no significant risk of inadvertent embolization of a vascular branch.

P-32

Vascular and extravascular complications of percutaneous transhepatic biliary drainage: ways to resolve them

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Background

Percutaneous transhepatic biliary drainage is used to treat various benign and malignant biliary diseases. The technique is safe and effective. However, in a relatively low number of cases, vascular and extravascular complications are associated with this technique. In malignant patients who are frequently severely debilitated by disease, there is a higher incidence of complications related to percutaneous transhepatic biliary drainage.

Clinical Findings/Procedure

The aim of this poster is to illustrate the 1) anatomic consideration of vascular and biliary trees, 2) complications of vascular and extravascular percutaneous transhepatic biliary drainage, 3) and ways to solve these complications (from cold saline flush to transcatheter embolization).

Conclusion

Percutaneous transhepatic biliary drainage is a safe and effective technique to treat biliary diseases. However, vascular and extravascular complications may occur and every interventional radiologist has to know when and how to treat these.

P-33

How should an interventional radiologist interpret commonly encountered lab values for hepatocellular carcinoma

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Learning Objectives

1. To understand which clinical lab values are of interest for patients with hepatocellular carcinoma (HCC) and cirrhosis.
2. To understand the physiological and clinical implications of commonly encountered lab values in this clinical setting.
3. To understand how various clinical lab values factor into predictive models for cirrhosis and HCC treatment algorithms.

Background

Commonly encountered lab values of interest for evaluating liver function include liver function testing (AST, ALT, alkaline phosphatase, and bilirubin); renal function, including creatinine and glomerular filtration rate; prothrombin time; International Normalized Ratio; and serum sodium and albumin levels. Physiological implications of these values, related to their production and regulation, allow the clinician to understand the degree, the potential causes, and the potential clinical complications of hepatic dysfunction. Clinical implications of abnormal lab values affect the staging of the degree of cirrhosis along with the potential eligible treatments that individuals can receive.

Clinical Findings/Procedure

Understanding commonly encountered laboratory values in patients with HCC allows for a more thorough clinical management. Using these aforementioned lab values to understand the severity of liver disease and implications of liver dysfunction are crucial as they affect further management of the patient by the interventional radiologist. Using an objective classification, such as the Barcelona staging system, stratifies patients based on the degree of liver dysfunction with resection, transplantation, ablation, chemoembolization, or supportive care serving as a guide to manage these complex medical cases.

Conclusion

Review commonly encountered lab values in patients with HCC. Review how abnormalities in encountered lab values allow one to glean the areas of hepatic dysfunction.

Review clinical factors that stratify patients with HCC and cirrhosis. Understand how a multidisciplinary team approach allows physicians to provide the highest quality of care to their patients.

P-34

Percutaneous transhepatic cholangioscopy and holmium laser lithotripsy for management of biliary calculi

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Learning Objectives

This educational abstract provides the reader with the inventory, required knowledge (e.g. laser safety and laser pulse settings) as well as tips and tricks for effective percutaneous transhepatic cholangioscopy and holmium laser lithotripsy for patients with intrahepatic or refractory choledocholithiasis. The abstract, illustrated with instructional case images, will allow a new user to start a biliary laser lithotripsy service safely and successfully.

Background

Advances in interventional radiology have seen the adaptation of urological endoscopic laser techniques to treat biliary calculi. Percutaneous transhepatic cholangioscopy and holmium laser lithotripsy comprise an effective procedure for the management of intrahepatic or refractory choledocholithiasis validated in several studies.

Clinical Findings/Procedure

Angiosuite room preparation, safety measures and equipment set up for cholangioscopy and laser lithotripsy. Biliary access is obtained using ultrasound and fluoroscopic guidance as for a PTC with anaesthetic support. A flexible cholangioscope is inserted through a large sheath (12 French minimum). Saline irrigation distends the bile ducts, improving anatomical and calculus visualisation and assisting in the removal of biliary debris. A laser fibre is positioned in direct contact with the target calculus through the working channel of the cholangioscope. Laser lithotripsy is performed on the target calculi and settings are adjusted accordingly. Balloon dredging or basket extraction is used to remove residual fragments.

Conclusion

Percutaneous transhepatic biliary laser lithotripsy is a safe and effective method of stone clearance for intrahepatic or refractory choledocholithiasis and can be easily performed in the angiosuite room.

P-35

Staged percutaneous cholecystectomy followed by antero-grade gallbladder stenting for treatment of cholecystitis

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Learning Objectives

1. To understand the role of percutaneous gallbladder stenting in patients with cholecystitis.
2. To understand the procedure technique and considerations.

Background

- Image-guided percutaneous cholecystectomy is a recognized temporary treatment for critically ill patients with acute cholecystitis.
- Definitive treatment following cholecystostomy is usually by means of subsequent cholecystectomy.
- In some cases, cholecystectomy is contraindicated due to pre-existing patient comorbidities. In such cases, endoscopic gallbladder stenting can be performed, although this has a reported technical failure rate of around 20%.
- Anterograde gallbladder stenting via the existing cholecystostomy tract provides an alternative minimally invasive approach.

Clinical Findings/Procedure

Areas that will be presented in this poster include the following:

- Indications for anterograde gallbladder stenting.
- Procedural considerations for performing anterograde gallbladder stenting, including approach used for initial cholecystostomy to facilitate subsequent gallbladder stenting.
- A step-by-step guide to perform the procedure.
- Expected outcomes and follow-up drawing based on experience from our institution.

Conclusion

With increasing number of elderly patients showing multiple comorbidities presenting with cholecystitis, alternatives to conventional surgical intervention such as percutaneous gallbladder stenting need to be considered. Procedure success depends on careful patient selection and preprocedural planning.

P-36

Biodegradable stents in the biliary tract

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Learning Objectives

To evaluate our current results with the application of bioabsorbable (biodegradable) stents into the biliary tract.

Background

Benign biliary tract stenoses are a relatively rare condition. In some cases, interventional treatment is a challenge. Balloon dilatation and temporary metallic stent placement are possible treatment options, though biodegradable stents seem to be a very good alternative.

Clinical Findings/Procedure

Our group consisted of 12 patients with biliary tract stenosis recurrence after standard percutaneous treatment. Initial treatment for all patients was percutaneous transhepatic drainage, followed by a series of balloon dilatation (average 2.9 per patient) and middle-term percutaneous drainage (average 4.8 months). In all cases, patients underwent the manometric test before cessation of drainage. A biodegradable stent (ELLA company) was implanted in all patients. After stent implantation, all patients were followed up at regular intervals at our intervention department. Patients were monitored using ultrasound and clinical examination, including laboratory tests for determining bilirubin and liver enzyme levels.

Conclusion

Stent implantation was achieved without complications, with a technical success rate of 100%. Early complications, such as pain, bleeding, and infection, did not occur in any patient. During follow-up, 10 out of 12 patients with benign stenosis showed no signs of restenosis. Biodegradable stents represent a new safe method of interventional radiology treatment of benign biliary stenosis. In future, BDG stent implantation could possibly replace balloon dilatation treatment, which is more time consuming.

P-37

Perforated haemorrhagic acute cholecystitis treated with cystic artery embolisation and percutaneous cholecystostomy

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A 55-year-old male with cirrhosis and MELD score 30 presented with severe abdominal pain. CT showed perforated haemorrhagic acute cholecystitis and large-volume haemoperitoneum. The patient was treated with cystic artery embolisation and percutaneous cholecystostomy and subsequently stabilized clinically.

P-38

Uncommon cough

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We report the case of a 51-year-old man with biliptysis due to a bronchobiliary fistula following HCC treatment with a combination of TACE and RFA. He was treated with n-butyl cyanoacrylate subselective biliary transhepatic embolization with an occlusive balloon.

P-39

Balloon and adrenaline technique in hemorrhage complications during percutaneous bile duct stone removal

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A 66-year-old male patient with a previous gastrectomy was a candidate for percutaneous transhepatic bile duct stone removal. During the procedure, a biliary hemorrhage complication appeared, which was treated by an occlusion balloon and intrabiliary duct adrenaline infusion.

P-40

Port for bile duct surveillance

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We present the successful novel use of a port for bile duct surveillance and access during stentgraft management of a post-transplant anastomotic bile duct stricture.

P-41

Percutaneous transhepatic endoscopic laser lithotripsy for biliary stones

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We present three cases of patients with intrahepatic biliary stones not suitable for endoscopic procedure treated with percutaneous laser lithotripsy. After biliary drainage, all patients underwent bilioplasty, followed by percutaneous insertion of a laser fiber that was used to fragment the biliary stones.

P-42

Successful interventional removal of a migrated biliary stent using a novel approach

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A patient with a pancreatic mass presented with a migrated ERCP-guided biliary stent eroding through the duodenum into an abscess cavity. This was successfully snared via a pre-existing retroperitoneal drain tract using combined PTC approach, stent catheterisation and ballooning.

P-43

Percutaneous recanalization of totally occluded hepato-jejunostomy in a 5-year-old girl after living donor liver transplantation

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Following liver transplantation, a 5-year-old girl developed cholangitis and early-stage cirrhosis due to total hepatojejunostomy occlusion. After the endoscopic approach failed, US/fluoroscopy was used for percutaneous progression of a Rosch-Uchida needle from the bile duct to the jejunum, achieving recanalization of bilioenteric anastomosis.

P-44

Acute pancreatitis due to the migration of lipiodolized HCC to the distal bile duct: an endoscopic removal

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A 69-year-old woman underwent transarterial chemoembolization for HCC with intrahepatic bile duct invasion. Three days later, the lipiodolized tumor isolated and migrated to the distal CBD, with newly developed acute pancreatitis. We successfully removed the lipiodolized mass via the endoscopic approach.

Biopsy and drainage

P-45

Percutaneous needle biopsy of mediastinal masses under C-arm cone-beam CT guidance: diagnostic performance and safety

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Purpose

The aim of this study is to evaluate the feasibility of percutaneous needle biopsy of mediastinal masses under cone-beam computed tomography (CBCT) and "XperGuide" navigation guidance.

Material and methods

From September 2013 to April 2016, 40 patients (25 men and 15 women; mean age 52.5 years; range 18.7–86.4 years) with 40 mediastinal masses underwent CBCT/"XperGuide" guided percutaneous needle biopsies. Technical success, sensibility, specificity, positive predictive value (ppv), negative predictive value (npv), and complication rate were evaluated.

Results

Technical success evaluated as the correct positioning of the needle inside the lesion was 100%. Based on histopathological diagnosis, 2/40 biopsies (5%) resulted in false negatives. Diagnostic accuracy was 95%, sensitivity was 95%, specificity was 100%, ppv was 100%, and npv was 0%. The mean total procedure time was 32 minutes (range 15–60 minutes) revealing a reduction of time compared with the first group of 20 patients (mean time: 45 minutes) with the last group of 20 patients (mean time: 17 minutes). No major complications were recorded. Only three patients (7.5%) had mild pneumothorax, as demonstrated by post-procedural CBCT, resolved spontaneously.

Conclusion

CBCT/"XperGuide" navigation system is a new, safe, and accurate technique that can be used as a guidance for mediastinal mass biopsies. It also permits the use of CT machines for diagnostic exams, relieving them from interventional procedure burden.

P-47

Comparing diagnostic yield, complication rates, and cost between US- and CT-guided peripheral lung lesion biopsies

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Purpose

To demonstrate that US guidance is superior to CT guidance in the biopsies of peripheral lung lesions touching the pleura. The former has a higher diagnostic yield, a lower complication rate, a shorter procedural time, and is more cost effective.

Material and methods

A retrospective chart review of peripheral lung nodule biopsy patients was performed between Jan 2010 and Sep 2016. The cohort was divided into 2 groups: one with US guidance and the other with CT guidance. Variables were stratified based on characteristics of the nodule, such as its location and size. Radiological, pathological, and clinical data were reviewed. Cost analysis was performed for each type of guidance.

Results

Forty-three patients underwent primary US-guided biopsy and 55 underwent only CT-guided biopsy among the total 98 peripheral lung lesion patients. In the US group, 4% patients showed pneumothorax, whereas in the CT group, 9% patients showed the condition. The average procedure time was 17 min in the US group and 35 min in the CT group. The pathological diagnostic yield was 94% in the US group and 92% in the CT group. There was a 7% conversion rate from primary US guidance to CT guidance. Radiation exposure was negligible in the US group and 525 mGy-cm in the CT group. Average cost was \$253 for an US procedure and \$542 for a CT procedure. Time cost money was included.

Conclusion

US guidance resulted in a higher diagnostic yield, a lower complication rate, and a shorter procedure time compared with CT guidance in the biopsies of peripheral lung lesions touching the pleura.

P-48

Risk factors for major complications in CT-guided biopsy of pulmonary lesions

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Purpose

In ambiguous lesions of the lung, CT-guided biopsy is part of the clinical work-up. The aim of this study was to investigate the correlation between risk factors and development of a major complication (i.e., pneumothorax or pulmonary hemorrhage) after CT-guided biopsy of intrathoracic lesions.

Material and methods

We retrospectively analyzed the data from 236 patients in a period of 3 years, who underwent a CT-guided lung biopsy. Data concerning age, sex, total table time, intervention time, lesion diameter, distance lesion-skin/lesion-pleura, passages through pleura, lesion

position in the pleural space, interlobar fissures, dominant vessels > 3mm, and use of conventional CT vs. CT-fluoroscopy were evaluated. For statistical analysis, Mann-Whitney and Pearson's chi-squared tests and logistic regression analysis were used.

Results

Overall rate for complications was 85/236 (35%), with pneumothorax in 41/236 (17%) and pulmonary hemorrhage in 55/236 (23%). There was no significant dependency in the occurrence of complications related to sex, age, distance lesion-skin, and lung segment. There was a significant difference concerning the overall rate of complications for lesions next to greater vessels (OR=9,525; p<.001) and for the passages of the pleura during biopsy (OR=11,465; p<.001). Risk factors for development of a pneumothorax were numbers of pleura passages (OR=20,885). The risk factors for the occurrence of pulmonary hemorrhage are the proximity to greater vessels (OR=32,157) and the number of pleura passages (OR=4,618).

Conclusion

In CT-guided lung biopsy, the number of pleura passages and the lesion's proximity to greater vessels are significant risk factors for developing major complications such as pneumothorax or pulmonary hemorrhage.

P-49

Comparison of diagnostic yield of malignancy of CT-guided lung biopsy with transbronchial biopsy in the same patient

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Purpose

To compare the diagnostic yield of malignancy and complication rate of CT-guided percutaneous transthoracic core needle biopsy of lung masses and transbronchial biopsy in the same patient.

Material and methods

A retrospective chart review of 22 patients with suspected primary lung cancer who underwent both CT-guided and transbronchial biopsies from May 2014 to September 2016 was performed. There were 11 men and 11 women with the average age of 63 ± 13 years and average mass size of 3.7 ± 2.6 cm. Only the lung parenchymal lesion was biopsied under CT guidance. Transbronchial biopsy targeted the lung parenchymal lesion as well as mediastinal lymph nodes.

Results

Malignancy was identified in 17 (77%) patients who underwent CT-guided biopsy, including 12 adenocarcinomas, 4 squamous cell carcinomas, 1 lymphoma, and 5 inflammatory lesions. Five patients (23%) developed subclinical lung parenchymal hemorrhage (grade 1 in four patients and grade 2 in one patient). One patient (5%) developed pneumothorax requiring a chest tube. Malignancy was diagnosed in 7 patients (32%) who underwent transbronchial biopsy. Only 2 patients (9%) developed significant hemorrhage, which was subclinical. No patients developed pneumothorax. The difference in the diagnostic yield of malignancy between transthoracic CT-guided lung biopsy and transbronchial biopsy was statistically significant (P<0.01).

Conclusion

Our results indicated that CT-guided lung biopsy has a higher diagnostic yield of malignancy compared with transbronchial biopsy but with a higher complication rate, including parenchymal hemorrhage and pneumothorax. Transbronchial biopsy offers a simultaneous advantage of sampling the mediastinal lymph node without significant added complications.

P-50

Transgluteal versus transabdominal percutaneous drainage for pelvic abscess management

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Purpose

Both the transgluteal and transabdominal percutaneous drainage approaches are effective for pelvic abscess management; however, there is limited information regarding which approach should be selected when both are available. This study aimed to compare the effectiveness of the transgluteal approach with that of the transabdominal approach for pelvic abscess management.

Material and methods

This retrospective study included 40 patients who underwent percutaneous drainage for pelvic abscesses that were both anteriorly and posteriorly puncturable. The medical records of the patients were retrieved to compare the complete resolution rate, additional drainage incidence, major complications, and tube placement duration between patients who underwent transgluteal drainage (TG group) and those who underwent transabdominal drainage (TA group). The Mann-Whitney U test was used for analysis of the tube placement duration.

Results

Of the 40 patients, 11 and 29 patients were included in the TG and TA groups, respectively. Complete resolution of the abscess following percutaneous drainage, without subsequent surgery, was noted in 10 (91%) patients of the TG group and all patients of the TA group. Additional percutaneous drainage was required in one patient of the TG group (9%) and nine patients of the TA group (31%). No severe complications, including major bleeding, were noted in either of the groups. The median tube placement duration was significantly shorter in the TG group than in the TA group (10 days vs. 16 days, $p = 0.046$).

Conclusion

Both the transgluteal and transabdominal percutaneous drainage approaches are effective for pelvic abscesses. However, transgluteal drainage is associated with a shorter drainage duration.

P-51

Normal saline plugging: a simple yet effective way of reducing the severity of pneumothorax post-percutaneous biopsy

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Purpose

To evaluate the role of tract plugging with normal saline in the prevention of clinically significant pneumothorax following CT-guided percutaneous transthoracic biopsies of lung lesions.

Material and methods

Since May 2016, for CT-guided lung biopsies, we have routinely started administering 1–3 mls of normal saline through the coaxial sheath needle to seal the tract before withdrawing it. The imaging and medical records of 40 consecutive patients were reviewed for lesion size, location, approach, and incidence of clinically significant (requiring percutaneous drainage for symptom relief) pneumothorax. These findings were compared with 40 consecutive patients who underwent biopsies before adoption of this workflow.

Results

The mean age was 64 years in the saline plugging (SP) group and 67 years in the no plugging group (NP). Eleven (27.5%) patients developed pneumothorax in the SP group compared with 12 (30%) in the other group. Only a single patient (2.5%) in the SP group developed pneumothorax significant enough to warrant percutaneous

drainage. Three patients (7.5%) underwent percutaneous drainage in the NP group for their symptomatic pneumothorax. The mean lesion size was comparable (3.8 cm in SP vs. 4 cm in NP). The lesion to pleura distance was slightly higher in the SP group (2.3 cm vs. 1.9 cm).

Conclusion

Our preliminary results demonstrate a favorable trend for saline plugging to be helpful in preventing clinically significant pneumothorax.

P-52

Diagnostic accuracy and complications in the transthoracic CT-guided biopsy of small pulmonary lesions

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Purpose

Small pulmonary lesions (<10mm) are more frequently encountered due to the increased use of computed tomography (CT). Consequently, the number of requests to obtain histological samples of small pulmonary nodules has increased. It is unclear if the diagnostic accuracy of transthoracic biopsies of small pulmonary nodules is different compared to that of larger lesions. The purpose of this study was to assess the diagnostic accuracy and complications in CT-guided transthoracic core biopsy of small pulmonary lesions.

Material and methods

Transthoracic CT-guided core biopsy procedures between 1/1/2012 and 15/6/2016 were retrospectively analyzed. Patient characterizations, lesion type, and details of the procedure were collected from medical records and PACS archiving systems. Biopsy results were compared with pathological reports and imaging follow-up as reference standards to determine the diagnostic accuracy. Fisher's exact and Student's t-tests were used for analysis.

Results

Overall, 360 procedures were included; 342 lesions were (partly) solid and 18 were of ground-glass density. Thirty-four lesions were <10mm, with the smallest being 5mm in diameter. There was no difference in the diagnostic accuracy between biopsies taken from lesions <10mm and lesions ≥10mm (91.2% vs. 94.8%; $p=0.290$). There was no difference in the occurrence of pneumothorax requiring and not requiring chest-tube placement (5.9% vs. 7.7%; $p=0.515$). Emphysema and length of the traversed lung parenchyma were risk factors for the occurrence of a pneumothorax requiring chest-tube placement ($p<0.001$ and $p=0.018$, respectively).

Conclusion

The size of a pulmonary nodule does not significantly influence diagnostic accuracy and complication rate of transthoracic CT-guided core biopsies. Emphysema and the length of the biopsy trajectory are predictors of clinically significant pneumothorax.

P-53

Does CT-guided bone biopsy based on prior FDG-PET/CT demonstrate improved accuracy: a comparison with the conventional procedure

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Purpose

To assess whether information provided by FDG-PET/CT resulted in a decreased false negative rate and improved accuracy of CT-guided bone biopsies (CT-GBB).

Material and methods

Between February 2011 and October 2015, we performed CT-GBB on 123 consecutive patients. The patients were divided into 2 groups. Group A was defined as CT-GBB combined with a prior PET-CT performed within the past 30 days. Group B was defined as CT-GBB without PET-CT. The biopsy results were compared with the final diagnostic results based on surgical histopathological outcome or clinical follow-up. Inflammatory bone lesions were excluded from this analysis. Biopsy samples that did not provide sufficient pathological material for diagnostic evaluation due to necrotic debris or blood were also excluded from further analysis. We compared the diagnostic accuracy rate of CT-GBB between Groups A and B.

Results

Group A consisted of 41 patients (aged 39–83 years with a median age of 62 years). Group B consisted of 42 patients (aged 9–86 years with a median age of 67.5 years). Correct diagnosis was achieved for 39 patients (95%) in Group A and for 40 patients (95%) in Group B. Both groups had 2 false-negative biopsies. The difference in diagnostic accuracy between Groups A and B was not statistically significant ($p=0.98$).

Conclusion

CT-GBB allowed for a high diagnostic success, and PET-CT-assisted CT-GBB provided no significant diagnostic advantages.

P-54

Efficacy of in-bore magnetic resonance-guided biopsy on prostate lesions detected by multiparametric MR imaging with high PI-RADS scores

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Purpose

To determine the efficacy of in-bore magnetic resonance-guided prostate biopsy (MRGB) on lesions detected by multiparametric MR imaging (mp-MRI) with a PI-RADS score of 4 or greater.

Material and methods

A total of 93 patients, with at least 4 or 5 PI-RADS scores having MRGB were analysed retrospectively. Twenty-nine of the patients had also undergone radical prostatectomy (RP). High-risk prostate cancer (PCa) lesion was defined as Gleason Score (GS) $\geq 4+3$. Descriptive statistics of mean and median were reported. Chi-square test was used for categorical data. A p value less than 0.05 was considered statistically significant.

Results

Mean patient age was 65 years; median prostate-specific antigen (PSA) was 6.6 ng/mL. On average, 3.4 cores were sampled from each patient. Significant adverse events (urosepsis) occurred only in one patient. Overall, MRGB detected PCa in 77.4% (72/93) of the patients. PCa detection rates were 51.7% (15/29) and 89.1% (57/64) in patients having a PI-RADS 4 and 5 lesions, respectively. A GS 6 was detected in 18.1% (13/72), GS 7 (3+4) in 34.7% (25/72), GS 7 (4+3) in 25.0% (18/72), and GS 8-9 in 22.2% (16/72) of the PCa cases. Detection rate for high-risk PCa lesion was 47.2% (34/72). There was an evidence of a relationship between PI-RADS and GS ($p<0.01$).

Conclusion

In-bore MRGB provides good efficacy on prostate lesions detected by mp-MRI with high (4 or 5) PI-RADS scores.

P-55

Outcomes of percutaneous drainage in patients with severe necrotizing pancreatitis

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Purpose

To evaluate the outcomes of percutaneous drainage for acute necrotic collections (ANC) and walled-off necrosis (WON) in patients with severe necrotizing pancreatitis.

Material and methods

A retrospective review of all patients with severe necrotizing pancreatitis (Atlanta Classification 2012) with multi-organ failure requiring level 2-3 care, who underwent percutaneous drainage at a single large tertiary hepatobiliary centre between March 2007 and December 2016, was conducted. All drains were placed following a multidisciplinary team discussion. Patients were regularly assessed for the need of drain exchange or necrosectomy.

Results

Seventy-five patients were treated in total (mean age 51.2 ± 18.3 years). Mean modified CT severity index was $9.15 (\pm 1.36)$. Overall, 78.7% cases were external transfers (11 different hospitals). Mean inpatient stay was $71.5 (\pm 71.6)$ days. In total, 60% patients had WON and 40% had ANC. Overall, 253 drains were inserted (101 CT-guided, 15 US-guided, 2 transgastric, and 136 fluoroscopic-guided drain exchanges). Technical success was achieved in all patients. Major complication rate of drain insertion was 1.5% (1 colonic injury and 3 significant bleeding requiring embolization). Four patients underwent open necrosectomy due to uncontrolled sepsis. Overall mortality rate was 26.7%. Mortality rate following necrosectomy was 50%.

Conclusion

From our experience, majority of the patients can be treated with percutaneous image-guided drainage alone without progression to necrosectomy, which is inherently of high risk. Mortality rate remains high in this challenging group of patients though our series, demonstrating a favourable outcome when compared to existing literature (up to 43%).

P-56

Blood pressure control at the time of renal biopsy: does it make a difference?

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Purpose

To evaluate the incidence of clinically significant bleeding following percutaneous renal biopsy before and after implementation of a quality initiative protocol with strict blood pressure requirements.

Material and methods

Beginning January 1, 2016, the division of interventional radiology implemented a protocol with strict blood pressure parameters prior to percutaneous renal biopsy as a quality initiative to minimize the risk of post-biopsy bleeding. All percutaneous renal biopsies performed in the division of interventional radiology were reviewed for the 2 years preceding implementation of the protocol and for the year 2016 following implementation of the protocol. Rates of clinically significant post-biopsy bleeding requiring angiography were calculated for the two time periods. Blood pressures in the peri-biopsy period were evaluated.

Results

Prior to implementation of the protocol, the total number of biopsies, the number of native renal biopsies, transplant renal biopsies, and the number of clinically significant bleeding were 217, 108 (50%), 109 (50%), 3 (1.4%), respectively, for the year 2014 and 235, 130 (55%), 105 (45%), 2 (0.9%), respectively, for the year 2014. For the year 2016 (after implementation of the protocol), these same results were 206, 120 (58%), 86 (42%), and 3 (1.5%), respectively. Two of the 5 patients who experienced clinically significant bleeding were hypertensive prior to biopsy before implementation of the protocol. No patients who experienced clinically significant bleeding were hypertensive prior to biopsy after implementation of the protocol.

Conclusion

Strict blood pressure control prior to percutaneous renal biopsy did not affect the rates of clinically significant bleeding post-biopsy.

P-57

CT-guided percutaneous trans-scapular lung biopsy of upper posterolateral pulmonary nodules using large needles

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Purpose

To assess safety and feasibility of CT-guided percutaneous trans-scapular lung biopsy (tPLB) of upper posterolateral pulmonary nodules (UPLN) using large needles.

Material and methods

We retrospectively collected all CT-guided lung biopsies performed in our center and selected 12 patients (7 male, 5 female; mean age 74.9 years) having undergone a tPLB. After local anesthesia, a 15G bone marrow biopsy needle was inserted in the scapular body; subsequently, an 18G full-core biopsy needle was coaxially inserted and advanced into the lesion to collect the histologic specimen. A CT scan was performed after the removal of all needles. The patients were kept under observation for 6 hours, and a chest X-ray was performed 3 hours after the biopsy to assess pneumothorax (PTX). Also, post-procedural pain (VAS score) and shoulder mobility were evaluated.

Results

Two patients showed a 1 and 4 mm PTX layer at procedure's end. At the 3-hour thoracic X-ray, the PTX disappeared in one patient and increased in the other (from 1 to 25 mm); a third patient developed a 13 mm PTX. None of the patients required a pleural evacuation, and all confirmed the absence of pain at 24–72 hours and 30 days. Only one case of pulmonary hemorrhage was present on the post-procedure CT; no cases of other or major complications were encountered. In one case, the sample was insufficient for diagnosis.

Conclusion

This study confirms the feasibility, safety, and effectiveness of tPLB using large full-core biopsy needles, with a low risk of PTX in case of UPLN.

P-58

Percutaneous transhepatic endoluminal biopsy in patients suspected of having malignant biliary obstruction

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Purpose

The aim of this study was to evaluate percutaneous transhepatic transluminal forceps biopsy in patients suspected of having a malignant biliary obstruction.

Material and methods

From August 2014 to January 2017, 18 consecutive patients (7 men and 11 women; mean age, 67.2±17 years) with obstructive jaundice underwent percutaneous transhepatic transluminal forceps biopsy during or after percutaneous transhepatic biliary drainage. The Cook™ endoluminal forceps biopsy set was used in all cases. Pathological results were compared with surgical findings or with long-term clinical and instrumental follow-ups. Success rates, sensitivity, specificity, positive predictive value, and negative predictive value of the technique were assessed.

Results

Eleven patients had malignant strictures confirmed by surgery, histology, and clinical follow-ups. Most of the patients presented with jaundice as the most common symptom. Lesions involved the common bile duct (n: 12), hilum (n: 4), right left intrahepatic bile duct (n: 1), or left intrahepatic bile duct (n: 1). The success rate of biopsy was 93%. The efficacy of the method was as follows: sensitivity of 80%, specificity of 100%, positive predictive value of 100%, and negative predictive value of 60%. The forceps sample was negative in 2 cases of adenocarcinoma. No major complications related to the biopsy procedures occurred.

Conclusion

Percutaneous transhepatic transluminal forceps biopsy is a safe procedure that is easy to perform through the transhepatic biliary drainage tract. It provides relatively high accuracy in the diagnosis of malignant biliary obstructions.

P-59

Ultrasound-guided renal intervention training using anatomically realistic kidney simulator

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Purpose

The use of image-guided percutaneous renal interventions (i.e. biopsy and/or nephrostomy) is growing worldwide, whereas the methods of resident training have not been lately developed. We aimed to evaluate the role of the anatomically realistic and economically affordable kidney simulator in resident training.

Material and methods

One-day training of urology residents and 5-day training of radiology residents were conducted using anatomically realistic kidney simulators build from disposable bio-soluble material based on 3D data sets of CT (SafeToAct Ltd., Estonia). The physical content of the phantom material and its ultrasound properties were similar to those of the human tissue. Ten urology trainees in Moscow and 12 radiology residents in Tallinn were trained by two experienced interventional radiologists. Following hands-on training, trainees completed validated questionnaires regarding their previous experience

in ultrasound-guided interventions, simulator ultrasound properties and overall usefulness, and they rated their confidence (on a scale of 1–40) in performing renal interventions prior to and following the training.

Results

The confidence of urologists in performing renal interventions increased by 14% after 1-day training and that of the radiologists increased by 26% after 5-day group training. All trainees, regardless of their previous experience, reported that they would recommend such training to colleagues and that it should be available for their daily practice. Moreover, respondents emphasised the importance of real-time feedback and simulators for other anatomical regions.

Conclusion

The survey revealed that anatomically realistic simulators should be included in the resident training program for renal interventions. The development of real-time performance feedback software and simulators of additional anatomies is under way.

P-60

Do Hounsfield units of abdominopelvic fluid collections correlate with positive cultures

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Purpose

To study if Hounsfield units (HU) of abdominopelvic fluid collections on CT correlate with positive cultures and if other variables predict an infectious etiology.

Material and methods

A retrospective analysis was performed between January 2013 and December 2016, wherein 385 patients underwent percutaneous CT-guided drainage of abdominopelvic fluid collections. Only initial drainage procedures, where aspirated fluid was sent for diagnostic microbiological cultures, were included. CT characteristics included contrast- (CECT) and non-contrast-enhancement (NECT), HUs, entrapped air, and peripheral enhancement of the collection. HUs were categorized as <15, 15–25, and >25. Clinical data included patient age; gender; BMI; diabetic status; use of preprocedural antibiotics; WBC count; final cultures; and history of malignancy, recent surgery, or bowel perforation. Chi-square analysis assessed variables with significant factors assessed using multivariate logistic regression.

Results

Positive cultures were observed in 73% (279/385) of all aspirated collections. Following multivariate assessment, HUs>15 were significantly associated with an increased risk of a final positive culture (OR=2.3, 95% CI 1.1–5.0, $p<0.05$), with no significant difference observed between HUs 15–25 (44%) and HUs>25 (37%) among CECT and NECT. Additional variables associated with final positive cultures include male gender (OR=3.3, 95% CI 1.4–5, $p<0.01$), leukocytosis (OR 3.9, 95% CI 1.7–9.0, $p<$), entrapped gas (OR=5.8, 95% CI 2.7–12.4), and wall enhancement (OR=3.0, 95% CI 1.5–5.7).

Conclusion

Abdominopelvic fluid collections with HUs>15 were significantly associated with positive cultures; however, no additional risk of infection was observed if HUs>25. Additional variables predictive of positive cultures include male gender, leukocytosis, entrapped gas, and wall enhancement.

P-61

Hydrodissection: application in interventional radiology

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Learning Objectives

To overview the spectrum of procedures using hydrodissection in interventional radiology.

Background

The spectrum of interventional radiology has been on the rise and now successfully covers percutaneous pigtail catheterisations, image-guided biopsies and ablation of masses that are anatomically difficult to access. The approach used to reach these masses is often assisted by hydrodissection for negotiating and safeguarding vital structures in close proximity. Techniques using hydrodissection include biopsy of retroperitoneal structures, i.e. adrenal, pancreatic and nodal masses, and radiofrequency or microwave ablation of liver/renal masses.

Clinical Findings/Procedure

Pre-operative assessment of the lesion is performed through a CT scan or MRI. Pre-procedural workup includes CBC, coagulation profile and RFT. Most of these procedures are performed under local anaesthesia, and day care and fasting are not required. For procedures requiring general anaesthesia (e.g. radiofrequency/microwave ablation), overnight fasting is required and the patient requires to be admitted.

These procedures are performed under CT guidance (Siemens sensation 16 slice, Germany) or fluoro guidance (Artis Zee, Siemens, Germany/GE Innova 4100, General Electric Healthcare, USA).

Depending on the type of procedure, biopsy needles/RFA electrodes are advanced into the fat planes in close proximity to the lesion, and a minimum 5% of dextrose solution/dilute contrast medium/air/hydro dissection gel material, etc. is injected to displace the adjacent vital viscera or vasculature for allowing proper passage of the needle through the space created by hydrodissection, which varies from 20 to 50 ml.

Conclusion

Hydrodissection is a safe, precise and effective aid to different techniques in intervention radiology and has resulted in a significant reduction in morbidity.

P-62

Practical guide for image-guided percutaneous drainage of abscesses and fluid collections

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Learning Objectives

A practical guide to describe technical notes, access routes, and main tips/tricks for image-guided percutaneous drainage of abscesses and fluid collections.

Background

Image-guided percutaneous drainage is defined as the placement of a catheter using image guidance to provide continuous drainage of fluid collection using access pathways that may be either transcutaneous or transorificial (e.g., transrectal, transvaginal, and peroral). Image-guided percutaneous drainage or aspiration of abscesses and abnormal fluid collections (PDAFC) has become the diagnostic and therapeutic treatment of choice for a wide variety of fluid collections. The procedures have resulted in reduced morbidity and mortality and have helped reduce the length of hospital stay and hospital costs.

Clinical Findings/Procedure

Indications for PDAFC are ever expanding, and most abscesses are amenable to this procedure. Reviewing our five-year experience, we want to highlight the role, technical challenges, and potential pitfalls of image-guided PDAFC, describing the anatomy and pathophysiology, percutaneous techniques (e.g., needle, guidewire, and drainage catheter use), and advantages and disadvantages of one imaging modality versus another for any particular drainage procedure as well as tips and tricks to avoid complications.

Conclusion

Adequate knowledge of the anatomy, familiarity with most types of drainage procedures, and expertise in procedural tools and techniques form the basis to perform image-guided percutaneous drainage with a high rate of technical and clinical success, reducing complications and avoiding operation morbidity.

P-63

All that we should know about draining deep pelvic abscesses

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Learning Objectives

To learn several technical tips to successfully perform image-guided percutaneous drainage of deep pelvic abscesses (DPAs).

Background

DPAs usually occur in postoperative complications such as viscus perforation or inflammatory bowel disease. Image-guided percutaneous drainage is an established less-invasive and effective treatment. However, sometimes, DPAs surrounded by vital structures or organs are inaccessible. We analyzed all techniques used for the percutaneous drainage of DPAs, avoiding the complications and reducing the pain.

Clinical Findings/Procedure

By reviewing 48 consecutive percutaneous drainages for DPAs, we evaluated the effectiveness and feasibility of each technique in successfully performing the drainage of DPAs.

1. Image for guidance

Among the ultrasonography, computed tomography (CT), and fluoroscopy images, which image guidance had advantages depending on the location and condition of DPAs.

2. Puncture routes

- About the pelvic anatomy.
- Advantages and disadvantages of puncture routes such as presacral, perirectal, transgluteal, etc.

3. Devices

- Seldinger technique versus trocar technique.

- Shape of the catheter tip.

4. Trick puncture

- Analyze the safety and usefulness of tricks such as tilted CT gantry technique and hydro-/pneumodissection.

Conclusion

Suitable image modalities, puncture routes, devices, and tricks make the drainage of inaccessible DPAs possible.

P-64

US-guided transgluteal approach for percutaneous drainage: why, who, and how

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Learning Objectives

Image-guided abscess drainage is a well-established procedure. We will review its indications and steps as well as the feasibility and safety of US versus CT guidance.

Background

Percutaneous abscess drainage is the standard of care in the absence of other indications for immediate surgery. Variety of disorders can lead to fluid collection in the lower abdomen and pelvis. These pelvic collections can be drained using several approaches, with the transgluteal approach being useful and effective. The advantages of the US approach are that it is safer, faster, and lacks radiation; less procedure and sedation time, no radiation exposure, and the use of real-time color Doppler can avoid vascular structures. The main disadvantage is the poor sonographic penetration of the deep pelvic tissues even for an average-sized adult.

Clinical Findings/Procedure

We elect to scan a patient with US first to overcome the necessity of CT guidance for draining pelvic collection; if not feasible, the procedure has to be performed under CT guidance.

Patient in prone position.

Utilizing a curved 3–5MHz transducer to scan the pelvis from the parasacral window.

The coccyx can be palpated and used as a landmark to have the puncture site just lateral to it to avoid the neuro-vascular bundle. The needle should be then directed caudo-cranially towards the targeted collection.

Start scanning in oblique-sagittal or axial planes.

Choose your entry point.

Drainage can be performed using the Seldinger or trocar technique under local and conscious sedation.

The catheter is to be removed if the output drops to <20ml/day for 48–72hours.

Conclusion

US-guided transgluteal drainage is an alternative route for pelvic collections. It is safe and effective for moderate-to-large fluid collection in non-obese patients and can spare the valuable CT time.

P-65

Breast cancer with uncommon cystic liver metastases

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Breast cancer can often lead to metastasis in the liver and these metastases are usually solid. In a patient, FNA showed that cystic lesions in the liver were metastatic. Cystic lesions in the liver might be quite significant and should be biopsied.

P-66

Role of cut biopsy in selective treatment of heart masses

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A male presented with a heart mass diagnosed based on CT and ultrasound. We decided to perform percutaneous biopsy of the mass under CT guidance. The mass was defined as fibrolipoma, and embolization of the tumor supply branches was performed. At the 7-month follow-up, the mass had decreased in size.

Bone, spine and soft tissue intervention

P-67

Embolization of the geniculate arteries is a safe and effective treatment for recurrent hemarthrosis following TKA

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Purpose

Recurrent hemarthrosis is a late complication in up to 1.6% patients following total knee arthroplasty (TKA). In the absence of intrinsic coagulopathy, the probable etiology is bleeding of the hypertrophic vascular synovium. The aim of this study was to evaluate the clinical outcome of patients referred to our center who underwent angiographic embolization of the geniculate arteries for the treatment of recurrent hemarthrosis following TKA.

Material and methods

We retrospectively studied a cohort of patients who were referred for embolization of the geniculate artery following TKA between August 2011 and September 2016.

Results

A total of 24 embolization procedures were performed on 14 patients. Seven (50%) of these 14 patients underwent one embolization procedure. Because of symptom recurrence, four patients underwent a repeated procedure and three patients underwent a third procedure. All embolization procedures were technically successful. Two patients reported an inguinal hematoma that healed without further treatment. At a mean follow-up of 26.8 months, clinical success was achieved in 12 of the 14 patients (86%).

Conclusion

Embolization of the geniculate arteries in our study was a safe and effective treatment for recurrent spontaneous hemarthrosis following TKA. We report 100% technical and 86% clinical success rates. No patient experienced cutaneous ischemic complications even though reinterventions were performed in 50% patients. Our results showed that embolization could probably be the treatment of choice when conservative measures fail.

P-68

Percutaneous image-guided osteosynthesis of impeding and pathological/insufficiency fractures of the femoral neck in non-surgical cancer patients

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Purpose

To present percutaneous image-guided screw-mediated osteosynthesis (PIGSMO) for fixation of impeding fractures (ImF) and non-displaced/mildly displaced pathological/insufficiency fractures (PF/InF) of the femoral neck in non-surgical cancer patients.

Material and methods

This is a double-centre single-arm observational study. Retrospective review of electronic records identified all oncological patients who had undergone femoral neck PIGSMO. Inclusion criteria were non-displaced or mildly displaced PF/InF and ImF (Mirels' score ≥ 8), life expectancy ≥ 1 month, unsuitability for surgical treatment due to sub-optimal clinical fitness, refusal of consent, or unacceptable delay to systemic therapy.

Results

Eleven patients were treated (mean age 63.7 ± 13.5 years) for ImF (63.6%, mean Mirels' score 10.1), PF (27.3%), or post-radiation InF (9.1%) under CT/fluoroscopy (36.4%) or CBCT (63.6%) guidance. Thirty-two screws were implanted and cement injection was added in 36.4% cases. Technical success was 90.9%. No procedure-related complications were noted. At the 1-month clinical follow-up (pain/walking impairment), 63.6% and 27.3% patients reported a significant and mild improvement, respectively. Imaging follow-up (available in 63.6% cases) showed no signs of secondary fractures and neither of the screws loosened at a mean of 2.8 months. Five patients (45.5%) died after PIGSMO (mean time interval 3.6 months).

Conclusion

PIGSMO is technically feasible in cancer patients with a limited life expectancy; it offers good short-term results. Further prospective studies are required to corroborate mid-term and prove long-term efficacy of the technique.

P-69

Polymethyl methacrylate does not confer any significant consolidative advantage to a cadaveric dyaphyseal model undergoing bending stresses

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Purpose

To test the consolidative properties of two different intramedullary (IM) techniques (osteoplasty and Kirshner-augmented osteoplasty) in a diaphyseal cadaveric model undergoing a three-point bending test.

Material and methods

Thirty different human cadaveric tibia specimens were randomly and equally assigned to receive no IM consolidation (Group 1), osteoplasty (Group 2), or Kirshner-augmented osteoplasty (Group

3). All specimens were subsequently tested on a dedicated servo-hydraulic machine with a three-point bending test. Fracture load and Young's module were obtained for each tested specimen. In the end, fracture occurrence and its morphology both to bone and to IM consolidative material was evaluated.

Results

The median quantity of PMMA injected was 18 ml for group 2 (p25–p50; 15–21) and 19 ml for group 3 (p25–p50; 17–21).

In terms of the fracture load, no significant difference was found when comparing groups 1 and 2 ($z=-0.793$; $P=0.4295$), groups 1 and 3 ($z=-0.944$; $P=0.3472$), and groups 2 and 3 ($z=-0.454$; $P=0.6501$).

In terms of the Young's module, a significant difference was found when comparing groups 1 and 2 ($z=0.121$; $P=0.9044$), groups 1 and 3 ($z=0.338$; $P=0.7278$), and groups 2 and 3 ($z=0.148$; $P=0.8807$).

The most common type of bone was B0 (14/30, 46.6%) and A2 (8/30, 26.6%).

Fractures to the IM material occurred in 4 cases (4/30, 13.3%) and were always consistent with PMMA fracture.

Conclusion

PMMA does not confer any consolidative advantage to dyaphysis undergoing bending stresses compared with native non-PMMA-augmented dyaphysis.

P-70

Preoperative embolization of hypervascular spinal tumors using a liquid embolic agent (Onyx): a single-center experience

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Purpose

Surgery for hypervascular spinal malignancies is associated with significant intraoperative blood loss. Our aim was to evaluate the efficiency of preoperative embolization using Onyx for reducing intraoperative blood loss in patients with hypervascular spinal tumors.

Material and methods

We retrospectively analyzed the outcomes of hypervascular spinal tumor management in patients treated between 2013 and 2016: 45 patients aged 26–77 years, male/female 21/24, 15 primary tumors and 30 metastases, and lesion distribution cervical/thoracic/lumbar 1/27/17. We performed embolization in all cases using superselective catheterization of feeding vessels and embolization of hypervascular focus with a liquid embolic agent, Onyx. Open surgery was performed within 1–10 days post-embolization. We calculated the average intraoperative blood loss in each case and compared it with the published data.

Results

In all cases, we achieved total or subtotal occlusion of feeding arteries. Two patients experienced a transitory neurological deficit. Average intraoperative blood loss was 719.5 ± 106.1 ml, 6–8 times lower than that in those without embolization. There was no in-hospital mortality associated with the volume of intraoperative blood loss. Comparison of the results with the published data (500–1945 ml) and our experience with particles and coils (643 ± 110 ml) showed similar results in perioperative blood loss reduction but better results in postintervention morbidity and mortality.

Conclusion

Preoperative embolization of hypervascular spinal malignancies using a liquid embolic agent (Onyx) is safe and significantly reduces the intraoperative blood loss. Onyx provides precise embolization control and better radiopacity compared with the particles and coil group, thus reducing the number of complications associated with non-target embolizations.

P-71

Safety, efficacy, and accuracy of combined liver trans-arterial embolization and ablation using cone-beam CT navigation

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Purpose

To assess the safety and efficacy of combined liver trans-arterial embolization (TAE) and radiofrequency ablation (RFA) during a single session using cone-beam CT (CBCT) navigation.

Material and methods

An IRB approved the retrospective analysis of 19 consecutive patients treated between May 2014 and December 2016. Twelve patients underwent TAE and RFA during two separate sessions under fluoroscopy and CT guidance, respectively (group 1). Seven patients underwent single-session combined treatment under fluoroscopy and CBCT roadmapping (group 2). The tumor size, total procedure time (PT), patient effective dose (ED), and the number and purpose of CBCT and those of CT were examined. Immediate technical success and local recurrences using mRECIST criteria at 1 month were recorded. Paired t-test and Wilcoxon test were used with 0.05 significance levels.

Results

The mean tumor size was comparable between the groups [2.5cm (1.0–7.3) vs 2.8cm (1.1–5.1), $p=0.46$]. An average of 9.6 CTs were performed in group 1 vs. 5.1 CBCT performed in group 2 (range 1–3 vs. 1 for planning purposes, 2–13 vs. 1–5 for probe positioning, and 1–2 vs. 1 for technical success assessment) ($p=0.002$). The mean PT was shorter in group 1 (120' vs 179', $p=0.003$), nevertheless the mean ED was lower in group 2 (41.8 vs 78.9 mSv, $p=0.05$). Technical success was reached in all procedures. No major complication was observed. One death unrelated to the procedure occurred in group 2 before the follow-up. Complete responses were equivalent in both groups (67% vs 71%, $p=1$).

Conclusion

CBCT guidance may facilitate liver cancer combination therapy delivery.

P-72

Radiographic local tumor control of musculoskeletal primary and metastatic soft tissue sarcoma lesions with percutaneous ablation

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Purpose

To evaluate the effectiveness of percutaneous ablation in achieving local tumor control in soft tissue sarcomas.

Material and methods

Retrospective review was performed of 66 primary or metastatic sarcoma lesions in 26 women and 17 men (total = 43) treated with percutaneous image-guided ablation. The mean age of the cohort was 47.6 ± 18.5 years. A variety of histologic subtypes of sarcomas were treated with an average treated tumor volume of 27.9 cm^3 (range: $0.1\text{--}484.7 \text{ cm}^3$). In total, 50% (33/66) patients were treated with cryoablation and 50% (33/66) were treated with radiofrequency ablation. Forty-one percent (27/66) patients were also treated with vertebroplasty/cementoplasty and 15% (10/66) patients were treated with radiation therapy within 3 months of ablation. Computed tomography (CT), magnetic resonance imaging (MRI), and combined

positron emission tomography (PET)/CT were performed for various indications at the request of the referring oncologist as follow-up to determine if local control was achieved. Thirty-seven patients were lost to follow-up secondary to death/hospice, stability of disease warranting no further imaging, or miscellaneous reasons at 1 year.

Results

The local tumor control rate was 86% (36/42) at 3 months, 78 % (25/32) at 6 months, 76% (22/29) at 9 months, and 69% (20/29) in all patients and 67% (12/18) in the setting of progressive systemic disease at 1 year. In patients with oligometastatic disease, the tumor control rate was 92% (11/12) at 1 year. In patients with no metastatic disease at the time of treatment, the control rate was 100% (10/10) at 1 year.

Conclusion

Image-guided percutaneous ablation is an effective therapeutic option for local tumor control of primary or metastatic sarcoma lesions and demonstrates durability early in the disease process.

P-73

Targetability of osteoma osteoids and bone metastases by MR-guided high-intensity focused ultrasound (MRgHIFU): feasibility study

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Purpose

To evaluate the feasibility of treating bone tumours with MR-guided high-intensity focused ultrasound (MRgHIFU) according to lesions treated with invasive ablation.

Material and methods

This monocenter study was based on a retrospective analysis of 112 bone lesions treated between October 2014 and October 2016 by percutaneous ablation procedures for osteoma osteoids (OOs) or metastases. Cases were analysed with respect to the type, matrix, volume, location and anatomic relations of the lesions. The necessity to protect or consolidate neural structures was also notified. Three categories were defined: HIFU may be performed (1) alone, (2) with protecting or consolidating sensitive structures and (3) it is not feasible.

Results

Of the 112 lesions, 71 were metastases and 41 OOs. Tumours were located in the pelvis (35), upper and lower limbs (35), spine (30), ribs (10) and sternum (2). Thirty-three (80%) OOs were considered targetable by HIFU alone (46%) or with dissection (34%). The mean volume was 0.7 cm³ and the matrix of OOs was sclerotic (13), lytic (8) or mixed (12). Fifty-one (72%) metastases were considered targetable by HIFU alone (41%) or with dissection and/or consolidation (31%). The mean volume was 43.7 cm³, and the matrix of metastases was sclerotic (9), mixed (20) or lytic (22). Majority of the lesions located in the pelvis (30, 86%) and the peripheral bone (32, 91%) could be treated by HIFU, whereas in 20 of the 30 (66%) lesions located in the spine, HIFU was not considered feasible.

Conclusion

MRgHIFU is a promising therapy for bone lesions. However, many parameters must be taken into consideration to affirm its feasibility.

P-74

US-guided radiofrequency ablation for primary thyroid cancer: efficacy and safety of long-term follow-up in a large population

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Purpose

To assess the long-term follow-up, efficacy, and safety of US-guided radiofrequency ablation (RFA) for primary thyroid cancer in a large-population single-center study.

Material and methods

Between May 2008 and January 2017, we included patients who underwent RFA for primary thyroid cancers in patients at a high surgical risk (old age, severe comorbidity) and in patients who refused to undergo surgery, with a follow-up of more than 6 months. RFA was performed using the Cool-Tip RF system, modified straight-type internally cooled electrode, and moving-shot technique.

Results

Finally, 188 primary papillary thyroid cancers of 151 patients were included. The mean follow-up duration was 40±24 months. The number of RF sessions was one (167 cancers) or two (21 cancers). Mean maximum diameter of tumors was 4±2.1 mm (range, 1–19 mm). In total, 173 tumors (92.0%) completely disappeared. There was no local tumor recurrence at the treatment site. No distant or neck lymph node metastases were detected during the follow-up period. In four patients, new papillary thyroid carcinoma was detected during the follow-up period and completely disappeared after an additional RFA. There was no procedure-related death or major complication. Minor complications such as minor bleeding (2), skin burn (1), transient hoarseness (1), and transient hypothyroidism (5) were reported.

Conclusion

This large-population long-term follow-up study demonstrated that RFA is an effective and a safe treatment for primary papillary thyroid cancer in patients at a high surgical risk and in patients who refuse to undergo surgery.

P-75

Percutaneous cryoablation of vertebral metastases: is it feasible under local anaesthesia

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Purpose

Modern management of spine metastases involves techniques such as ablation and cementoplasty. Because this is commonly used with several primary neoplasms, our research aims to investigate the feasibility of percutaneous cryoablation under local anaesthesia in patients with ASA III.

Material and methods

We treated 12 oncological patients, classified as ASA III by a multidisciplinary team. Subsequently, we retrospectively performed a complete appraisal of their clinical status. We managed interventions under local anaesthesia, delivering low doses of bupivacaine 2.5

mg/ml (from 10 up to 30 ml) along the needle pathway. Seventeen-gauge cryoprobes were introduced under CT guidance. We evaluated VAS scores before, during and up to 3 months after the intervention. We used Student's t-test to determine statistical analysis.

Results

We performed a total of 14 spinal metastases cryoablations (a total of 12 patients: 6 F, 6 M; mean age 54 years, range 52–82 years). The reported tumour locations were as follows: sacrum (n = 7), lumbar spine (n = 4) and thoracic spine (n = 3). The VAS average value during intervention was 5.27 (s = 0.90). Our results comprise a statistically noteworthy decrease in the median VAS score after the intervention [at 1 week, 1 month or 3 months ($P < .001$ for all)]. Technical success was achieved in all cases. Some clinical improvement could be assessed in patients with neurological deficits.

Conclusion

In our experience, cryoablation may be safely accomplished with local anaesthesia for pain assistance in patients with a high ASA score and with concomitant higher risk of developing complications in the absence of other appropriate treatment strategy.

P-76

Needle approach for acetabuloplasty according to the bone lesion location

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Purpose

Acetabuloplasty (cement augmentation) of malignant lesions around the acetabulum is used to obtain pain relief and walking improvement. Only the supra-acetabular approach was previously reported. We describe five different needle approaches according to lesion location.

Material and methods

Acetabulum was divided into six areas: anterior roof (AR), posterior roof (PR), anterior and posterior column, ilio-pubic and ilio-ischiatic ramus. Five different needle approaches were created according to these six locations. The AR and PR are approached in decubitus position, through an anterolateral route along the main bone axis using 6 anatomical landmarks. Approach is horizontal for the AR and descending for the PR. The anterior column is reached by a direct anterior approach. The ilio-pubic ramus is approached through the pubis with an ascending route along the main axis of the ilio-pubic ramus. The ilio-ischiatic ramus is reached through a posterior ascending approach in a prone position.

Results

91 acetabuloplasty were done in 87 patients (age 63 +/- 13). Needle approaches were: anterolateral horizontal n= 73 (80%), anterolateral descending n= 24 (27%), ilio-pubic n= 9 (1%), direct anterior n= 2, and ischiatic n=1. Asymptomatic complications were cement leakage in the soft tissue (50%) and minimal intra-articular cement leakage (6%). There were no clinical complications related directly to the procedure. Pain improvement was moderate in 29%, and significant in 70%. Walking capacities improvement was moderate in 35% and significant in 63%.

Conclusion

Acetabulum has a complex 3D anatomy. Needle approaches for acetabuloplasty need to be adapted to lesion location and extent for an optimal clinical result.

P-77

Analgesic effectiveness of percutaneous cryotherapy of extra-abdominal tumors

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Purpose

Extra-abdominal desmoid tumors are benign tumors that cause significant morbidity, including high pain. The treatment of desmoid tumors used to be very aggressive using large resection surgery, chemotherapy, and radiotherapy. Percutaneous cryotherapy has become a new alternative for the treatment of symptomatic desmoid tumors. The aim of our study is to assess the effectiveness of percutaneous cryotherapy on the treatment of painful desmoid tumors.

Material and methods

Between July 2012 and September 2016, 35 patients underwent cryotherapy as a treatment of painful extra-abdominal desmoid tumors (41 tumors treated in 54 procedures). For each patient, the pain was evaluated before and 3 months, and 6 months after cryotherapy. Each patient underwent an MRI before and 3 months and 6 months after cryotherapy. The size of the tumor, its volume, and the enhanced part of the tumor were measured.

Results

Cryotherapy had significant effectiveness on pain ($p < 5\%$). The average pain before cryotherapy was 53 before cryotherapy and 22 six months after the treatment. The MRI follow-up shows a significant decrease in the enhanced volume at 3 months after cryotherapy but no significant decrease in the total volume of the tumors or its size according to RECIST criteria. At 6 months, there was significant decrease in the volume of the tumor and its size. A relationship was found between the decrease of pain and that of the tumor volume.

Conclusion

Percutaneous cryotherapy is an effective treatment of painful desmoid tumors. The decrease of the tumor volume has not shown any relationship with decrease in pain.

P-78

Clinical and instrumental evaluation of different O2-O3 chemiodiscolysis treatment sessions: which is the best for managing partially responding patients

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Purpose

To compare the therapeutic outcome of different treatment sessions of oxygen-ozone (O₂-O₃) therapy in patients with lumbar disc herniation.

Material and methods

We retrospectively evaluated 432 patients (mean age 44.3 years, range 26–69 years) who underwent multiple treatment sessions of O₂-O₃ lumbar chemiodiscolysis between January 2014 and January 2017. We excluded patients with multiple level pathology, those with multiple causes of low back pain, and those who underwent surgery during the follow-up period.

For each patient, we evaluated the number of treatment sessions and type of treatment performed. Treatment outcome was assessed

using a modified MacNab method to assess the clinical response and by performing MRI to evaluate the modifications in the disc herniation area.

Results

In total, 235 patients were treated with 2 sessions of intradiscal injection associated with periganglionic steroid injection (group A) and 197 patients underwent an intradiscal-periganglionic injection of O₂-O₃ and a second periganglionic injection with steroids (group B). The mean time interval between each treatment was 32.6 (range 15–62) days. Treatment was successful in terms of clinical outcome in 82.3% patients in group A and 78.7% patients in group B. Statistical analysis showed no statistically significant difference between the two groups in terms of clinical results and reduction in the disc herniation area ($p \geq 0.005$).

Conclusion

According to the results of our follow-up, in partially or non-responding patients after a O₂-O₃ intradiscal injection, a better cost-effective protocol should include a second periganglionic steroid injection because multiple ozone injections are not associated with a superior herniation volume reduction or with better clinical outcome.

P-79

CT-guided pulsed radiofrequency treatment of the lumbar dorsal root ganglion (DRG) in patients with acute radicular low back pain

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Purpose

To determine the clinical impact of pulsed radiofrequency for the treatment of patients with neuroradicular low back pain.

Material and methods

Patients were eligible for this study if they presented acute or subacute neuroradicular low back pain (EMG confirmed) refractory to usual treatments and if they could safely undergo a pulsed radiofrequency procedure. Treatment was performed using a 22–20 G needle electrode with probe tip directed to the symptomatic DRG, and pulsed radiofrequency was generated for 10 min at 45 V with a constant local T of 42°C. Clinical evaluation was conducted using the visual analogue scale (VAS) and Oswestry Disability Index (ODI) quality of life assessment, both obtained at baseline and at 1 week, 1 month, and 1 year follow-ups. Analyses were performed on a per-protocol basis.

Results

Over 3 years, 80 patients were treated with pulsed radiofrequency (Cosman). Median VAS scores decreased from 7.8 at baseline to 3.5 at 1 week after treatment, 2.6 at 1 month, and 1.3 at 1 year; median ODI scores decreased from 78.0 at baseline to 12.5 at 1 week, 6.0 at 1 month, and 5.5 at 1 year ($p < 0.001$). Overall, 90.0% of patients reached a 0 VAS score within the first month after treatment, and 97.5% had a decrease of at least 20 points in the ODI score in the same interval. There were 6 patients considered partial responders who required a second PRF session.

Conclusion

Pulsed radiofrequency has shown to be a promising and effective percutaneous treatment option for patients with acute or subacute neuroradicular low back pain.

P-80

Efficacy of a vertebral augmentation system used for bone remodeling as a treatment for vertebral fractures

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Purpose

The aim of this study was to evaluate the effectiveness and safety of a bone remodelling system in the treatment of painful vertebral compressive fractures.

Material and methods

Thirty consecutive patients with painful vertebral compressive fractures underwent the bone remodelling (Tektona, SpineArt, CH) procedure. Patients had been previously evaluated by clinical examination, X-ray, CTMs and MRI-T2wSTIR. All the procedures were executed with local anaesthesia and a bilateral approach under digital fluoroscopic guidance. In total, 37 vertebrae were treated. Clinical evaluation and assessment of pain using a 11-point visual analogue scale (VAS, 0–10) was performed at baseline, immediately after the procedure and at 6 months after the procedure; disability and health status by means of ODI and SF36 were also evaluated. Height restoration by volume calculation with CTMs was assessed before and immediately after the procedure in addition to vertebral heights and the local kyphosis angles.

Results

We obtained a progressive reduction of pain in all the patients (Av. VAS pre: 7.63, post: 2.8, 6M: 2.1), improvement of functions (Av. ODI pre: 55.5, 6M: 22.34), a good height restoration (Av. median h pre: 13.64 mm, post: 15.25 mm, difference: 1.61 mm) and a good increase in the volume of the vertebral bodies (Av. V pre: 21.61 cm³, post: 23.08 cm³, difference: 1.47 cm³). The local kyphosis angle showed a 2.23° decrease. No major complications arose.

Conclusion

From our study, the use of bone remodelling system was found to be safe and effective in the treatment of painful vertebral fractures, providing pain relief and anatomical restoration.

P-81

Percutaneous vertebroplasty in aged patients with osteoporotic vertebral compression fractures: a bicentric retrospective cohort study

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WITHDRAWN

P-82

Percutaneous coblation nucleoplasty in the treatment of lumbar disc herniation: early significant improvement in the quality of life (preliminary results)

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Purpose

Percutaneous coblation nucleoplasty represents a minimally invasive method for intervertebral disc decompression. The method can be used in patients with disc protrusions and contained disc herniation when surgical intervention is postponed. Authors present preliminary results of studying its early effect on the quality of life.

Material and methods

Coblation nucleoplasty, which enables low-temperature volumetric tissue removal through molecular dissociation, was performed by interventional radiologist in 20 patients in whom magnetic resonance imaging confirmed disc protrusion or contained herniation. Sciatica was present in 16 (80%) and lumbalgia in 4 (20%) treated patients. Clinical evaluation at baseline (before the procedure) and 2 and 6 months after the procedure using visual analogue scale (VAS) and Oswestry Disability Index (OSD) was performed by a specialist in pain medicine.

Results

Immediate symptom relief on the first postprocedural day was recorded in 18 (90%) patients. Patients presented with statistically significant improvement in the quality of life 2 and 6 months after the procedure, as confirmed by VAS and OSD reduction ($p < 0.0001$).

Conclusion

Our preliminary results of percutaneous coblation nucleoplasty show early significant improvement in the quality of life. The procedure represents an efficient minimally invasive technique in selected patients with intervertebral disc protrusion or contained disc herniation.

P-83

Ultrasound-guided wire-localisation-aided excision of deep, very small non-palpable musculoskeletal lesions ensures complete excision and symptom relief and obviates re-exploration

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Purpose

To assess the efficacy of ultrasound-guided, wire-localisation-aided excision of deep, very small non-palpable musculoskeletal lesions in ensuring complete excision and subsequent effective symptom relief.

Material and methods

A retrospective review of the imaging, case and operative notes of three patients presenting with deep, very small non-palpable musculoskeletal lesions: two glomus tumours (one intramuscular and the other in deep subcutaneous fat) and one retained foreign body after remote war-zone abdominal surgery.

Results

Patient 1: a 50-year-old male complaining of abdominal pain following appendectomy performed 20 years previously in a war-zone field hospital. CT demonstrated an inflammatory mass, within which

a retained suture was visible on ultrasound. The margins of the mass and the location of the suture were localised preoperatively, thereby facilitating complete excision of the suture and the surrounding mass with complete symptom relief.

Patient 2: a 70-year-old female complaining of pain on the medial aspect of her arm secondary to a very small (0.8×0.7 mm) non-palpable mass in the deep subcutaneous fat overlying triceps. Wire-localisation-aided excision permitted complete excision of the glomus tumour with complete symptom relief.

Patient 3: a 69-year-old male complaining of pain on the anterior thigh secondary to a very small (0.9×0.7 mm), non-palpable mass deep within the rectus femoris. Wire-localisation-aided excision permitted complete excision of the glomus tumour with complete symptom relief.

None required re-exploration (at the 13-month, 5-month and 6-year follow-up in patients 1, 2 and 3, respectively).

Conclusion

Ultrasound-guided wire-localisation-aided excision permits complete excision of deep, very small non-palpable musculoskeletal lesions with effective symptom relief obviating re-exploration.

P-84

Non-invasive treatment with MR-guided focused ultrasound surgery in paediatric patients with osteoid osteoma: the Italian multicentre experience

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Purpose

To retrospectively evaluate the effectiveness and safety of MR-guided focused ultrasound surgery (MRgFUS) of osteoid osteoma (OOs) in paediatric patients (age < 18 years) based on the experience of three university hospitals in Italy. Because OOs mostly affect paediatric patients, it is of paramount importance that the employed techniques are as minimally invasive as possible. MRgFUS aims to become the standard care, producing no skin lesion or damage to the soft tissues.

Material and methods

Over a period of 4 years, we performed MRgFUS on 33 patients (age < 18 years, mean 13.8 years) affected by symptomatic non-spinal OOs. Pretreatment mean VAS for pain was 7.5 (CI: 4–10). Each lesion was treated in a single session. Outcomes were evaluated with clinical and imaging follow-up studies up to 5 and 3 years, respectively.

Results

After treatment, absence of pain was observed in 31 patients (94% complete success; VAS: 0) confirming the effectiveness of the procedure. The procedure was repeated on 1 patient who complained of persistent pain (VAS decreased from 9 to 5) and the symptoms resolved completely thereafter. Another patient reported of VAS 1 during follow-up and additional treatment was not deemed necessary. Neither relapse nor complications were observed. The long-term imaging control showed a progressive restoration to the original condition of the bone segments without signs of treatment or residual inflammatory findings.

Conclusion

MRgFUS of OOs is a safe and effective treatment and could be the first and definitive choice for paediatric patients.

P-85

Preoperative and long-term follow-up imaging characteristics of osteoid osteoma treated with CT-guided radiofrequency ablation

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Purpose

To evaluate the imaging characteristics of osteoid osteoma and CT-guided radiofrequency ablation (RFA) therapy related changes with a long term standard periodic radiological follow-up with CT and MRI.

Material and methods

Total of 28 patients (21 male, 7 female) who underwent RFA therapy for osteoid osteoma between 2005-2015 were included in this retrospective study. Their mean age was 18 years (3-46 years). The duration of complaints was between 6-36 months. One patient was a recurrent case after surgery. CT and dynamic contrast enhanced MRI exams were performed just before RFA therapy and 1., 3., 6. and 12. months afterwards. Radiologic characteristics of lesions, contrast enhancement pattern, access for probe insertion, imaging appearances and sequential changes after treatment at ablation site were noted.

Results

The mean lesion diameter was 8 mm (3-18 mm). Distribution of lesions were as follows; femur (18), tibia (6), iliac crest (1), metatars (1), ulna (1) and humerus (1). Lesions were intraarticular in 10 patients. A characteristic ring like hypodensity related to RFA zone was observed in patients with thicker periost reaction on CT immediately after treatment. Periost reaction persisted whereas calcified nidus was disappeared with time (n=20). Lytic appearance was also disappeared in patients with smaller lesions (n=9). Characteristic contrast peak in preoperative MRI was found to be diminished in postoperative period.

Conclusion

CT-guided RFA therapy is an effective treatment method. Dynamic contrast enhanced MRI findings are important in the diagnosis and follow-up. Radiologists should be aware of characteristic findings of osteoid osteoma and posttreatment changes to ensure efficiency of treatment.

P-86

Effect of PMMA dosage on pain reduction and complication rate in vertebroplasty for compression fractures in patients with multiple myelomas

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Purpose

Despite multiple publications that confirm the efficacy of vertebroplasty in the treatment of painful vertebral compression fractures in patients with multiple myelomas, we have found no published reports in which the dosage of PMMA used in the procedure and its effect on the outcome and possible complications was analyzed.

Material and methods

A retrospective analysis was performed from data collected from 36 patients with confirmed diagnosis of multiple myeloma that were treated with vertebroplasty at our institution. We analyzed the visual analogue scales (VAS) scores for pain, qualitative outcome data (use of narcotics and mobility), and the complications before the procedure and at 1 week and 3 months after the procedure and correlated

the results to the amount of PMMA used for each single vertebra that was affected by the disease. The patients were divided into groups according to the Genant classification.

Results

All patients in our study manifested with significant improvement in all outcome measures. However, when observed in specific Genant groups and correlated to the amount of PMMA applied, there was no significant difference in the analogue pain score or qualitative outcome data depending on the amount of PMMA used in the Genant 2 or 3 groups, whereas there was a significant difference in the VAS score and mobility between the two dosage groups (< or > 3 mL of PMMA) both at 1 week and 3 months after the procedure in the Genant 1 group of fractures. There was an expected difference in the complication rate between the two dosage groups with respect to Genant 3 fractures.

Conclusion

In compression fractures in patients with multiple myelomas, the amount of PMMA used for vertebroplasty can have an effect on the pain relief and mobility in patients with mild (grade 1) vertebral deformity.

P-87

Percutaneous vertebroplasty in the treatment of painful osteoblastic metastatic vertebral compression fracture

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Purpose

To explore the efficacy, complication, and key techniques of percutaneous vertebroplasty (PVP) in the treatment of painful osteoblastic metastatic vertebral compression fracture.

Material and methods

Twenty patients (22 vertebrae) with painful osteoblastic metastatic vertebral compressions treated with PVP were retrospectively analyzed. Visual analog scale (VAS) points before PVP and 1 day, 1 week, 1 month, and 3 months after PVP were recorded and analyzed using one way ANOVA. The analgesic effectiveness of PVP was defined when the VAS score 3 months post treatment was lower than 3 points compared with that pretreatment. Fluoroscopy duration, the amount of bone cement used, and the cement leaked during PVP were also recorded.

Results

The effective analgesic rate was 85% (17/20). The VAS score before PVP and 1 day, 1 week, 1 month, and 3 months after PVP was 8.4 ± 1.2 , 3.3 ± 1.6 , 2.9 ± 1.9 , 3.0 ± 1.9 , and 3.3 ± 2.0 , respectively ($F=62.221$, $P<0.05$). The VAS score after PVP decreased significantly compared with that pretreatment. The average fluoroscopy duration for each vertebral lesion was 14.2 ± 2.3 min, whereas the amount of bone cement used for each vertebral lesion was 2.67 ± 0.83 ml. The asymptomatic bone cement leakage rate was 31.8% (7/22).

Conclusion

PVP may serve as an alternative treatment for painful osteoblastic metastatic vertebral compressions because of its satisfactory analgesic effect and few complications. However, more attention should be paid to the puncture skill during the procedure, and the amount of bone cement injected should be chosen with consideration.

P-88

Percutaneous vertebroplasty combined with sclerotherapy for the treatment of symptomatic spinal hemangiomas: study of the clinical safety and efficacy

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Purpose

To prove the safety and efficacy of percutaneous vertebroplasty (either solely performed or in combination with alcohol sclerotherapy) for the treatment of symptomatic, aggressive vertebral hemangiomas in a series of consecutive patients.

Material and methods

During the last 10 years, 25 patients with 31 symptomatic, aggressive vertebral hemangiomas suffering from pain with or without neurologic compromise underwent percutaneous vertebroplasty either solely performed or in combination with alcohol sclerotherapy. When a hemangioma was restrained to the vertebral body, percutaneous vertebroplasty was performed as the only treatment technique. When an epidural component was also present causing pressure effects upon the spinal sac, sclerotherapy was additionally performed with an alcohol injection at the level of the vertebral pedicles. Computed tomography scan assessed implant distribution the morning post-therapy and magnetic resonance imaging was performed 6 months later. NVS pain scores prior to and post-therapy were compared using the paired samples t-test and Wilcoxon signed-rank test.

Results

Mean pain score prior to any therapy was 8.52 ± 1.388 NVS units. Mean pain score at 12 months post-therapy was 1.68 ± 2.445 NVS units. There was a mean reduction of 6.84 ± 3.145 NVS units. The comparison of the patients' self-reported outcomes concerning pain reduction and mobility improvement prior to and post-therapy is statistically significant ($p < 0.001$). No complication was noted.

Conclusion

Percutaneous vertebroplasty (either solely performed or in combination with alcohol sclerotherapy) seems to be a safe and efficient technique for the treatment of symptomatic, aggressive vertebral hemangiomas resulting in significant pain reduction and mobility improvement. Proper patient selection is a prerequisite for a high success rate.

P-89

A prospective randomized study comparing three different approaches for fluoroscopy-guided shoulder arthrography according to the training experiences of practitioners

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WITHDRAWN

P-90

An aneurysmal bone cyst: single-centre experience using combined sclerotherapy and hydroxyapatite and calcium sulphate injection

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Purpose

We describe our preliminary experience of aneurysmal bone cyst (ABC) treatment in a paediatric population using a combination of percutaneous sclerotherapy and biocompatible bone-graft substitute injection.

Material and methods

From July 2015 to July 2016, we treated 5 patients with ABC (hip: 2 patients, sacrum: 1 patient, tibia: 1 patient and mandible: 1 patient, M/F ratio: 3/2, median age: 5 years). Our treatment protocol was as follows: direct cyst puncture under fluoroscopic control, followed by sclerotherapy (ethanol and sodium tetradecyl sulphate) and injection of a ceramic bone void filler. Follow-up was managed with clinical data and X-ray and MRI examinations.

Results

Preliminary data were encouraging: pain resolution and volume reduction occurred in all patients; in addition, bone re-ossification was more rapid by our treatment than by the standard treatment.

Conclusion

The sclerotherapy of ABC is a routine procedure that we follow. Recently, we introduced the injection of biocompatible bone-graft substitute that accelerates bone re-ossification. A longer follow-up and more case series are necessary to validate our data.

P-91

Safety and efficacy of Kiva-assisted augmented vertebroplasty in the treatment of split vertebral fractures: effect on pain reduction and height restoration during a 2-year follow-up

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Purpose

To evaluate the safety and efficacy of augmented vertebroplasty using a PEEK implant (Kiva) for treating lumbar or thoracic vertebral fractures (A2 according to the Magerl classification) and to analyze pain reduction, height restoration, and complications during a 2-year follow-up.

Material and methods

During a 2-year period, 21 painful split vertebral fractures (20 patients) were treated with percutaneous augmented vertebroplasty using a Kiva device. A numeric visual scale (NVS) questionnaire (0–10) was used for pain evaluation before the procedure and during the follow-up. Imaging was performed by CT and X-ray examination 1 day and 6, 12, and 24 months after the procedure. The minimum craniocaudal diameter at the level of the fracture and the maximum craniocaudal diameter at the middle of the fracture were measured before the procedure and during the follow-up.

Results

Successful implant positioning was achieved in all patients. No major clinical complication was observed. On comparing the mean pain scores on the day before (8.56 ± 1.413) and on the first day after (1.44 ± 2.220) the treatment, a decrease of 7.12 NVS units ($p < 0.001$) was observed. Minimum and maximum vertebral height were

increased by 56.58% and 13.7%, respectively, after the procedure ($p < 0.001$). Both pain relief and height restoration remained statistically significant during the follow-up period.

Conclusion

A2 Magerl thoracic or lumbar fractures were successfully treated with augmented vertebroplasty using the Kiva implant. Further randomized studies including more number of patients are warranted to confirm the effectiveness of the technique on pain reduction and height restoration.

P-92

TIRADS classification of subcentimeter thyroid nodules: our experience with fine-needle aspiration in 1094 patients

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Purpose

Nowadays, the detection of subcentimeter thyroid nodules by ultrasound (US) is a common clinical situation. In the last decade, the incidence of thyroid cancer has increased especially due to increased detection rate in screening exams. Almost 50% of these detected thyroid cancers are carcinomas smaller than 1.0 cm in diameter. US characteristics have been studied as predictors of thyroid malignancy and have been grouped under TIRADS classification. In this study, we aimed to identify the relevant US characteristics and to classify these subcentimeter thyroid nodules according to TIRADS classification, thereby determining whether a patient should undergo fine-needle biopsy.

Material and methods

We conducted a retrospective study from 2008 and 2016 in which 1094 subcentimeter thyroid nodules smaller than 1.0 cm in diameter that underwent fine-needle aspiration biopsy (FNAB) were evaluated. We classified them according to TIRADS classification and highlighted their main US characteristics.

Results

We assessed the value FNAB of thyroid nodules smaller than 1.0 cm and correlated the sonographic criteria by comparing the obtained results with the cytological findings in 1094 thyroid nodules. In the analysis based on all nodules, the proportion of malignancies among nodules classified as TIRADS 2 was 0.91% and that among nodules classified as TIRADS 3 was 2.87%. Among nodules classified as TIRADS 4A, 12.26% nodules with 4B classification, 34.43% with 4C classification, and 66.6% among those with rating 5, this proportion was 85.7%.

Conclusion

Thus, we concluded that TIRADS classification based on US characteristics may stratify the subcentimeter thyroid nodules with high risk for malignancy.

P-93

MRI-guided high-intensity focused ultrasound: a new first-line technique in the treatment of osteoid osteoma

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Purpose

To demonstrate that non-invasive ablation of osteoid osteoma with MRI-guided high-intensity focused ultrasound (MRgFUS) is a safe, effective and durable treatment option.

Material and methods

Patients with typical clinical and radiological diagnostic findings of osteoid osteoma, suitable for MRgFUS and anaesthesia, were enrolled in a dual-centric study. Safety (rate of complications) and clinical effectiveness (VAS reduction) of MRgFUS were evaluated as primary outcomes, and tumour control (nidus ablation) at imaging were evaluated as secondary outcome. All patients underwent a minimum follow-up of 3 years.

Results

Forty-five out of 50 screened subjects were enrolled and submitted to MRgFUS. No treatment-related complications were observed. A complete and durable response was achieved in 80% cases. Median VAS pain score dropped from 8 to 0 at 1 week and at all subsequent follow-ups (1, 6, 12, 24 and 36 month). Scores evaluating interference of pain with sleep and physical and daily activities showed a similar trend. Among subjects with partial response (20%), 4 underwent a second treatment (3 with CT-guided radiofrequency ablation and 1 with MRgFUS) and 5 did not need any other treatment. All re-treated patients achieved a VAS score of 0. Overall, 87% patients attained and maintained a stable VAS score of 0 after MRgFUS treatment during follow-up. At the 3-year MRI, osteoid osteoma showed no vascularization in 32/42 (76%) patients.

Conclusion

MRgFUS is safe and effective in the treatment of osteoid osteoma. This technique provides relevant advantages in the treatment of such a benign, impairing disease mostly affecting a young population: no ionizing radiation, incisions, needles or complications. MRgFUS is a candidate first-line treatment.

P-94

Cone-beam CT compared with multi-detector CT guidance for percutaneous biopsy of bone lesions: comparison of technique, success rate, complications, and dose

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Purpose

Cone-beam computed tomography (CBCT) combines a flat panel detector and a C-arm system allowing 3D reconstruction of the imaged tissue and virtual navigation guidance during biopsy. We compared CBCT with multi-detector CT (MDCT) guidance for percutaneous biopsy of bone lesions.

Material and methods

In total, 113 biopsies of bone lesions under CT guidance were performed in 108 patients between December 2010 and July 2016. Fifty-five patients underwent biopsy under CBCT guidance (Dyna CT™, Siemens, Erlangen, Germany) and 53 patients underwent biopsy under MDCT guidance (Siemens Sensation™ 64-slice, Forchheim, Germany). Patient demographics, bone lesion characteristics, and size of and depth to the bone lesion were recorded. Comparison of technical success, incidence of complications, and dose were analyzed.

Results

Successful biopsy was performed in 53/56 (94.6%) patients in the CBCT group and 52/57 (91.2%) patients in the MDCT group ($p = 0.38$). The average bone lesion size was 6.5 cm in the CBCT group and 5.7 cm in the MDCT group ($p = 0.62$). The depth to the target biopsy site was 7.5 ± 1.6 cm in the CBCT group and 6.9 ± 0.8 cm in the MDCT group (range 1.9–11 cm, $p = 0.17$). A sample was obtained in majority of biopsies using a 13-gauge needle ($n = 76$). The mean procedure duration was 27 in the CBCT group and 31 minutes in the MDCT group ($p = 0.54$). The average effective dose was 62.6 mSv in the CBCT group and 117.1 mSv in the MDCT group ($p = 0.04$). No immediate complications were recorded in either group.

Conclusion

CBCT guidance is comparable to MDCT guidance for biopsy of bone lesions with similar technical success rates and with the advantage of reduced dose and shortened procedure time.

P-95

Non-invasive MR-guided focused ultrasound (MRgFUS) therapy is associated with bone integrity restoration in patients with osteoid osteoma

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Purpose

To analyze MRgFUS outcomes for osteoid osteoma (OO) treatment and the relationship of residual nidus vascularity with bone remodeling.

Material and methods

Patients with typical clinical and radiological findings of OO and suitable for MRgFUS and anaesthesia were recruited. The study was designed with an intention-to-treat protocol, and bone behavior was analyzed before and after MRgFUS; patients underwent CT and dynamic contrast-enhanced (Gd-BOPTA, Bracco) MRI scans yearly over a period of 3 years. Nidus perfusion was measured using a semi-quantitative method; bone remodeling was determined with CT scans for complete or partial restoration. Multivariate analysis was conducted to understand the relationship between imaging (CT and DCE-MRI) and clinical outcomes (VAS for pain), BMI, sex, and age.

Results

Among 35 subjects recruited, 30 underwent MRgFUS, 28 had complete clinical benefits with VAS=0 during the follow-up, and 2 required retreatment with RFA at 1 month due to residual pain (VAS=1–3). At 36 months, MRI evaluation showed absence of residual nidus perfusion in 76.7% of cases, with restitutio ad integrum in 30%. Multivariate analysis demonstrated that restoration is associated with absence of perfusion and patient age: subjects younger than 18 years presented complete bone restoration, 0% residual perfusion, and complete clinical response, while older patients more frequently showed variable results of healthy bones irrespective of the clinical outcome. These results are independent of BMI and sex.

Conclusion

MRgFUS is an effective treatment option for OO; results are dependent on subject age, and patient selection may be influenced by this factor in future when seeking complete bone restoration.

P-96

Transvertebral biopsy of mediastinal and retroperitoneal masses

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Background

Traditionally, posterior, mediastinal, and retroperitoneal masses are biopsied using the paraspinal approach. However, in specific cases, the size and location of the mass make it difficult to access for biopsy. In addition, there is a high risk of complications such as pneumothorax, vascular injury, or paraspinal hematoma. In these circumstances, the transvertebral approach would be useful to perform tissue diagnosis in a safe manner.

Clinical Findings/Procedure

In the past decade, there were three cases in which the transvertebral biopsy technique was employed. All these cases were handled by experienced musculoskeletal interventional radiologists. The lesions were initially entered via the transpedicular route, followed by entering the vertebral body and the target. In all cases, successful tissue diagnoses were obtained. There was no complication.

Conclusion

Transvertebral biopsy employs the technique of spine biopsy and is a safe and useful approach to target posterior mediastinal and retroperitoneal masses, particularly when the size and location limit other options, and it can reduce the chance of pneumothorax or paraspinal vascular injuries.

P-97

Role of interventional radiology in vertebral pathologies: a pictorial essay

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Learning Objectives

To review different vertebral interventional techniques.

Background

There are various pathologies involving vertebrae causing significant morbidity to patients. Interventional radiological procedures offer minimally invasive, safe and effective diagnostic/therapeutic option to these patients. Some of the procedures are performed as 'day care' procedures. These procedures include CT guided biopsy, radiofrequency ablation, sclerotherapy, embolisation, vertebral body augmentation (vertebroplasty/kyphoplasty), etc.

Clinical Findings/Procedure

Pre-operative assessment of vertebral lesion is done with CT scan or MRI. Pre-procedure work up includes CBC, coagulation profile, RFT, etc. Most of these procedures are performed under local anesthesia and as day care and no fasting required. For procedures requiring general anesthesia (e.g. radiofrequency ablation), overnight fasting is required and patient requires admission.

These procedures are done under CT guidance (Siemens sensation 16 slice, Germany) or fluoro guidance (Artis Zee, Siemens, Germany/GE Innova 4100, General Electric Healthcare, USA).

Depending on type of procedure, biopsy needles, RFA electrode, sclerosant (sodium tetradecyl sulphate, polydocanol or ethyl alcohol), embolisation materials (Polyvinyl alcohol or N-Acetyl Butyl Cyanoacrylate.), bone cement (Polymethyl methacrylate) are used.

Conclusion

Vertebral interventional procedures offer minimally invasive, safe and effective diagnostic and therapeutic options and has resulted in significant reduction in morbidity.

P-98

Repeat percutaneous vertebroplasty at treated levels with recurrent pain

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Learning Objectives

To investigate the incidence and clinical significance of repeat percutaneous vertebroplasty (PVP) at treated vertebral bodies with recurrent pain.

Background

Percutaneous vertebroplasty (PVP) is a minimally invasive procedure involving the injection of bone cement within a collapsed vertebral

body to treat painful osteoporotic compression fracture of the spine. New fractures after PVP often occur at a different vertebral level. However, recurrent pain arising from previously treated vertebral levels rarely occurs after PVP. In this study, we evaluated the therapeutic benefit and safety of repeat PVP for recurrent pain at previously treated vertebral bodies.

Clinical Findings/Procedure

We retrospectively reviewed 1821 patients who had undergone 2876 PVPs with polymethylmethacrylate at our institution between January 1999 and January 2017. Among the 1821 patients treated by PVP, 28 (1.5%) underwent repeat PVP for recurrent pain at previously treated vertebral levels. They suffered from refractory pain due to refracture of cemented vertebrae or appearance of an intravertebral cleft. All patients experienced improvement in symptoms after repeat PVP. No major complications occurred.

Conclusion

Repeat PVP is a safe and clinically effective procedure for patients with recurrent pain arising at treated vertebral levels.

P-99

Double epidural blood patch injection (DEBIT) for treatment of spontaneous acute cerebrospinal leak

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Learning Objectives

We aim to provide a more robust treatment option in the form of a computed tomography-guided double epidural blood patch injection (DEBIT) for patients suffering from intracranial hypotension due to an acute spontaneous non-iatrogenic cerebrospinal fluid leak.

Background

Epidural blood patches have been used to relieve symptoms associated with intracranial hypotension. Intracranial hypotension has diverse origins and most cases result from a cerebrospinal fluid leak that can occur after lumbar puncture, myelography, and spinal anesthesia or spontaneously. Iatrogenic leaks allow a more targeted treatment approach with an epidural blood patch due to the knowledge of the location of the leak, while the origin of spontaneous leaks is more covert. A lumbar approach is often considered given the lower risk of spinal cord damage. However, it has a lower efficacy rate when compared with a targeted one. Hence, in the treatment of spontaneous cerebrospinal fluid spinal leaks, a double epidural approach (DEBIT) allows for greater coverage of the spinal epidural space with an autologous blood patch.

Clinical Findings/Procedure

Under computed tomography guidance, two 22-G spinal needles are positioned within the epidural space via a translaminar approach at C7-T1 and T12-L1 levels. The loss of resistance technique with hand injection of air was used to ensure accurate positioning of the needle tip before performing simultaneous injection with 20ml of autologous venous blood. The patient remained in a supine position for approximately 4 hours following the injections.

Conclusion

The DEBIT technique is a safe and effective method of treating spontaneous spinal cerebrospinal fluid leaks when a specific level is not localized.

P-100

Approaches for percutaneous vertebroplasty of the upper cervical spine

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Learning Objectives

1. To describe different approaches for performing percutaneous vertebroplasty of the upper cervical spine.
2. To present an original transvertebral approach using C1 and C2 under fluoroscopic control.
3. To discuss the advantages and disadvantages of these different approaches.

Background

The craniovertebral junction is a critical skeletal site. Osteolytic processes put the bulb and spinal cord at risk. Surgical approaches to this skeletal site carry a risk of complications such as vascular and nervous wounds. In selected situations, interventional treatment may obviate the need for a surgical approach or may be used with surgery. Percutaneous cementoplasty because of its minimally invasive nature has been spread, developed, extended, and adapted to other anatomical regions. However, percutaneous vertebroplasty of the upper cervical spine is challenging because of the presence of large vessels, nerves, and airway, which may intervene in the projected needle path. Due to the presence of various bone lesions, several approaches are needed to avoid vital anatomical structures.

Clinical Findings/Procedure

In this presentation, we review the different approaches (anterolateral, transvertebral, posterolateral, lateral, and transoral) for vertebroplasty of the upper cervical spine, focusing on the relevant anatomy, technical aspects, advantages, and limitations of each approach.

Conclusion

Percutaneous vertebroplasty of the upper cervical spine is a treatment of choice for pain or instability when medication and surgery are insufficient or impossible with the patients' treatment. It can also be coupled with surgery. Various approaches are available for optimal support, safety, and adaptability of each patient.

P-101

Use of 3D angiography to perform preoperative transarterial embolization of musculoskeletal tumors

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We demonstrated two cases of preoperative transarterial embolization (TAE) for unusual hypervascular tumors of the musculoskeletal system with a reduction in the intraoperative blood loss. These tumors had non-predictable arterial supplies that were successfully embolized with the aid of 3D angiography and reconstruction software.

P-102

A very rare case of pseudoaneurysm within a pathological vertebral fracture

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A 61-year-old female with sudden onset of back pain (after mild trauma) was found to sustain a pathological vertebral compression fracture of Th5. On preoperative angiography, we found a pseudoaneurysm within the fracture site, which was successfully treated endovascularly.

P-103

Transarterial embolization and cryoablation of a giant left shoulder intramuscular hemangioma

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A 55-year-old man presented with left shoulder pain, weakness, and an enlarged 8.9-cm intramuscular hemangioma of the supraspinatus muscle. The mass was successfully treated with transarterial bland embolization and cryoablation, after which the patient's shoulder pain and weakness resolved.

P-104

Percutaneous nailing and cementoplasty for palliative management of supra-acetabular iliac wing metastases

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A minimally invasive technique that combined percutaneous nailing of the iliac bone with a customized nail and cementoplasty was employed to perform an osteosynthesis of an extensive osteolytic supra-acetabular iliac wing metastatic lymphoma.

P-105

Clinical and imaging results of a case of recurrent soft-tissue liposarcoma of the leg treated with a mini-invasive technique (CT-guided percutaneous radiofrequency ablation, RFA)

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WITHDRAWN

P-106

CT-guided percutaneous vertebroplasty of a metastatic lesion of C1 via the posterolateral approach

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A 42-year-old man with a painful metastatic left lateral mass lesion of C1 received vertebroplasty under CT guidance via the posterolateral approach. Cement filling of the lesion and substantial pain relief were achieved post-procedure and remained stable at the 2-month follow-up.

Clinical practice development

P-107

Personalised EVAR surveillance intervals based on stratification of individual patient risk of secondary intervention from readily measurable parameters

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WITHDRAWN

P-108

Potential role of arterial cone-beam CT in patients undergoing transarterial embolization or transarterial infusion

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Purpose

To assess the potential efficacy of cone-beam CT (CBCT) in patients with thoracic diseases undergoing transarterial infusion (TAI) or transarterial embolization (TAE).

Material and methods

In total, 216 patients (127 males, 89 females; mean age, 56.1±14.7 years) with thoracic diseases, such as lung cancer, malignant mediastinal tumor, and hemoptysis, who underwent TAI or TAE were enrolled in this retrospective study. All patients underwent bronchial arteriography to confirm the blood supply of the lesion. If necessary, intercostal or internal mammary arteriograms were obtained. After obtaining arteriograms, an additional arterial CBCT was performed for each artery. Spinal cord and esophageal wall enhancements were recorded in both arteriogram and CBCT scans.

Results

Among the 216 patients, 296 bronchial arteriograms, 164 intercostal arteriograms, and 46 internal mammary arteriograms were obtained. In bronchial arteriograms, 11 spinal cord enhancements and 4 esophageal wall enhancements were observed at the rates of 3.7% (11/296) and 1.3% (4/296), respectively. However, in bronchial arterial CBCT scans, 19 spinal cord enhancements and 10 esophageal wall enhancements were observed at the rates of 6.4% (19/296) and 3.4% (10/296), respectively. Bronchial arterial CBCT was more effective than arteriography in detecting spinal cord and esophageal wall enhancements. A similar finding was also obtained in the intercostal and internal mammary arteries. During the procedure, no severe complications, such as spinal cord injuries, esophageal ulceration, and broncho-esophageal fistula, developed.

Conclusion

Arterial CBCT is a potential tool for reducing severe complications in patients with thoracic diseases undergoing TAI or TAE.

P-109

Impact of chronic renal failure on safety and effectiveness of paclitaxel-eluting stents for femoropopliteal artery disease: 24-month results of the Zilver PTX Japan Post-Market Surveillance Study

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Purpose

Favorable long-term outcomes of the Zilver PTX drug-eluting stent (DES) in femoropopliteal lesions have been demonstrated. Chronic renal failure (CRF) has been shown to be a risk factor for restenosis and decreased limb salvage. The results of DES in patients with CRF have not previously been reported. This study compares the results of DES in patients with CRF with those in patients without CRF.

Material and methods

This retrospective analysis from the Zilver PTX Japan Post-Market Surveillance Study included 321 patients with CRF and 584 patients without CRF. Outcomes included freedom from target lesion revascularization (TLR), patency, and clinical benefit.

Results

Of the patients included in this subgroup analysis, 2-year data of 209 patients in the CRF group and 453 patients in the non-CRF group were available. The two groups were similar in terms of lesion length and the frequency of in-stent restenosis. Critical limb ischemia, severe calcification, and diabetes were common in patients with CRF, whereas total occlusion was common in patients without CRF. Freedom from TLR rates were 81.4% and 84.9% ($p=0.24$), patency rates were 70.7% and 70.3% ($p=0.95$), and clinical benefit rates were 74.1% and 82.5% ($p<0.01$) in patients with and without CRF at 24 months, respectively.

Conclusion

This is the first comparative study on outcomes of DES in femoropopliteal artery lesions in patients with and without CRF. These results indicated that DES placed in femoropopliteal artery lesions of patients with CRF is safe and effective with patency and TLR rates similar to those in patients without CRF.

P-110

Clinical profiles of patients who underwent emergent interventional procedure for hemodynamically unstable severe trauma: initial experience of an angiographic suite in the largest regional trauma center in Korea

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Purpose

Patients with hemodynamically unstable trauma represent therapeutic challenges for the traumatologist, and interventional management is now regarded as essential. We conducted this retrospective study to determine the role of interventional procedure in trauma care.

Material and methods

We performed a retrospective review of 351 patients who had undergone emergent interventional procedures at an angiographic suite of the largest regional trauma center in Korea between November 2015 and January 2017. Clinical profiles of patients, angiographic and clinical success rates, recurrent bleeding rate, procedure-related complications, and clinical outcomes were evaluated.

Results

A total of 1060 patients with an injury severity score of more than 15 were transferred to the trauma center, and 351 (33.1%) patients were referred to the angiographic suite. Transcatheter arterial embolization (TAE) was performed in 341 patients; all underwent CT angiography for the evaluation of arterial hemorrhage. TAE was performed for hemorrhage associated with pelvic fractures ($n=93$), splenic lacerations ($n=52$), liver lacerations ($n=44$), renal lacerations ($n=41$), gastrointestinal bleeding ($n=20$), musculoskeletal injuries ($n=11$), and other injuries ($n=5$). Stentgraft deployment, including thoracic endovascular repair, was performed in 10 patients. Initial hemostasis was achieved in 330 (94.0%) patients. Rebleeding occurred in 11 patients, and hemostasis was achieved with a second embolization.

Conclusion

Emergent interventional procedure is a safe and effective method for hemostasis after traumatic vascular injuries. The full-time availability of an angiographic suite in the trauma center has served as a front-line therapeutic intervention that prevents delays in definitive bleeding control, and this improvement was enough to result in better clinical outcomes in trauma care.

P-111

Impact of structured vs. narrative fibroid MRI reporting on procedural planning

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Purpose

To evaluate the impact of structured vs. narrative fibroid MRI reporting on procedural planning as assessed by gynecologists and interventional radiologists.

Material and methods

Our IRB approved this HIPAA-compliant retrospective study and waived informed consent. We reviewed 29 consecutive patients with narrative fibroid MRI reports. These patients were re-interpreted using a structured reporting template established by gynecologists, interventional radiologists, and body MRI radiologists. The presence of 19 key features and the usefulness of structured vs. narrative reporting were evaluated by three gynecologists and three interventional radiologists to assess the impact on procedural planning. Statistical analysis was performed using Student's t-test, Fisher's exact test, and Wilcoxon's signed-rank test.

Results

Narrative reports missed more key features than structured reports [7.3 ± 2.5 (range 3–12) vs. 1.2 ± 1.5 (range 1–7), ($p<0.0001$)]. Structured reports were more helpful in surgical planning and grade determination by gynecologists [8.5 ± 1.2 (range 5–10) vs. 5.7 ± 2.2 (range 1–10), ($p<0.0001$)] and interventional radiologists [9.6 ± 0.6 (range 7–10) vs. 6.0 ± 2.9 (range 0–10), ($p<0.0001$)]. Similarly, structured reports were graded as easier to understand by gynecologists [8.9 ± 1.1 (range 6–10) vs. 5.8 ± 1.9 (range 2–9), ($p<0.0001$)] and interventional radiologists [9.4 ± 1.3 (range 4–10) vs. 6.3 ± 1.8 (range 3–10) ($p<0.0001$)].

Conclusion

Structured fibroid MRI reports miss less key features essential for surgical planning compared with narrative reports. Therefore, structured reports were more helpful to gynecologists and interventional radiologists for surgical planning and easier to understand.

P-112

Predictive factors of 1-month mortality in spontaneous intramuscular hematoma

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Purpose

Spontaneous intramuscular hematoma (SIMH) is a life-threatening complication mostly in anticoagulation therapy. The purpose of this retrospective cohort study was to evaluate predictive factors of 1-month mortality and to compare clinical and imaging characteristics in patients who underwent embolization vs those who did not undergo embolization.

Material and methods

All consecutive patients from April 1, 2005 to February 1, 2017 with SIMH diagnosed by CT were included. The clinical files, CT examinations, and procedure details of patients who underwent embolization were reviewed. Uni- and multivariate analyses were performed to identify predictive factors of 1-month mortality.

Results

Sixty-eight consecutive patients were included. Ten patients (14.7%) died at 1 month. Forty-six patients were undergoing anticoagulant therapy (67.7%) and overdosage was found in 6/46 (13%) patients. Active bleeding on CT and the volume of hematoma were not associated with increased mortality (50% vs 46.6%, $P=0.84$ and 1715 ± 495 vs 1214 ± 1166 cm³, $P=0.15$). In multivariate analysis, no factor was identified to be associated with the 1-month mortality. The clinical condition was more severe in patients who underwent embolization than in those who did not undergo embolization (SAPSII score = 26 ± 12 vs 21 ± 7 , $P=0.029$), but despite this, there was no difference in the mortality rate between the two groups (5/32 vs 5/36, $P=0.55$).

Conclusion

SIMH is a severe condition with a high mortality rate. Although patients with higher severity underwent embolization, no increase in the mortality rate was found, suggesting that the treatment may be efficient and useful in most severe patients. A randomized clinical trial should be performed to draw definitive conclusions.

P-113

Comparison of the therapeutic efficacy of lymph node embolization using N-butyl cyanoacrylate with that of alcohol sclerotherapy in the management of symptomatic postoperative lymphocele

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Purpose

To compare the therapeutic efficacy of lymph node embolization (LNE) using N-butyl cyanoacrylate with that of alcohol sclerotherapy in the management of symptomatic postoperative lymphocele

Material and methods

Patients who underwent sclerotherapy or LNE after drainage catheter placement for symptomatic postoperative lymphoceles from 2009 to 2016 were included in this single-center retrospective study. Initial daily drainage amount, catheter indwelling time, and clinical success rates of both treatment groups were determined and compared statistically.

Results

Thirty-one lymphoceles of 28 patients were included [sclerotherapy group (group A), $n = 16$; LNE group (group B), $n = 15$]. The initial drainages were larger in group B (271 mL vs. 365 mL, $P = 0.391$), whereas the catheter indwelling time was longer in group A (25.3 days vs. 12.0 days, $P = 0.273$), although this difference was not statistically significant. The clinical success rate of LNE (group B) was 86.7%, which was significantly higher than that of sclerotherapy (group A; 37.5%) with a P value of 0.009. No major complications related to the procedure were reported in both groups.

Conclusion

LNE is a safe and effective treatment modality in comparison with alcohol sclerotherapy in the management of symptomatic postoperative lymphocele.

P-114

TAE combined with systemic lanreotide treatment alleviated the type III liver metastases burden of p-NET significantly and rapidly

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Purpose

To evaluate the effect of transcatheter arterial embolization (TAE) combined with systemic lanreotide treatment of type III liver metastases of neuroendocrine tumors of the pancreas (p-NET).

Material and methods

From September 2015 to December 2016, this retrospective study enrolled 10 p-NET patients. There were all stage IV pancreatic neuroendocrine tumors. In total, 7/10 were Grade 2 and 3/10 were Grade 3. These patients underwent 16 rounds TAE using 100–300 μ m PVA as the embolism material. All patients underwent systemic therapy of 40 mg lanreotide per month. All patients underwent pre- and post-TAE (1, 3, and 6 months) CT scans to evaluate the liver lesions according to mRECIST criteria.

Results

During the study, the disease control rate was 80%, including 1/10 CR, 3/10 PR, and 4/10 SD. One of two PD patients died during the study 4 months after the second TAE. The overall response rate was 40%. No acute serious complications occurred after the first week of TAE. The common complications were fever, upper abdomen pain, and vomiting. These complications could be easily reduced by using short-acting somatostatin simultaneously. Overall, 8/10 patients reduced the dosage of lanreotide to 20 mg per month 3 months after the first TAE.

Conclusion

TAE combined with systemic lanreotide treatment could alleviate the type III liver metastases burden of p-NET significantly and rapidly. Most patients could reduce lanreotide dosage 3 months after the first TAE. However, its long-term effect remains to be further studied.

P-115

Prospective clinical and pharmacological evaluation of the Delcath System's second generation (GEN2) hemofiltration system in patients undergoing percutaneous hepatic perfusion with melphalan

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Purpose

To analyze the pharmacokinetics and toxicity of percutaneous hepatic perfusion (PHP) with melphalan using a new Delcath System's second generation (GEN2) filter in patients with hepatic metastases and compare this with first generation filters.

Material and methods

From February 2014, two prospective phase II studies were initiated in patients with hepatic metastases from ocular melanoma or colorectal cancer. In 10 PHP procedures performed in the first 7 enrolled patients, blood samples were obtained to determine filter efficiency and systemic drug exposure. PHP was performed with melphalan 3 mg/kg with a maximum dose of 220 mg. Complications were assessed according to CTCAE v4.03. Response was assessed according to RECIST 1.1.

Results

Pharmacokinetic analysis of blood samples showed an overall filter efficiency of 86% (range 71.1%–95.5%). The mean filter efficiency decreased from 95.4% 10 minutes after the start of melphalan infusion to 77.5% at the end of the procedure ($p=0.051$). Bone marrow depression was observed after up to 80.0% in 10 procedures, but was self-limiting and mostly asymptomatic. No hypotension-related complications or procedure-related mortality occurred.

Conclusion

The GEN2 filter had a higher melphalan filter efficiency than the first-generation filter and a more consistent performance. PHP with the GEN2 filter appears to have an acceptable safety profile, but this needs further validation in larger studies.

P-116

A structured approach to mortality and morbidity meetings in interventional radiology

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Purpose

Interventional oncology (IO) has led to increasing numbers of complex interventions being performed in radiology departments. Ensuring patient safety remains a priority, and the mortality and morbidity (M&M) meeting is an important forum for discussing deaths and complications. These meetings have the potential to initiate important improvement measures and provide accountability that is vital for patient safety and professional learning.

Material and methods

We proposed a structured M&M review process for interventional radiology that allowed systematic evaluation of adverse events with a focus on improving safety and accountability, rather than individual culpability. The framework included adverse outcome categorization, qualitative assessment of patient harm, evaluation of system or process failures, and recommendations for action. This system was implemented in our single tertiary IO centre, and over a 6-month evaluation period, data was collected and reviewed.

Results

Over the 6-month period, 15 adverse events were reviewed at the M&M meeting. Fourteen adverse events were given a Clavien–Dindo classification of ≤ 3 , 4 resulted in moderate harm, no severe harm was recorded, and 3 were unanticipated complications. Recommendations included repeat M&M discussion in 3 cases; opportunities for further education and training in 2 cases and a change in departmental protocol in 1 case. A summary report of M&M data was submitted to the departmental clinical governance and hospital quality and safety committees.

Conclusion

Interventional radiology M&M meetings are an important clinical governance tool. By introducing a structured system, the detection and potential to effect significant improvements in patient safety can be maximized.

P-117

Technical effectiveness of computer-assisted thermal ablation of malignant liver tumors: initial results

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Purpose

To compare the technical effectiveness (absence of residual tumor tissue on CECT and CEMRI performed 6 weeks after treatment) of computer-assisted and CT–fluoroscopy guided free-hand ablation of malignant liver tumors.

Material and methods

We retrospectively analyzed 196 thermal ablations of liver tumors (172 microwave and 24 radiofrequency ablations) in 104 patients (23 women, 81 men, mean age 61 years). Seventy-seven procedures were performed using CT–fluoroscopy by two interventional radiologists (>300 ablations done); the other 119 cases were undertaken with stereotactic or robotic guidance. All patients underwent 6-week follow-up examinations, including contrast-enhanced CT and MR imaging. The technical effectiveness was retrospectively evaluated by a consensus reading of two experienced radiologists.

Results

Follow-up after 6 weeks showed complete ablation in 101 of 119 (84.9%) computer-assisted and 56 of 77 (72.7%) manual ablations, with the difference being significant ($p = 0.04$).

Conclusion

The computer-assisted approach for thermal ablation of malignant liver tumors using stereotactic or robotic navigation is in ascendancy over the CT–fluoroscopy guided manual approach concerning the technical effectiveness.

P-118

Does emergency interventional radiology induce intraprocedural hypothermia

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Purpose

To evaluate body temperature (BT) changes during emergency interventional radiology (IR) procedures.

Material and methods

Consecutive 121 patients underwent emergency IR during 19 months. fifty-seven patients were excluded because of no data on bladder temperature ($n = 55$) and mechanical error ($n = 2$). The remaining 64 patients (mean age, 59.8 years; range, 17–96 years)

were enrolled. Bladder temperature before and after IR procedure, clinical manifestation, blood tests, and prognosis were assessed. Hypothermia was defined as BT below 36.0°C.

Results

All procedures were successfully performed. Seventeen patients (26.6%) suffered from hypothermia after procedures (postprocedural hypothermia). Among them, 15 patients (88.2%) were in hypothermia from the beginning of procedures ($P = 1.00$). Univariate analysis showed that shock index (SI), hypothermia at arrival, transfusion volume, prothrombin ratio (PR), and lactate were significantly related to postprocedural hypothermia ($P = 0.020, 0.007, 0.004-0.012, 0.001$, and 0.006). Multivariate analysis showed that SI (odds ratio, 13.2; $P = 0.008$), hypothermia (odds ratio, 7.65; $P = 0.009$), and PR (odds ratio, 0.95; $P = 0.009$) at arrival were associated with postprocedural hypothermia. Second session of IR was performed in 3 patients (17.6%) for postprocedural hypothermia and in 2 patients (4.3%) in the normothermia group ($P = 0.112$).

Conclusion

Our result revealed that IR procedures would not induce intraprocedural hypothermia. However, patients with higher SI, hypothermia, and prolonged PR at arrival are at a risk for hypothermia and need appropriate warming during the IR procedure.

P-119

Uterine fibroid embolization (UFE) performed in an outpatient clinic reduced costs and increased the amount of procedures

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Purpose

To report the results of a UFE program run in an outpatient clinic (OC) in comparison with those of a similar clinical program run in a regular general hospital (GH).

Material and methods

During a 4-year period (2013–2016), 825 patients were evaluated to have UFE. Overall, 711 patients met inclusion criteria and 679 (95.4%) had some healthcare insurance. Patients were referred to perform the procedure either in an OC or in a GH. Clinical protocol and UFE technique were identical in both places. Differences were imaging facility (fixed machine in the GH vs mobile C arm in the OC) and revenue method (fee for service in the GH vs managed care in the OC). Decision to perform the procedure at each institution was taken upon insurance or patient approval.

Results

Overall, 188/359 (52.36%) patients underwent UFE in the OC, while 66/320 (20.62%) underwent UFE in the GH. Among 32 patients having no insurance, 24 (75%) underwent the procedure in the OC, 2 (6.25%) underwent the procedure in the GH, and 6 (18.75%) declined to perform the procedure. The mean total cost of UFE was \$ 37,568,00 in the GH vs \$23,490,00 in the OC. There were no differences in supplies consumption, hospital stay, or outcome.

Conclusion

Performing UFE in an OC is safe and efficient similar to performing the procedure in a GH. However, the lower price achieved in OC makes the procedure more attractive to be approved by insurance companies and patients having no insurance.

P-120

Laser guidance reduces the number of control CT scans in all phases of the learning curve in CT-guided needle punctures: a phantom study

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Purpose

To assess whether using laser guidance can shorten the training and learning curve of radiology residents in CT-guided needle punctures.

Material and methods

Fourteen trainees were divided into two groups to perform needle punctures using either laser guidance or freehand technique in a paraffin-gel phantom. Training was in four sessions at one-week intervals. Each session entailed performing three simple and three difficult punctures. Each trainee participated in three sessions using either laser guidance or freehand technique. For the fourth session, the trainees switched technique to measure the effect of training. For each puncture, needle placement time, number of control scans, and accuracy were obtained.

Results

For both techniques, the learning curve showed a reduction in the needle placement time across the three consecutive sessions: 36% for simple and 42% for difficult punctures in the freehand group and 43% and 51%, respectively, in the laser group. In the third session, the laser group required fewer scans for needle positioning than the freehand group: one versus three scans ($P < 0.001$). Puncture accuracy did not differ between groups ($P = 0.64$). For the fourth technique-switching session, the only difference in comparison to the third session was needle placement time for difficult punctures using the freehand technique; time increased by 1.50 s/cm during the fourth session ($P = 0.043$).

Conclusion

The learning curve using either laser or freehand technique is equal in terms of accuracy and time. Importantly, using laser guidance, a significantly lower number of control scans was required, signifying less radiation exposure to a patient.

P-121

A simple and safe method to preoperatively locate small peripheral pulmonary nodules not involving the visceral pleura

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Purpose

Currently, percutaneous computed tomography (CT)-guided hook-wire placement is the most common method for the preoperative location of small peripheral pulmonary nodules (SPPNs). However, it is sometimes accompanied by complications, such as displacement of the hook or persistent pulmonary air leakage. Here, we report a simple and safe method to preoperatively locate the small peripheral pulmonary nodules not involving the visceral pleura.

Material and methods

Preoperative CT scans were performed 1 hour to 24 hours before thorascopic wedge resection. Under CT guidance, the 22G puncture needle was inserted into the lung tissue until a distance of 5 mm to the lesion. Then medical glue (α -cyanoacrylate) was injected in the lung tissue through the needle. Immediately, a hard and solid glue stick was located just near the SPPN, which was quite easy to see and touch when the lung collapsed during the operation.

Results

A total of 210 patients with 298 SPPNs were included in this study. The lesion size was 8.1 (3.5–21) mm. The distance from the lesion to the visceral pleura was 16.5 (6–25) mm. Wedge resection under VATS was successful in all cases. The postoperative histology diagnosis was primary lung cancer (n=166), metastatic lung cancer (n=32), and benign lesion (n=12). No relevant complications were observed, especially pertaining to air leak or bleeding, which could be avoided due to the characteristic effect of α -cyanoacrylate. Meanwhile, displacement was impossible. Besides, not touching the lesion could avoid its fracture and dissemination.

Conclusion

CT-guided α -cyanoacrylate injection is a simple, effective, and safe technique for the location of SPPNs when difficulty in recognition is anticipated.

P-122

Radiofrequency ablation for symptomatic benign thyroid nodules: a single-center experience with 470 patients

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Purpose

The usual treatment of patients with symptomatic and autonomously functioning benign thyroid nodules was surgery until the advent of new techniques, such as radiofrequency ablation (RFA). This study aimed at estimating the efficacy of RFA of benign thyroid nodules.

Material and methods

The retrospective analysis included the results of treatment of 470 patients with symptomatic benign tumors of the thyroid gland who underwent RFA at the Samara Oncology Center. Among the patients, 98 (20.6 %) patients had autonomously functioning thyroid nodules with hyperthyreosis and 372 (79.4 %) had symptomatic ones. The thyroid image reporting and data system (TIRADS) was used for ultrasound estimation. TIRADS 2 and TIRADS 3 included 38% and 62% patients, respectively. The mean follow-up was 21 (3–36) months.

Results

RFA reduced the nodule volume by 70% after 6 months and by 84% after 1 year, and it was an effective method for treating nodule-related clinical problems and "hot" nodules. The thyroid status normalized in 2 months. Cosmetic results were excellent in 96% patients.

Conclusion

RFA was effective and safe for treating benign thyroid nodules. RFA had no serious complications, and it might be recommended for treating benign thyroid nodules as the first-line of treatment.

P-123

Determination of inferior vena cava diameter: is it true on cava venography?

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Purpose

On cross-sectional imaging, inferior vena cava (IVC) always shows an irregular shape, which may lead to an inaccurate diameter measurement. The purpose of this study was to (a) compare the discrepancy between anteroposterior projection diameter (PD) on cross-sectional CT and calculate a hypothetical diameter (HD) based on IVC circumferences and (b) to determine whether differences exist between PD and HD and how often they can affect IVC filter

selection, i.e., whether one method calculates the IVC diameter as ≤ 28 mm and the other method calculates the diameter as > 28 mm.

Material and methods

A total of 3056 patients who underwent abdominal contrast-enhanced CT were enrolled. The following parameters were measured on cross-sectional CT: (a) the anteroposterior PD and (b) the cross-sectional circumference of IVC. PD and HD were compared using Mann-Whitney U test. Cohen's Kappa test was used to evaluate the agreement of measurement consistency between PD and HD where one yielded a diameter of > 28 mm and the other yielded a diameter of < 28 mm.

Results

The results of our study showed that HD was significantly smaller than PD (19.7 ± 14.6 vs. 23.1 ± 15.2 , $P < 0.05$), indicating that the IVC diameter on vena cavography is always overestimated. On performing a Cohen's Kappa test, an agreement of consistency for the diameter of 28 mm was poor with a Kappa coefficient of 0.36.

Conclusion

PD is unreliable for determining the IVC diameter because of the irregular shape of IVC. Based on the circumference, the calculated diameter may be useful for determining the true IVC diameter.

P-124

Technical implications for endovascular treatment under percutaneous cardiopulmonary support (PCPS)

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Learning Objectives

1. To deepen the knowledge about altered hemodynamics during the use of PCPS.
2. To describe technical pitfalls and potential complications of endovascular treatment.
3. To summarize technical implications for performing angiography and using embolic materials.

Background

PCPS is a powerful life support system for severe heart failure, fatal arrhythmia, or cardiac arrest. The use of PCPS enables us to perform endovascular treatment for vessel injuries and idiopathic hemorrhages by stabilizing hemodynamics and preventing the progression to multiple organ failure through PCPS insertion; however, endovascular intervention under altered systemic circulation during the use of PCPS involves multiple complication risks, including cerebral infarction and myocardial infarction. We demonstrate a safe and feasible technique to perform endovascular treatment based on our experience and physiological considerations of altered blood circulation under PCPS.

Clinical Findings/Procedure

1. Description of systemic hemodynamics during the use of PCPS; heart and brain are perfused by non-pulsatile backward circulation from extracorporeal circuit through femoral artery.
2. Summary of technical implications for performing aortography and using embolic material:
 - (i) Angiography should be performed so as to capture the pigtail catheter placed at the periphery of the target site because of the backward blood flow.
 - (ii) Special care should be taken at the moment of delivery of embolic materials because of the risk of cerebral infarction and myocardial infarction.

Conclusion

We illustrate a theoretically safe and feasible endovascular technique under PCPS with physiological considerations. Familiarity with hemodynamics under PCPS will provide opportunities to IRs to get involved in emergency management under critical care settings.

P-125

Usage and applicability of cyanoacrylate in V and IR

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Learning Objectives

To show the usage, indications, strengths, and weaknesses of cyanoacrylate liquid embolics in the field of V and IR. We explain the technical aspects, cautions, and advices for proper handling. Different outstanding examples will be shown based on the experience of 340 cases.

Background

N-butyl-2-cyanoacrylate is a biocompatible acrylic glue with CE Mark. The original indication for intravascular use began during the 90s to treat AVM in neuroradiology. Cyanoacrylate is a colorless, water-dense, highly adhesive, and radiolucent liquid substance. It has a characteristic smell and hemostatic and bacteriostatic properties. It polymerizes in contact with any biological fluid, making a solid cast that causes an irreversible occlusion of blood vessels or visceral ducts. The polymerization time is 30–90 seconds at a temperature of 45°C–90°C. After embolization, the glue is slowly removed by means of a hydrolytic breakdown process that takes months or years according to the amount of glue and type of tissue.

Clinical Findings/Procedure

Cyanoacrylate has to be mixed with lipiodol to obtain radiopacity. The polymerization time also is modulated by the ratio of glue/lipiodol. The catheter has to be flushed and primed with a non-ionic liquid to prevent intra-catheter polymerization before the injection. Catheter requirements, the method and speed of the injection, and the product concentration are exposed and supported with the different real cases.

Conclusion

Cyanoacrylate is a very effective, quick, and cheap liquid embolic. It causes irreversible embolization. The proper use of intravascular cyanoacrylate has a learning curve.

P-126

Current status of liver transplantation in the United States and the role of interventional radiology (IR)

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Learning Objectives

1. To provide an overview of the history of organ allocation for liver transplantation.
2. To review the current organ allocation system and United Network of Organ Sharing (UNOS) criteria for liver transplantation.
3. To present varying types of liver transplantation and describe the role of IR in liver transplantation.

Background

Hepatocellular carcinoma (HCC) is the most common liver cancer and third highest cause of cancer-related mortality. Treatment options include surgical resection, liver transplantation, and ablation for early-stage disease. Transplantation, guided by the recently updated UNOS criteria, offers the best overall survival for early-stage disease. The demand far exceeds the number of available transplantation organs.

Clinical Findings/Procedure

Transplantation eligibility is determined using the Milan criteria and model for end-stage liver disease (MELD) score. A MELD exception score prioritizes patients with HCC due to increased mortality. To

standardize the imaging characteristics that determine transplantation eligibility, the UNOS criteria was introduced. Recently, application of the MELD exception score was delayed to 6 months due to imbalances in transplantation opportunities between candidates with HCC exceptions and those with MELD score-based allocation priority. A tubular illustration of the organ allocation system with UNOS criteria will be presented. Subsequently, the varying techniques of liver transplantation and the role of IR in early-stage disease will be discussed via clinical examples. A brief overview of complications of liver transplantation pertaining to percutaneous interventions will also be presented.

Conclusion

Liver transplantation offers the best chance of cure in HCC patients. A thorough understanding of organ allocation, liver transplantation techniques, and roles of IR in both pre- and postoperative management is crucial.

P-127

C-arm cone-beam computed tomography in interventional oncology: technical aspects and clinical applications

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Learning Objectives

In this poster, we want to highlight the technical aspects and clinical applications of C-arm cone-beam computed tomography (CBCT) imaging and navigation and explore its utility for common locoregional oncological treatments.

Background

CBCT is a new imaging technology that enables acquisition of cross-sectional imaging with modern angiographic systems equipped with a flat panel detector; it allows the combination of tomography with conventional 2D angiographic imaging and dedicated software during interventional procedures to plan treatment, navigate/position the catheter or device, monitor the treatment, and assess the final result.

Clinical Findings/Procedure

CBCT can be very effective during embolotherapy procedures in the visualization and localization of hepatic, renal, prostate, and renal lesions; in tumor-feeding vessel identification; and in therapy assessment. CBCT may also enable ablation procedures requiring CT guidance in the interventional fluoroscopy/angiography suite without CT and without impacting workflow, especially in facilities without a dedicated IR CT. Once the ablation is complete, repeat CBCT can be performed to rule out periprocedural complications and assess the adequacy of the ablation zone.

Conclusion

CBCT imaging is a new and empowering imaging technology to add to the arsenal of the interventional radiologist/interventional oncologist; thus, CBCT is expected to become a mainstay imaging modality in tumor embolotherapy. Multimodality navigation, semi-automatic fusion, semi-automatic vessel detection, dual-phase CBCT, ablation planning, and synergy with ultrasound are early and emerging options, the added values and potential advantages of which are in the process of being defined. Certainly, CBCT is one of the most interesting and empowering IR/IO tools to emerge in recent times.

P-128

Introduction of interventional radiology in a resource-limited nation: our initial Rwanda experiences

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Background

Medical intervention has supplanted more invasive surgical techniques for both diagnosis and therapy in economically developed nations. In a setting of low physician-to-population ratios, insufficient nursing care, medical supply shortage, and lack of basic healthcare infrastructure, such as those in Rwanda, minimally invasive interventional radiology would greatly benefit patients and the healthcare system.

Clinical Findings/Procedure

Over a three-week period, nine image-guided procedures were performed, including the first two computed tomography-guided biopsies completed in Rwanda, four ultrasound-guided biopsies, two ultrasound-guided catheter drainages, and one ultrasound-guided aspiration at the Centre Hospitalier Universitaire Kigali in Rwanda. Nine procedures were technically successful (100%), as defined by successful image-guided placement of the biopsy device or drainage catheter. One mild complication, a post-procedural hematoma, and one major complication, sepsis requiring the addition of antibiotics, were reported.

Conclusion

This exhibit discusses the initial experiences and outlines the benefits, feasibility, challenges, and future directions of image-guided procedures in resource-limited nations. Moreover, it highlights lessons learned and serves as a call for diagnostic and interventional radiologists to become more actively involved in international health outreaches.

P-129

Value-based healthcare: the role of interventional radiology

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Learning Objectives

1. To learn about the Triple Aim initiative (Institute for Healthcare Improvement, 2007) and the Imaging 3.0™ program (American College of Radiology, 2014).
2. To understand the concept of value-based healthcare, its theoretical background, and the economical and professional implications regarding the practice of interventional radiology (IR) in Europe.
3. To figure out the role of IR in the changing scenario of healthcare systems and how can the specialty best fit into this new framework by overcoming the existing drawbacks.

Background

Health systems all over the world are struggling to move from a supply-driven system to a patient-driven system. Promoted by the Triple Aim initiative and the Patient Protection and Affordable Care Act of 2010, value-based healthcare is a new model that defines value as patient health outcomes per dollar spent. In this ideological re-engineering, integrated multidisciplinary teams focus on specific medical conditions, with outcomes and costs measured throughout the total cycle of care. Concurrently, the American College of Radiology launched Imaging 3.0™, an initiative to highlight the value radiologists can deliver beyond the interpretation of images.

Clinical Findings/Procedure

IR ideally meets both Triple Aim and Imaging 3.0™ criteria: it is effective and delivers quality care less invasively, is poised for growth, provides longitudinal care, is integrated in collaborative teams, and enables health systems to provide greater indigent care using fewer resources and maximize reimbursement under value-based payment models.

Conclusion

In spite of the potential of IR, its contributions, and its recognition as a primary specialty (USA), there are several drawbacks to a full inclusion of IR in the framework of value-based healthcare models.

P-130

From jelly to virtual reality: simulation-based education in interventional radiology

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Learning Objectives

1. To understand the role of simulation-based training and assessment in interventional radiology (IR).
2. To understand the principles and theory of simulation-based education.

Background

Within IR and the wider healthcare sector, there has been an increasing recognition of the potentials of simulation-based education. The simulation technologies used in IR education encompass a wide range of devices from low-cost home-made part-task trainers to virtual reality with full angiosuite reproduction. Simulation can be a means of providing patients a "risk-free" training, especially for novices prior to performing procedures on patients for the first time. There is also increasing evidence for using simulation in the assessment of competency.

Clinical Findings/Procedure

This poster will discuss simulation-based education in IR in terms of the following:

- types of simulation modalities from low to high tech
- terminology used in the simulation literature
- current education theory guiding the use of simulation
- overview of the current evidence in terms of training effectiveness and assessment validity
- practical aspects of implementing a simulation-based training programme in IR
- future developments such as patient-specific simulation

Conclusion

There is proven merit in using simulation to augment competency development in IR. However, successful implementation of simulation-based training requires an understanding of the various technologies and the underpinning educational principles and the consideration of costs and faculty development.

P-131

Cost analyses: a primer for the interventional radiologist

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Learning Objectives

1. To understand methodologies used in cost analyses in medicine.
2. To understand the importance of cost analyses in demonstrating the importance of interventional radiology procedures.
3. To explain the benefits and limitations of cost analyses performed for interventional radiology procedures.

Background

As the price of healthcare continues to increase, it has become increasingly important to evaluate the cost and benefit of competitive medical procedures and treatments. By evaluating both cost and outcomes, cost analyses allow comparisons across studies and interventions. Depending on the perspective, the outcomes, costs, and importance of an intervention can vary widely. The purpose of this poster is to introduce the reader to the basic premises of cost analyses and methodologies used for such investigations and explain the benefits and limitations of the different methodologies.

Clinical Findings/Procedure

Cost analyses follow strict methodologies similar to basic, translational, or clinical science investigations. The important components of cost analysis methodologies include the following. First, which methodology will be used, e.g., cost minimization, cost utility, and cost effectiveness. Second, from what perspective is the analysis performed, i.e., who pays for the intervention? Third, what is the outcome evaluated, e.g., overall survival, freedom from subsequent interventions, and quality-adjusted life years. Each of these issues will be discussed in this poster presentation.

Conclusion

Interventional radiology procedures are perceived to be very expensive. Only by evaluating the cost and effectiveness of these procedures relative to other treatment options can their value be truly determined.

P-132

Social media in interventional radiology: friend or foe

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Learning Objectives

We intend to share our experience of the use of social media in practice development to connect with patients, promote services and improve the quality of care.

Background

The use of social media has played a significant role over the past few years in many fields for private as well as professional purposes. It has also gained a lot of attention in recent years in many diagnostic and interventional services across North America and Europe. Despite its widespread adoption internationally, this technology has been significantly unexplored in the Middle East.

Clinical Findings/Procedure

Saudi Arabia has one of the highest per capita YouTube and active Twitter users in the Arab region. We have been using several social media platforms, including Twitter, Snapchat, YouTube, Facebook, Instagram and WhatsApp, for many purposes such as public awareness, IR education, service promotion as well inter-hospital consultations across the country and region. We would like to share our

experience on how this has affected our practice in the recent years and suggest a targeted use for each of these different platforms.

Conclusion

Social media is a great tool for practice development at many levels. However, our experience shows different advantages for different platforms that we believe can significantly improve their public and patient impact.

P-133

Safe preprocedural, periprocedural and postprocedural management of anticoagulants and antiplatelet agents: what the interventional radiologist needs to know

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Learning Objectives

1. To provide an overview of the most commonly encountered anticoagulant and antiplatelet agents in the interventional radiology (IR) suite.
2. To review current challenges in the management of anti-thrombotics, including reversal agents, and measures to reduce complications related to excessive bleeding and thrombosis.
3. To highlight the pharmacology of novel agents and recent developments in anticoagulation and antiplatelet therapy and their impact on IR.
4. To show our institutional practice for providing safe and effective anticoagulation for IR procedures.

Background

Interventional radiologists are commonly required to temporarily discontinue antithrombotic agents prior to performing percutaneous procedures and prescribe or advise the recommencement of anticoagulation or antiplatelet agents postintervention. Unfamiliarity with newer antithrombotic agents and a lack of awareness of IR guidelines for the management of commonly used anticoagulants could adversely affect patient outcomes.

Clinical Findings/Procedure

To improve patient safety, interventional radiologists should have up-to-date knowledge of antithrombotic medications routinely used in clinical practice. Adherence to the Society of Interventional Radiology anticoagulation guidelines should be adopted where appropriate; promotion of preprocedure time out and use of checklists locally should be incorporated into the IR department daily practice when managing antithrombotic agents.

Conclusion

Interventional radiologists should endeavour to increase their familiarity with the mechanism of action and appropriately prescribe and reverse antithrombotic agents to ensure safe, effective, and holistic delivery of care to patients undergoing percutaneous procedures.

P-134

Treating cardiac tamponade caused by catheter-directed thrombolysis of a saddle pulmonary embolism: a clinical challenge

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Catheter-directed thrombolysis of a saddle pulmonary embolism resulted in a rare complication of perforation of the heart with a subsequent cardiac tamponade. Concurrent consideration of thrombolysis of the embolus and hemostasis of the pericardial effusion is a clinical dilemma.

P-135

Embolic control using coils and n-butyl cyanoacrylate for a ruptured central pulmonary artery aneurysm in a patient with Behcet's disease

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In a 34-year-old man with Behcet's disease and massive hemoptysis from a ruptured pulmonary artery aneurysm (PAA), it was indicated that transjugular pulmonary artery embolization using coils and n-butyl cyanoacrylate in presence of IVC occlusion has a therapeutic role in life-threatening hemorrhages.

Dialysis intervention and venous access

P-136

Safety and efficacy of the AngioJet device in thrombosed arteriovenous fistulas and grafts: a systematic review

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Purpose

The AngioJet device is a rheolytic thrombectomy device that can be used in the treatment of hemodialysis arteriovenous fistula and graft thrombosis.

We aim to appraise the current evidence on AngioJet thrombectomy in hemodialysis vascular access thrombosis and to determine its safety, including complications, and efficacy.

Material and methods

An electronic literature search was performed on Medline and Embase databases. References of retrieved articles were also reviewed.

Articles using AngioJet device (Boston Scientific, Malborough, MA, USA) for the treatment of arteriovenous fistula or graft were included. Patients aged less than 18 years, non-English articles, single case reports, small case series (<5 cases), conference publications, and non-human models were excluded.

Results

Overall, 650 articles were initially evaluated and ten articles fulfilled the inclusion criteria that included 732 patients with 431 grafts and 234 fistulas.

Results were heterogenous. However, the average primary patency rates for 1, 3, 6, and 12 months were 61.9%, 49.3%, 42.5%, and 35.5% respectively; at 3, 6, and 12 months, average secondary patency rates were 79%, 78%, and 75.5%, respectively, and assisted primary patency rates were 62.1%, 49%, and 45.8%, respectively.

There were 126 complications, most were minor. There were seven deaths that were unlikely due to the AngioJet device.

Conclusion

The AngioJet device is an effective and safe treatment option for thrombosed fistulas and grafts. However, the quality of the current evidence is poor. Further research with prospective randomized controlled trials using standardized data reporting methods is needed to prove its safety and efficacy.

P-137

Freeway paclitaxel-releasing balloons reduce the risk of restenosis in hemodialysis patients with recurrent stenosis of the arteriovenous fistula

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Purpose

To evaluate early and mid-term outcomes of freeway paclitaxel-releasing balloons (Eurocor GmbH, Bonn, GE) in hemodialysis patients with recurrent stenosis of the arteriovenous fistula.

Material and methods

Between July 2013 and December 2016, 27 hemodialysis patients with recurrent stenosis of the arteriovenous fistula underwent endovascular treatment with a freeway paclitaxel-releasing balloon. All patients were previously treated at the target lesion with a standard balloon angioplasty (BA). The intervals (in months) between standard BA and the procedure with DCB (time between BA and DCB) and between the procedure with DCB and new restenosis (time between DCB and restenosis) were evaluated and compared with t-test. The 2-year estimated outcomes in terms of survival, primary patency, primary-assisted patency, secondary patency, and freedom from target lesion restenosis were assessed with Kaplan-Meier curves.

Results

Technical success was obtained in 96.3% cases. During the follow-up (mean duration 13.6 months, range 1-33), 13 patients (48.1%) developed a new restenosis with an estimated 2-year freedom from target lesion restenosis of 30.2%. The mean time between BA and DCB was 4.8 months, and the mean time between DCB and restenosis was 7.6 months with a statistically significant difference using t-test ($P < 0.001$). Estimated 2-year rates of primary patency, primary-assisted patency, and secondary patency were 31.8%, 76.4%, and 90.5%, respectively.

Conclusion

In our experience, freeway paclitaxel-releasing balloons were safe and effective for the treatment of recurrent stenosis in hemodialysis patients with recurrent stenosis of the arteriovenous fistula. At follow-up, approximately half of the patients had no new target lesion restenosis and the time to a new restenotic lesion was much longer than recurrence of stenotic lesions after standard BA.

P-138

Vacuum-assisted suction thrombectomy for declot procedures in arteriovenous and HeRO grafts

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Purpose

To determine the safety and feasibility of using a vacuum-assisted suction thrombectomy catheter for restoring patency to thrombosed hemodialysis reliable outflow (HeRO) and conventional arteriovenous (AV) grafts.

Material and methods

Between December 2016 and January 2017, seven consecutive patients (5 male, average age 62, range 39-73 years) with thrombosed HeRO (n=6) or AV (n=1) grafts underwent declot procedures using a Penumbra[®] CAT 8[®] (Alameda, CA) suction thrombectomy catheter to clear the venous outflow tract prior to pulling the arterial plug with a compliant balloon. Average procedure length and

fluoroscopy time, length of thrombus cleared, blood loss, complications, and primary patency were recorded and compared to the same patient's previous declot procedures.

Results

All procedures were technically successful (100%) in restoring patency. No procedure-related complications were recorded. Average thrombus length treated by suction thrombectomy measured 21.1 cm (range 12–27 cm). Average procedure length and fluoroscopy time was 76.7 and 11.2 minutes, respectively, compared with 75.4 and 10.6 minutes, respectively, in the previous declot procedures ($P>0.05$). Average blood loss was 205.7 mL (range 175–250 mL). Two patients thrombosed their access sites 2 and 15 days post-procedure, while the remaining 5 have remained patent to date. The average time to re-clot for previous procedures was 58.2 days.

Conclusion

Vacuum-assisted suction thrombectomy is a safe and feasible method for removing thrombus and restoring patency to thrombosed AV and HeRO grafts.

P-139

The effect of catheter diameter on left innominate vein stenosis in breast cancer patients after implantable venous access port placement

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Purpose

The purpose was to evaluate the effect of catheter size on left innominate vein stenosis in breast cancer patients after the placement of a totally implantable venous access port (TIVAP).

Material and methods

TIVPs were placed in 241 women with right breast cancer via the internal jugular vein (IJV) from January 2010 to December 2014 (mean age, 51.5 years, range, 19–83 years) via the left-side approach. There were 67 TIVAPs with a 6.5F catheter size and 142 TIVAPs with an 8F catheter size. Medical records were retrospectively reviewed. The presence of significant left innominate vein stenosis, tip location of the catheter, and retrosternal space were evaluated based on chest CT images. Statistical analysis was performed.

Results

Left innominate vein stenosis developed in 1 and 13 patients after the placement of 6.5F and 8F catheters, respectively. Differences in the cumulative incidence of left innominate vein stenosis were statistically significant between the 6.5F and 8F catheter size groups (log-rank test, $p = 0.002$). In Cox regression analysis, the hazard ratio for left innominate vein stenosis was 20.766 ($p = 0.005$) for the TIVP with an 8F catheter size. The distance between the sternum and the left innominate vein was found to be significantly and independently related to the development of left innominate vein stenosis, with a hazard ratio of 0.781 ($p = 0.003$).

Conclusion

The incidence of left innominate vein stenosis in breast cancer patients was higher after the placement of TIVPs with an 8F catheter size. In the left-side placement of TIVP in a patient with right breast cancer, TIVP with a 6.5F catheter size was more helpful in preventing left innominate vein stenosis.

P-140

Evaluating 3-year patency rate of arteriovenous fistulae after radiological intervention

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Purpose

To evaluate patency rates of arteriovenous fistulae (AVFs) after radiological intervention.

Material and methods

Retrospective review of angioplasty of AVFs and arteriovenous grafts (AVGs) from 2013 to 2015 was performed. Kaplan–Meier survival curves were used to estimate the post-interventional primary and secondary patency rates.

Results

Overall, 458 PTA procedures were performed on 216 patients with a mean age of 63 ± 15 years. Primary patency rates at 90 days, 180 days, 12 months, 18 months, and 2 years were estimated to be 81.0%, 53.4%, 33.8%, 22.5%, and 17.3%, respectively. Secondary patency rates at 90 days, 180 days, 12 months, 18 months, 2 years, and 3 years were estimated to be 97.1%, 95.6%, 89.4%, 85.3%, 80.0%, and 66.9%, respectively. The native fistula had a higher survival function, with the mean primary patency for vein and graft estimated to be 423 (95% CI 370–476) and 269 (95% CI 177–360) days, respectively, and mean secondary patency for vein and graft estimated to be 1159 (95% CI 1101–1217) and 892 (95% CI 766–1017) days, respectively. There were significant differences between sites of fistula. Forearm fistulae demonstrated significantly higher survival function with mean primary patency for forearm and upper-arm fistula estimated to be 538 (95% CI 414–663) and 369 (95% CI 319–420) days, respectively, and mean secondary patency for forearm and upper-arm fistula estimated to be 1372 (95% CI 1317–1428) and 1057 (95% CI 993–1121) days, respectively.

Conclusion

The patency rate of native forearm AVF was superior to that of upper-arm AVF. Patency of AVF remains superior to that of AVG, and AVF should be the first option when possible.

P-141

Transhepatic venous catheters for hemodialysis

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Purpose

To describe our experience with the technique of transhepatic venous access for hemodialysis and to evaluate its functionality and complications.

Material and methods

Twenty-three patients with age ranging from 12 to 71 years having end-stage renal disease were included in our study. In 21 patients, there were no remaining patent peripheral venous accesses. In 2 patients, there was only a last one venous access needed to be preserved. Complications were evaluated and calculated in terms of number of procedures, infection, dislodgement, and outcome and in terms of disfunctionality of the catheter.

Follow-up was performed by monitoring the catheter dialysis rate in each session, abdominal ultrasonography, fluoroscopy, or CT. Mean survival time and median survival time from the start of treatment were calculated using the Kaplan–Meier method.

Results

Twenty-three patients required a single transhepatic access procedure. Because of catheter dislodgment, two patients required

a second access placement. Technical success was achieved in 22 procedures. Functionality success was achieved in 20 patients. Functionality failure occurred in 3 patients.

The transhepatic catheters stayed in place between 90 and 300 days. Complications occurred in 14 patients.

Conclusion

Transhepatic hemodialysis catheters have proven to achieve good long-term functionality. A high level of maintenance is required to preserve patency, although this approach provides remarkably durable access for patients who have otherwise exhausted access options.

P-142

Heparin-coated Viabahn stent for hemodialysis shunt: efficacy, long-segment recanalization, and analysis of prognostic factors for reintervention

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Purpose

The study evaluated the heparin bioactive surface (HBS) Viabahn stent (W. L. Gore & Associates, Inc., Flagstaff, Arizona) efficacy in the maintenance or re-establishment of hemodialysis access, particularly when stent placement was performed after recanalization of a long-segment obstruction (LSO) of the venous outflow.

Material and methods

Fifty HBS Viabahn stents deployed in 37 consecutive patients with hemodialysis dysfunction from January 2008 to May 2016 were evaluated in a single-institution retrospective review.

The primary study endpoints were procedural and clinical success, primary circuit, and area patencies (PP, APP).

The secondary study endpoints included the secondary patency (SP) and risk factor analysis for hemodialysis dysfunction that required an additional endovascular procedure.

A subgroup analysis was conducted to assess the PP and SP of the HBS Viabahn stent in the treatment of peripheral venous LSO.

Results

Overall PP and APP at 12, 24, and 36 months were 60% (95% CI 47%–79%), 42% (95% CI 27%–65%), and 23% (95% CI 10%–53%) and 68% (95% CI 56%–83%), 49% (95% CI 35%–69%), and 40% (95% CI 25%–62%), respectively. SP rates at 12, 24, and 36 months were 85% (95% CI 74%–98%), 78% (95% CI 65%–94%), and 66% (95% CI 49%–89%), respectively. Estimated PP rates at 6, 12, and 24 months for stent placement after peripheral venous LS recanalization procedure were 73% (95% CI 51%–100%), 53% (95% CI 30%–94%), and 42% (95% CI 13%–80%), respectively. SP rates were 82% (95% CI 62%–100%), 82% (95% CI 62%–100%), and 68% (95% CI 43%–100%), respectively.

Conclusion

Considering the high rates of PP, APP, and SP, HBS Viabahn stents have been proven effective in maintaining or re-establishing the hemodialysis access. Moreover, stent placement after recanalization of LSO of the venous outflow represented a valid approach to rescue a dysfunctional fistula that would otherwise be abandoned.

P-143

Comparison of access patency between balloon angioplasty-related venous rupture and non-venous rupture in patients with failed hemodialysis

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Purpose

The aim of this study was to evaluate the access patency difference between balloon angioplasty-related venous rupture and non-venous rupture after treatment in patients with failed hemodialysis.

Material and methods

From January 1998 to December 2015, 13506 percutaneous angioplasty, mechanical thrombectomy, and thrombolysis procedures were performed in 6732 patients (3685 women, 3047 men; mean age, 58.60±12.84 years; mean hemodialysis access age, 34.32±39.35 months). Rupture rate was obtained and access patency was determined according to rupture status, with/without thrombosis, and treatment type (i.e., balloon tamponade and stent).

Results

Venous rupture was developed in 604 of 13506 procedures (4.5%). Rupture was more frequent in females than males (5.1% vs. 3.6%, $p=0.001$), AVG than AVF (4.9% vs. 3.9%, $p=0.006$), and thrombosis than stenosis (7.7% vs. 3.3%, $p=0.001$). A balloon tamponade was performed for a total of 604 rupture cases, and stents were deployed in 119 cases where contrast extravasation and flow stasis persisted. The primary patency time were better in the no rupture group than in the rupture group (11.0 months vs. 8.9 months, $p=0.001$). However, the access type ($p=0.372$) and with/without thrombosis ($p=0.358$) did not significantly differ with respect to the patency time. The primary patency time in rupture patients was 8.4 months after prolonged balloon tamponade and 11.2 months after stent placement ($p=0.014$).

Conclusion

Primary patency is better in non-ruptured than balloon angioplasty-related ruptured stenotic AVF. Balloon tamponade and bare metal stent placement are effective treatment methods for treating PTA-induced venous rupture. Particularly, stent placement shows patency time similar to non-rupture.

P-144

Endovascular treatment of hemodialysis arteriovenous fistula with DCB: results of a single-center study

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Purpose

The major cause of hemodialysis arteriovenous fistula (DIAVF) dysfunction is venous stenosis which is due to neointimal hyperplasia. This process can be influenced by local paclitaxel application with drug-coated balloon (DCB).

Material and methods

In our study from 2010 to 2016, 30 patients were included. The observation period was 6 months, 1 year, and 2 years. A retrograde venous approach was used. All stenoses were dilated with regular high-pressure PTA balloons. The procedure endpoint was hemodynamic success; this was less than 30% residual stenosis. After achieving hemodynamic success, DCBs were used for drug administration.

The results of DCB PTA were compared with those of plain balloon (PB) PTA performed in our institution between 2004 and 2010.

Results

Technical success was 100%. Primary patency (PP), assisted primary patency (APP), and secondary patency (SP) in PB PTA and DCB PTA groups were compared and the results will be presented.

Conclusion

Our results are promising and consistent with published data. We believe that DCB PTA is a promising approach for the clinical problem of the DIAVFs dysfunction.

P-145

Managing a failing permacath: a retrospective analysis of 510 procedures

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Purpose

To evaluate the results of a retrospective analysis on the management of dysfunctional tunneled dialysis catheters.

Material and methods

From January 2011 to December 2015 (5 years), 1,153 tunneled dialysis catheters were inserted in 853 patients (576 men, 67.5%) in our department. Of these, 648 patients had only one catheter placed, whereas 205 patients had ≥ 2 catheters/interventions, reaching a total of 510 procedures (2.35 procedures/patient). In 342 cases, catheters were placed in the jugular vein (J-group) and 168 catheters were placed in the femoral vein (F-group). In 413 cases, only catheter exchange took place (CE-group); in another 89 cases, balloon angioplasty was performed (PTA-group); and in 8 cases, a bare metal stent was inserted (BMS-group). A total of 272 CVCs had a split tip (SP-group) and 238 CVCs had a shotgun tip (SG-group). Outcome measures included intervention-free period and independent predictors that might influence patency.

Results

The mean follow-up period was 475.64 days (1–1712 days). The mean intervention-free period was 268.35 days (1–1545 days). CVCs with a shotgun tip had a significantly better intervention-free period than those with a split tip (126 days for SG-group vs. 80 days for SP-group, $p < 0.001$). There was a statistically significant difference in median survival with the J-group showing higher survival rates (136 days vs. 69.5 days for F-group, $p < 0.0001$). The CE-group had significantly better results than those with the PTA-group and BMS-group for median survival (CE-group 116 days, PTA-group 89 days, and BMS-group 73 days, $p < 0.0001$).

Conclusion

In this retrospective analysis, CVCs with a shotgun tip had significantly better patency rates than CVCs with a split tip. Catheters placed in the jugular vein had significantly better patency results than those placed in the femoral vein. Additional interventions (angioplasty and stenting) in a bail-out setting provided worse results compared with those with plain CE.

P-146

New devices for the treatment of dialysis access: do they translate into reduced radiation exposure in the patient undergoing dialysis

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Purpose

This is a prospective single-center observational study aiming to investigate radiation parameters in procedures involving high-pressure balloons (HPB), paclitaxel-coated balloons (PCB), and stent-grafts (SG) for the treatment of dysfunctional dialysis access.

Material and methods

In 2016 (12 months), 60 patients underwent an angioplasty procedure for their dysfunctional, upper limb, vascular access: an arteriovenous fistula (AVF) or a arteriovenous graft (AVG). Dose report variables including cumulative fluoroscopy time and dose area product (DAP) were recorded. Patients' baseline variables including weight, height, age, and vascular access were also recorded. Primary endpoints were comparison of effective dose (ED) measurements of different procedures and total DAP of patients undergoing different procedures in one year. Secondary endpoints included investigation of independent factors that could influence the results.

Results

Ninety-five procedures have been performed thus far in 60 patients. In 21 procedures, 24 SG were deployed (1.14/procedure); in 32 procedures, 39 PCBs (1.22/procedure) were used; and in 42 procedures, 54 HPBs (1.28/procedure) were inflated. The median ED was 6.18mSv for SG procedures, 4.32 for PCB procedures, and 3.65mSv for PTA procedures. There was no significant difference between ED in PCB and HPB angioplasties ($p = 0.71$), whereas there was a significant difference between HPB angioplasty and SG deployment procedures ($p = 0.02$).

Conclusion

Interim results show that PCB angioplasty provided no significant additional radiation exposure compared with HPB angioplasty, whereas there was a significant difference in the additional radiation exposure between PCB angioplasty and SG deployment procedures. Interim results concerning DAP in HD undergoing different procedures will be announced.

P-147

Outback re-entry device for the treatment of central venous occlusion in hemodialysis patients

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Purpose

To report our institutional experience with the Outback re-entry device for the treatment of central venous occlusion in hemodialysis patients.

Material and methods

Since January 2013, 8 consecutive patients (4 males and 4 females, mean age: 63.2 years) receiving hemodialysis underwent endovascular treatment for central venous occlusion using the Outback re-entry device after failed attempts of guidewire traversal. The patients had been referred for percutaneous angioplasty due to increased venous pressure during hemodialysis in 4 patients and upper extremity swelling in 4 patients. The mean age of their fistulas since creation was 21.3 months. Six patients had previously received endovascular treatment for malfunctioning fistulas.

Results

Occlusion sites were in the subclavian vein (n=4) and brachiocephalic vein (n=4). In all patients, the guidewire was passed into the subintimal plane but could not be re-directed into the distal true lumen. The Outback re-entry device was used as a bail-out measure with technical success in all cases. All patients underwent balloon angioplasty; 6 of them had provisional bare metallic stent placement due to elastic recoil. The fistulas were functionally restored and arm swelling was relieved in all cases. Excluding three patients who were lost to follow-up, the fistulas were functional up to a mean period of 8.3 months. During this time, 4 patients underwent repeated intervention. There were no complications related to the procedure.

Conclusion

The Outback re-entry device is a feasible and safe bail-out option in patients who fail conventional techniques for wire traversal during endovascular treatment of central venous occlusion.

P-148

Efficacy of single-dose prophylactic preprocedural antibiotic administration for port placement

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Purpose

To evaluate the effectiveness of pre-procedural single-dose IV antibiotics during port placement in preventing procedure-related infections, and to identify clinical and technical contributing factors.

Material and methods

This was a single-institution, IRB-approved study evaluating short-term (30-day) infection outcomes after the placement of a chest port. Correlation between infection rate and clinical factors, including solid vs. hematological malignancy, in-patient vs. outpatient status, and administration of prophylactic pre-procedural IV antibiotics was investigated. Additionally, correlation between infection rate and technical factors such as number of lumens and the operator experience level was evaluated. Chi-squared and t-tests were used for statistical analysis where applicable.

Results

Overall, 5,967 ports were placed between 2005 and 2016. Of the 3,983 patients who received prophylactic antibiotics (66.8%), 94.4% (3,759/3,983) received cefazolin. Port removal due to infection concern was performed in 96 patients, with no statistically significant difference in the rate of infection between those who received antibiotics (1.03%, 41/3,983) vs. those who did not (0.91%, 18/1,984; p=0.65). There was no significant difference in infection rate between single (0.80%, 33/4129) vs. double (1.09%, 20/1838) lumen port recipients (p=0.62). Operator credentials and inpatient vs. outpatient status did not predict the infection rate (p>0.05 for both). Although there was a significantly higher rate of infection in patients with hematological malignancies (1.9%, 12/637) vs. that in those with solid tumors (0.90%, 47/5330; p=0.03) in the entire cohort, no difference in the infection rate between patients with hematologic malignancy who received antibiotics (1.6%) vs. those who did not (1.4%) was observed (p=0.29).

Conclusion

Single dose of pre-procedural antibiotics does not appear to prevent short-term procedure-related infections.

P-149

Single-center experience of Vortex port for plasmapheresis

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Purpose

To determine the frequency of complications with the use of dual-lumen Vortex ports for plasmapheresis.

Material and methods

Clinical charts of patients who had a dual-lumen Vortex port implanted between May 23, 2012 and October 4, 2016 were retrospectively reviewed.

Results

Sixty-seven patients (age 42 ± 16 years) corresponding to 53 296 catheter days were included. Fourteen patients (20.6%) had one or more infectious or non-infectious complication. Among the complications, 4 were related to infection, 9 were related to blockages associated with fibrin sheath or malpositioning, and 1 was related to leakage. This equated to a rate of 0.01 infection-related and 0.02 dysfunction-related complications per 100 catheter days. Of the 67 implanted devices, 22 were removed: 6 due to complications and the remainder due to cessation of treatment.

Conclusion

Dual-lumen Vortex ports used for plasmapheresis favorably compared to tunneled hemodialysis catheters, an alternative for plasmapheresis, with much lower complication rates per 100 catheter days. Vortex ports show comparable or lower rates of complication than those reported in the literature for other implantable venous access ports.

P-150

Use of tissue adhesives for fistula access site haemostasis

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Purpose

The purpose of this study is to describe a novel technique for achieving haemostasis of haemodialysis arteriovenous fistula (AVF) access sites after percutaneous interventions. We compare the effectiveness, safety and patient acceptability of this new technique to conventional suturing closure methods.

Material and methods

A two-arm non-randomised prospective study comparing the use of skin adhesives (Histoacryl[®]) to close fistula access sites versus conventional surgical suturing was undertaken in a large tertiary care centre.

Thirty-nine procedures were performed on 33 patients who underwent percutaneous intervention of failing or thrombosed AVFs. In total, there were 39 access sites. Post-procedure haemostasis was achieved using Histoacryl[®] on 25 access sites, whilst surgical suturing was used for 14 access sites.

Procedure details, including time to haemostasis, size of access sheath, dose and time of heparin administration, immediate complications and patient self-reporting numeric pain intensity scale (0–10) were all recorded.

Results

Histoacryl[®] group had a mean pain rating of 0.4 (SD 0.7), and the suturing group had a mean pain rating of 2.6 (SD 0.7). Mean time to achieve haemostasis was 92 seconds in the Histoacryl[®] group (range 20–601 seconds) and 198 seconds in the suture group (range 58–361 seconds). No immediate complications were reported in either group.

Conclusion

Our study has shown that Histoacryl® offers a fast, technically simple, device/suture-free and painless technique for acquiring haemostasis after AVF intervention.

P-151

Techniques to improve the success rate of vascular access intervention therapy for troubles of arteriovenous fistula in dialysis: all that we should know

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Learning Objectives

To learn about several technical tips to improve the success rate of vascular access intervention therapy (VAIVT) for troubles of autogenous arteriovenous fistula (aAVF) in dialysis.

Background

VAIVT has gained importance in the treatment of vascular access troubles (VATs) in dialysis. VAIVT for arteriovenous graft succeeded in 75%–98% cases according to previous reports. However, in VATs of aAVF, 19%–42% of patients required additional surgical treatments owing to VAIVT failure. It is important to improve the success of VAIVT in order to avoid surgical treatments. We analyzed VAIVT techniques used by us for VATs of aAVF in 180 consecutive procedures wherein the success rate was 97%.

Clinical Findings/Procedure

On reviewing 180 procedures of VAIVT, we evaluated the effectiveness and feasibility of each technique for increasing success rate of VAIVT.

1. About approach

Optimal sheath insertion adapted to all the stenotic or occlusive lesions of aAVF.

Techniques of sheath insertion into fine or deeper vein.

2. About guidewire

Counterturn wire insertion technique for difficult branch vein insertion.

Pull-through technique (between the artery and the vein) so that the balloon catheter passes through severe stenotic or occlusive lesions.

3. About balloon dilatation

Parallel wire technique/single wire scoring technique for treating the remaining narrow segment after POBA.

4. Other

Finger-assisted technique by which a guidewire/catheter can be passed through.

Several techniques for successful thrombolysis.

Conclusion

To utilize a variety of techniques that allow successful VAIVT for VATs of aAVF.

P-152

Update on pain management strategy during percutaneous transluminal angioplasty for dysfunctional hemodialysis access: what interventional radiologists need to know

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Learning Objectives

1. To outline the pain management strategy during percutaneous transluminal angioplasty for dysfunctional hemodialysis access.
2. To review the basic knowledge related to analgesic and sedative agents, and to describe an advanced analgesic procedure, ultrasound-guided brachial plexus block (US-BPB).

Background

Percutaneous transluminal angioplasty (PTA) is a well-established first-line treatment for dysfunctional dialysis access; however, the procedure is typically painful. Severe pain is liable to affect patient compliance and hinder the procedure due to untoward body movements. Therefore, interventional radiologists should be well-versed with periprocedural pain management. Traditionally, local or systemic administration of sedative and analgesic agents has been used to control PTA-related pain; however, favorable results have been reported recently with use of US-BPB.

Clinical Findings/Procedure

1. Systemic administration of analgesics and/or sedative agents.
2. Local anesthetic injection at the site of balloon expansion.
3. US-BPB: supraclavicular, axillary, and brachial approaches.

Conclusion

Pain management during PTA for dysfunctional hemodialysis access is important to alleviate periprocedural stress for both the patient and operator. Interventional radiologists should know the pros and cons of various analgesic modalities and chose the most appropriate option based on the patient's condition.

P-153

A systematic approach for tunnelled dialysis catheter placement

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Learning Objectives

We will outline a systematic approach for the placement of tunnelled dialysis catheters (TDCs) and highlight the importance of the patient context and radiological evaluation of potential access sites. We will describe the conventional, alternative and salvage access options for TDC placement and the merits/drawbacks of each using patient examples.

Background

There are over 1,500 patients in Ireland requiring haemodialysis. Interventional radiology plays a crucial role in this patient population that relies on TDCs for chronic maintenance haemodialysis or while they await formation/maturation of arteriovenous fistulas (AVFs) or arteriovenous grafts (AVGs). There is a systematic approach for conventional, alternative and salvage access options that guides the site choice, but this must take the patient context, radiological evidence of suitability, future AVF/AVG site and awareness of the complications associated with different TDC sites into account.

Clinical Findings/Procedure

We will discuss patient considerations (e.g. arm dominance and AVF/AVG site) and illustrate the conventional, alternative and salvage TDC sites using patient examples. We will show venogram imaging of complications that may arise (stenosis, occlusion and dislodgement). We will also discuss the patency rates and complication profile of these access sites that guide systematic site selection.

Conclusion

TDCs are crucial in ESRD because they facilitate life-extending haemodialysis treatment for those unsuitable for AVF/AVG or renal transplant or act as an interim access for those awaiting AVF/AVG formation or maturation. TDCs are prone to complications that vary from site to site. A review of the systematic approach to access selection and highlighting the merits/drawbacks of each is of interest to both diagnostic and interventional radiologists.

P-154**Percutaneous placement of a dialysis catheter in the azygos vein: a rare alternative****A.M. Alduk**, R. Smiljanić*Department of Diagnostic and Interventional Radiology, University Hospital Centre Zagreb, Zagreb, Croatia*

A 25-year-old female with end-stage renal disease presented with chronic occlusion of the superior vena cava and collateral drainage through the dilated azygos vein. Percutaneous placement of a paired dialysis catheter (Tesio) in the enlarged azygos vein was performed.

P-155**Percutaneous fenestration and stentgraft for the treatment of a hemodialysis-related venous outflow tract occlusion: a case report****D.E. Goo**, Y.J. Kim, S.B. Yang*Radiology, Soonchunhyang University Hospital, Seoul, Korea*

A 48-year-old man with a left brachiojugular graft fistula was recommended segmental occlusion of the venous outflow tract, including the jugular vein. New subcutaneous tract with a stentgraft from a graft to the innominate vein was made after percutaneous puncture using a 21-G needle.

P-156**Risk factors for the unanticipated late maturation of an arteriovenous fistula after creation of a separate graft access****H. Li**¹, S. Jen¹, T. Ramayya¹, J. Edwards², G.H. Bowers³, E. Rotem³

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A patient with hypertension, coronary artery disease, and end-stage renal disease exhibited delayed maturation of an arteriovenous fistula for over a year and consequently received an extraneous prosthetic graft. This report examines the risk factors of delayed fistula maturation.

P-157**Iatrogenic fistula between a prosthetic graft and the native vein used for hemodialysis after balloon dilatation of cephalic vein stenosis****J.H. Kwon**¹, **Y.R. Kang**²

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We report a case of iatrogenic fistula between a prosthetic graft and the native cephalic vein that was used as a vascular access for hemodialysis during endovascular intervention even though the thrombosed venous limb of the graft could not be recanalized.

P-158**Fallen HeRO****A. Star**, G.J. Nadolski, S.O. Trerotola*Interventional Radiology, Hospital of the University of Pennsylvania, Philadelphia, PA, United States of America*

In a patient with ESRD, failed renal transplant, and extremely limited access options, an abandoned HeRO graft was utilized to salvage access via direct graft puncture, tunneled dialysis catheter placement via angioplastied graft tract, and graft explantation. TDC remains in use.

P-159**Transhepatic tunnelled catheter insertion for long-term dialysis access****C. Hazar**¹, S. Shaikh²

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A 38-year-old male, who had renal failure secondary to neurogenic bladder, showed bilateral upper-limb arteriovenous fistula formation, underwent renal transplantation, had multiple central venous lines, underwent peritoneal dialysis, and developed central vein occlusions. As the last option, transhepatic dialysis catheter insertion was performed.

Embolotherapy (excluding oncology)**P-160****Splenic artery embolisation for trauma: 5-year experience at a major trauma centre in UK****J.R.L. Davies**, M. Mossad, R.D. Wells*Interventional Radiology, University Hospital North Midlands, Stoke-on-Trent, United Kingdom***Purpose**

Management of splenic injury has changed, with non-operative management (NOM) now favoured. For those requiring intervention, splenic artery embolisation (SAE) is favoured, except in the most severely injured. Follow-up of these patients is variable, with guidelines highlighting the paucity of data addressing the need for further imaging and prophylactic antibiotics. This review was undertaken to assess practices and outcomes at our centre.

Material and methods

This retrospective study captured embolisations over 5 years (Jan 2012–Dec 2016). CRIS data was cross-referenced with TARN and HES data to include trauma cases. Collection and analysis was on Excel. Outcomes were compared with available standards from different sources.

Results

A total of 176 splenic injuries were identified: 122 NOM, 28 laparotomy first, and 26 embolisations with an increased trend toward embolisation first over time. Embolisation group: age 16–79 (median 35.5) years, M:F 18:8. Time to intervention 1.1–171.2 h (med 2 h 9 min), with 7 failed NOMs. Proximal vs. selective embolisation vs. both 10:13:1. Predominant mechanism was coiling. Two patients proceeded to splenectomy. Six were deemed to have complications, 5 ongoing left upper quadrant pain, 1 infected haematoma requiring drainage, 2 chest infections with 2 pleural effusions, with 1 requiring drainage and 2 deaths from other injuries. Follow-up imaging was performed in 16 and not in 7. Five patients were vaccinated as per splenectomy protocol, and 6 received prophylactic antibiotics.

Conclusion

Serious complications are not common following SAE, but variation exists in the follow-up. These findings will help implement local protocols. Further high-level data is required to assess requirements for follow-up, particularly to address immune function post-embolisation.

P-161

Feasibility of transradial access in acute hemorrhage

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Purpose

For certain interventions, transradial arterial access (TRA) demonstrates increased patient safety and satisfaction compared with that with transfemoral arterial access. Data suggests that TRA is safe and feasible across a range of noncoronary arterial interventions; however, the feasibility of TRA in patients with acute hemorrhage has not been evaluated. Given the potential benefits of TRA, we assessed the feasibility of performing TRA in the setting of acute hemorrhage.

Material and methods

Consecutive sampling was conducted on 19 patients referred for transarterial angiography with possible embolization for acute hemorrhage. The patient's left radial artery was measured approximately 1–2 cm proximal to the styloid process using ultrasound. Adequate collateral perfusion of the left hand was assessed using the Barbeau classification.

Results

The mean age of patients was 51 ± 19 years with 47% males. The mean weight was 71 ± 27 kg. Indications for emergent angiography with possible embolization included trauma (32%), post-partum (26%), and spontaneous hemorrhage (42%). In total, 42% patients required blood products and 74% patients were embolized. The mean left radial artery diameter was 2.1 ± 0.5 mm. Overall, 89% patients had adequate ulnopalmar collaterals based on Barbeau classification with 37%, 52%, and 0% categorized as A, B, and C, respectively. Two patients (11%) had Barbeau D classification. Using current clinical guidelines including a radial artery diameter of ≥ 2.0 mm and Barbeau A–C, 58% patients were eligible for TRA.

Conclusion

Using the current clinical guidelines, TRA is potentially feasible in over half of the heterogeneous patient population referred for transarterial angiography for acute hemorrhage and warrants further investigation.

P-162

Initial experiences of transcatheter arterial embolization with trisacryl gelatin microspheres for symptomatic enlarged polycystic kidneys

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Purpose

To assess the feasibility of transcatheter arterial embolization (TAE) with trisacryl gelatin microspheres in patients with symptomatic polycystic kidneys (PCKs).

Material and methods

Our institutional review board approved this prospective study, which was planned for patients with symptoms related to enlarged PCKs, such as a markedly distended abdomen and abdominal pain. All patients had been undergoing dialysis therapy for chronic renal failure, and their urinary volume had decreased to <500 mL/day at TAE. Bilateral renal TAE with microsphere injection followed by metallic coil placements was performed, and changes in the kidney volume, clinical symptoms, laboratory data, and complications were evaluated after TAE.

Results

Three patients (3 women; 54, 58, and 65 years) were enrolled. All 3 patients successfully underwent TAE. The mean kidney volume was 3885 ± 772 mL (range, 2589–4987 mL) before TAE and changed to $60.3\% \pm 14.0\%$ and $47.8\% \pm 12.4\%$ of the pre-therapeutic value at 6 and 12 months after TAE, respectively ($p < 0.05$). All patients reported improvement of clinical symptoms within 6 months after TAE. Abdominal pain, nausea, and inflammatory response developed in all patients after TAE, but they improved with conservative treatment. Two patients underwent blood transfusion because of transient deterioration of nephrogenic anemia. No other major complications related to TAE occurred in the remaining patients.

Conclusion

TAE with microspheres might be a feasible and effective treatment for symptomatic enlarged PCKs.

P-163

Paravesical arteriovenous malformation: therapeutic approach and anatomical considerations

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Purpose

The purpose of this case series is to evaluate the efficacy of embolosclecterotherapy with both the transvenous and transarterial approaches for paravesical space arteriovenous malformation (pAVM). Furthermore, the features of pAVM have been considered with a review of the literature.

Material and methods

We performed angiography on five patients with pAVM; four of these patients were treated with embolosclecterotherapy combined with the transvenous and transarterial approaches. Furthermore, previously published reports of pAVM were reviewed.

Results

All five cases had multiple feeders from the anterior division of the right internal iliac artery flowing into a dilated venous sac; in three of these cases (ascending group), a simple draining vein joined the internal iliac vein, and in two cases (descending group), a draining vein joined a deep dorsal vein in the retroperitoneal space. Two cases in the ascending group were treated with transarterial ethanol sclerotherapy combined with both venous and arterial balloon occlusions. Both cases in the descending group were treated by balloon-occluded retrograde transvenous ethanol sclerotherapy in combination with selective arterial embolization. All cases were successfully treated without further complications.

We identified six case reports of pAVM with the same anatomical characteristics as seen in the cases presented here, and all six reported satisfactory therapeutic effects following catheter intervention.

Conclusion

Typically, the treatment of pelvic AVM is difficult due to the complex vascular structures involved. Our report indicates that the part of the pelvic AVM located in the paravesical space can be treated satisfactorily by embolosclectherapy, especially when combined with the transvenous approach.

P-164

Are formal urodynamic studies an essential investigation prior to prostate artery embolisation (PAE)?

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Purpose

Despite promising early results using PAE, some patients fail to improve irrespective of technical success. Therefore, optimal patient selection is paramount to ensuring good outcomes; however, not all centres conduct formal urodynamic studies to confirm bladder outflow obstruction (BOO). Thus, we explored if formal urodynamics was a useful predictor of sustained symptomatic improvement.

Material and methods

Patients undergoing prostate artery embolisation from June 2012 to January 2016 were prospectively followed up. All patients underwent formal urodynamic assessment to confirm BOO in addition to completing an International Prostate Symptom Score (IPSS) questionnaire. Patients subsequently completed non-formal urodynamic assessment and IPSS questionnaires at 3, 6 and 12 months. Pre-embolisation variables were assessed for correlation with IPSS change at 12 months using the Pearson's bivariate correlation.

Results

Eighty-two patients with confirmed BOO were treated with PAE (mean age 64.5 years, mean Abrams-Griffiths score 77.7 ± 33.0 , mean post-void residual (PVR) 178.8 ± 153.9 , mean Qmax 8.1 ± 3.0 , mean IPSS 22.8 ± 5.3) and were followed up for 12 months. Mean PVR and Qmax improved significantly (PVR 101.3 ± 86.4 , $p=0.001$; Qmax 12.1 ± 7.0 , $p=0.037$) and IPSS reduced to 12.1 ± 7.5 . A high Abrams-Griffiths score pre-PAE correlated with a better symptomatic outcome at 12 months ($r=0.37$, $p=0.002$), as did detrusor pressure at maximum flow rate ($r=0.33$, $p=0.048$). Pre-PAE PVR and Qmax did not correlate well with symptomatic outcomes ($r=-0.10$, $p=0.55$ and $r=-0.10$, $p=0.50$, respectively).

Conclusion

Formal urodynamic assessment is considerably more reliable at identifying good candidates for PAE; therefore, it should be routinely performed to ensure optimal outcomes.

P-165

MRI infarction pattern after prostate artery embolisation (PAE): does it correlate with a sustained symptomatic improvement?

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Purpose

Prostate MRI imaging characteristics following PAE have been described, but it remains unclear as to which features are suggestive

of a sustained volume change and symptomatic improvement. A link between infarction pattern and symptomatic improvement would aid patient counselling and further our understanding of the PAE's mechanism of action.

Material and methods

Between July 2014 and December 2015, all patients undergoing PAE for urodynamics who confirmed bladder outflow obstruction were prospectively followed up (mean age 65.1 ± 5.9 , mean prostate volume $60.0 \pm 25.6 \text{ cm}^3$). An MRI performed at 3 months post-embolisation enabled characterisation of the infarct pattern and volume calculation. An IPSS questionnaire was completed pre-procedurally and subsequently at 3, 6 and 12 months after PAE. At 12 months, the prostate volume was recalculated using transrectal ultrasound.

Results

The most common infarction pattern was confluent devascularisation (21/44), subdivided into symmetrical (4/21) and asymmetrical (17/21) patterns. Patchy devascularisation (17/44) and full enhancement patterns (6/44) were also observed. Patients with 'confluent devascularisation' achieved significantly greater prostate volume loss by 12 months (41.0 vs. 25.1 ml, $p=0.006$) compared with those with 'full enhancement', with a greater reduction in IPSS, which was not statistically significant (14.9 vs. 9.5 , $p=0.14$). Patients with a 'patchy devascularisation' pattern saw symptomatic improvements at par with those with a 'confluent devascularisation' pattern, although these patients were more likely to experience continued late symptomatic improvement and volume reduction between 3 and 12 months (66.7% vs. 29.0% , χ^2 , $p=0.04$).

Conclusion

Three distinct MRI infarction patterns were observed, of which 'confluent devascularisation' was associated with the best overall symptomatic improvement. 'Patchy devascularisation' was associated with symptomatic improvement after 3 months, unlike the other patterns.

P-166

Rupture of pseudoaneurysm of the peripheral artery during transcatheter arterial embolization

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Purpose

To evaluate the rate of rupture of pseudoaneurysm during transcatheter arterial embolization (TAE) and predisposing factors for the rupture.

Material and methods

Forty-seven pseudoaneurysms in 45 patients were treated with TAE. Etiologies of the 47 pseudoaneurysms were as follows: 21 iatrogenic diseases, 9 inflammations, 9 traumas, 4 tumors, and 4 other diseases. Embolized arteries were as follows: 12 splenic, 7 renal, 4 inferior epigastric, 4 posterior superior pancreaticoduodenal, and 20 other arteries. In 45 TAEs, distal and proximal coil embolization was performed. In the remaining 2 TAEs, only proximal embolization was performed due to no visualization of a distal artery. The embolic materials used were coils only in 40; glue only in 3; coils and glue in 2; gelatin sponge and glue in 1; and gelatin sponge, glue, and coils in 1. We evaluated the rate of rupture of pseudoaneurysm during TAE, its predisposing factors, and clinical outcomes.

Results

Rupture during TAE occurred in 4 out of 47 pseudoaneurysms (8.5%). In all 4 cases, rupture occurred after embolization of the distal artery. Embolic materials used for the distal artery were coils in 2 and gelatin sponge in 2. After rupture, embolization of the proximal artery was immediately performed successfully in all cases without any clinical symptoms such as drop of blood pressure. Overall, all patients did well after TAE.

Conclusion

Rupture of pseudoaneurysms can occur during TAE. It is more likely to occur after distal arterial embolization; thus, it may be related to an increase in pressure inside the pseudoaneurysm.

P-167

Outcome of endovascular management of severe arterial hemorrhage after radical prostatectomy

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Purpose

The aim of this study is to assess the safety, effectiveness, and long-term outcome of endovascular management of arterial hemorrhage after radical prostatectomy (RP).

Material and methods

We retrospectively identified all patients who were treated endovascularly for refractory bleeding after RP between January 2008 and December 2016. Contrast-enhanced computed tomography (CT) was performed and followed by catheter-directed treatment by means of transarterial embolization (TAE) or stentgraft placement. Follow-up included analysis of bleeding recurrence, embolization-related adverse events, tumor recurrence, and functional outcome.

Results

Ten patients were included. Contrast-enhanced CT and catheter-directed angiography showed pelvic contrast extravasation in all patients. Nine patients were successfully treated with TAE using microparticles, coils, and/or glue. The remaining patients were treated with stentgraft placement in the external iliac artery, which was most likely injured during additional robot-assisted lymphadenectomy. Apart from a small puncture-site pseudoaneurysm, no complications related to the endovascular procedures occurred; in particular, no pelvic ischemic complications were identified. Mean follow-up period was 45 months (range 22–80). No tumor recurrence was noted.

Conclusion

Endovascular management, including transarterial embolization and stentgraft placement, are safe and effective in the treatment of refractory bleeding after RP without postinterventional pelvic ischemic events.

P-168

Time course change of trauma care by prompt and rapid endovascular strategies in trauma occasions

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Purpose

To evaluate time course change of trauma care after the introduction of prompt and rapid endovascular strategies in trauma occasions (PRESTOs).

Material and methods

A total of 102 trauma patients underwent transcatheter arterial embolization (TAE) over 40 months. Twenty-seven cases were excluded due to TAE performed after damage control surgery (n=16) and 24 hours after the injury (n=11). The remaining 75 cases (age range, 16–96 yrs; mean age, 60.1 yrs) constituted the study population. Patients were divided into two groups: patients treated 20 months before the introduction of PRESTO (P1 group, n=34) and 20 months after the introduction of PRESTO (P2 group, n=41). Patient

background, time to TAE of day- and night-time, TAE procedure time, transfusion volume, and patient prognosis were retrospectively evaluated.

Results

There was no significant difference in patient background between two groups. Mean time to TAE was significantly shorter in P2 than that in P1 (125 vs. 150 min; p=0.022). Time to TAE was significantly longer during the night than that during the day in P1 (171 vs. 125 min; p=0.004). No significant difference in time to TAE was shown between day and night in P2 (p=0.219). TAE procedure time was significantly shorter in P2 than that in P1 (74 vs 99 min; p=0.007). No significant difference was found in TAE procedure time between day and night in both the groups (p=0.391 and 0.513). There was no significant difference in transfusion volume and prognosis between the two groups.

Conclusion

Time to TAE and TAE procedure time were significantly shortened after introduction of PRESTO. Further evaluation of patient prognosis is needed.

P-169

Comparison and long-term follow-up results of giant hepatic hemangioma treatment with transcatheter arterial embolization (TAE) and transcatheter arterial chemoembolization (TACE)

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Purpose

Hemangiomas are the most common primary tumors of the liver. When and how to treat hepatic hemangiomas is controversial, and traditional treatment is by surgery. Transcatheter arterial embolization (TAE) and transcatheter arterial chemoembolization (TACE) have been reported as minimally invasive treatment methods. To our knowledge, there are no studies in the literature comparing use of TACE and TAE for hepatic hemangioma treatment. The purpose of this retrospective study was to evaluate symptom improvement, size-reducing effects, and complications of TACE and TAE for the treatment of giant hepatic hemangiomas.

Material and methods

Fifty-two patients underwent TACE using bleomycin, and 54 patients underwent TAE. The patients were followed up for 1 year and follow-up images at 6 months and 12 months were acquired. Lesion volumes in both follow-up images were calculated. The patients were examined for any possible procedure-related complications as well as the status of their initial symptoms.

Results

Both TAE and TACE resulted in significant volume reduction at 6 and 12 months (p=0.001 for TAE at 6 months, p<0.001 for all others). Lesions that underwent TACE were smaller compared to TAE at 6 months (p=0.043) and 12 months (p<0.001). Both methods were similarly successful in terms of symptom resolution; however, fewer complications were seen in TACE (p<0.05).

Conclusion

Both methods are effective in symptomatic relief in properly selected patients. TACE causes greater volume reduction with fewer complications; therefore, it is the better endovascular treatment option.

P-170

Ultrasensitive embolization for small intestinal bleeding using a 1.7-Fr catheter and soft bare platinum coil

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Purpose

To evaluate the safety and efficacy of embolization for treating acute small intestinal bleeding using a 1.7-Fr catheter and soft bare platinum coil.

Material and methods

The subjects were seven consecutive patients who experienced melena onset with small intestinal bleeding and underwent transcatheter arterial embolization (TAE) using 1.7-Fr catheters and 0.010-inch detachable coils (seven procedures in total). Technical and clinical success, relative post-procedural complication, source and cause of bleeding, and association between coagulopathy and embolization efficacy were examined by capsule endoscopy.

Results

We achieved 100% technical and clinical success for all TAE. Catheterizations of the vasa recta for the bleeding artery (jejunal artery, $n = 2$; ileal artery, $n = 5$) were performed using a 1.7-Fr catheter through the turn branch into the arcuate vessels (number of arcuate vessels, 2–5; mean, 4). Each embolization required one or two coils, with a mean total length of 10 cm. Embolization efficacy was high in three patients with coagulopathy. No rebleeding, intestinal ischemia, or necrosis was observed in the follow-up capsule endoscopy. We confirmed that peptic ulcers/ulcer scars caused bleeding in six patients and one patient had angiodysplasia.

Conclusion

Ultrasensitive embolization using 1.7-Fr catheters and 0.010-inch coils enabled the catheterization of extremely tortuous and/or multiple loops of arcuate vessels and the vasa recta, thereby leading to increased embolization success rates with low complication rates. Thus, thin catheters and soft bare coils are useful for embolization to treat acute small intestinal bleeding, and post-embolization follow-up capsule endoscopy is essential.

P-171

Sublingual glyceryl trinitrate improves prostate artery visibility on CTA performed preoperatively for prostate artery embolization

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Purpose

Prostate artery embolization (PAE) is emerging as a safe and efficacious treatment for symptomatic benign prostatic hyperplasia (BPH) but remains a challenging procedure principally due to the complex and variable anatomy of the prostatic arteries. We present a case-control study investigating the use of sublingual glyceryl trinitrate (GTN) to improve the quality of CTA performed preoperatively for PAE.

Material and methods

Patients were identified from an ongoing prospective cohort of patients undergoing PAE (STREAM Trial). Cases where patients received pre-CTA GTN were compared with those where consecutive patients did not receive GTN. CT angiograms were examined for prostate artery visibility, contrast density (Hounsfield units), and cross-sectional area. These were also correlated with PAE technical success, screening time, and radiation dose.

Results

A total of 32 prostate arteries were examined on CTA. GTN administration was shown to significantly improve the proportion of scans confidently demonstrating the whole prostate artery (88% vs. 44%,

OR=0.1, $P=0.023$) and the cross-sectional area of the prostate artery (2.5 vs. 1.7mm²) (95% CI=0.08–1.6, $P=0.03$). There was also a significant reduction in the mean procedural dose in patients receiving GTN (1.5 vs. 2.7Gy, $P=0.008$). There was no significant difference in prostate artery density, screening time, or technical success. No adverse events were recorded in either group.

Conclusion

CTA is a highly useful tool for the procedural planning of PAE. The quality of preoperative CTA with regards to confidently demonstrating the prostate artery anatomy is significantly increased by the administration of sublingual GTN without any increase in adverse events.

P-172

Percutaneous transcatheter arterial embolization of upper and lower gastrointestinal bleeding using n-butyl-2-cyanoacrylate

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Purpose

The purpose of this study is to evaluate the technical and clinical effectiveness and safety of superselective transcatheter arterial embolization (TAE) with n-butyl-2-cyanoacrylate (NBCA) for acute nonvariceal upper and lower gastrointestinal tract bleeding.

Material and methods

TAE using NBCA was performed for 21 patients (13 male and 8 female patients; mean age, 60.9 years) with acute nonvariceal upper ($n=15$) and lower ($n=6$) gastrointestinal tract bleeding. Technical success, clinical success, clinical failure, major and minor complications, bleeding-related 30-day mortality, and overall in-hospital mortality were analyzed.

Results

Overall technical success rate was 100% (21/21). Overall clinical success rate was 72.2% (13/18). Uncontrolled bleeding, recurrent bleeding, and clinical failure rates were 11.1% (2/18), 16.7% (3/18), and 27.8% (5/18). Two patients with uncontrolled bleeding underwent surgical treatment and recovered. One of the three patients with early recurrent bleeding underwent repeated TAE successfully but expired due to progression of the underlying disease. Second patient received conservative treatment but died of continued bleeding, and the other patient underwent surgical treatment but died of acute respiratory distress syndrome. Minor complication rate was 16.7% (4/21), and no major complication was encountered. Three patients showed ischemic damage on treated lesions and one patient showed epigastric pain. Bleeding-related 30-day mortality and overall in-hospital mortality rates were 5.6% (1/18) and 28.6% (6/21), respectively. Two patients died of septic shock and one died of myocardial infarction within 30 days after TAE.

Conclusion

TAE using NBCA was safe and showed high technical and clinical effectiveness in the management of acute nonvariceal upper and lower gastrointestinal tract bleeding.

P-173

Radial versus femoral approach for peripheral artery embolization procedures in patients with acute bleeding

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Purpose

We aimed to assess whether the radial approach (RA) was superior to the femoral approach (FA) for peripheral artery embolization in patients with acute bleeding.

Material and methods

Eighty-two patients with acute bleeding were enrolled in our study from October 2013 to January 2017. Twenty-seven patients had hemoptysis, 22 had epistaxis, 10 had upper gastrointestinal hemorrhage, and 23 had uterine hemorrhage. RA was used in 42 patients, and FA was used in 40 patients. Clinical characteristics of the patients were comparable between the two groups. Patients were evaluated for the success and duration of the procedure, radiation exposure, major and minor complications, and the quality of life associated with the procedure.

Results

Embolization procedures were successfully performed in all patients. The duration of the procedure (51.3 vs 57.1 minutes, $p>0.05$), time needed for catheterization of the target arteries (28.3 vs 32.1 minutes, $p>0.05$), and radiation exposure (0.52 vs 0.59 mZv, $p>0.05$) were comparable among the patients with hemoptysis, epistaxis, and upper gastrointestinal hemorrhage in the two groups. All parameters evaluated were significantly lower among the patients with uterine hemorrhage in the RA group. The rate of major vascular complications was lower in patients in the RA group (0% vs 5%) than that in those in the FA group. RA was associated with a statistically significant reduction in all parameters of procedural discomfort.

Conclusion

Use of RA in patients with acute bleeding undergoing peripheral artery embolization provides a significant reduction in the rate of vascular complications and procedural discomfort. RA significantly reduces the duration of the procedure and radiation exposure among patients with acute uterine hemorrhage.

P-174

Coil technique for short abdominal arterial segment: balloon-assisted coil embolization (BACE)

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Purpose

To evaluate the safety and feasibility of coil embolization for short abdominal arterial segments with proximal balloon inflation or combined proximal and distal inflation as well as to determine the volume embolization ratio (VER) and the ratio of the first coil diameter to the target vessel diameter (first coil diameter ratio).

Material and methods

From January 2014 to August 2016, we performed coil embolization of the short segment in 7 patients using 0.010–0.012 inch detachable microcoils. The target vessels were the common hepatic arteries before distal pancreatectomy with en bloc celiac axis resection in 5 patients, the superior mesenteric artery for isolation of the pseudoaneurysm in 1 patient, and the celiac trunk for preventing type II

endoleak before endovascular aortic repair in 1 patient. We evaluated VER and the first coil diameter ratio after single balloon-assisted coil embolization (single BACE) with only proximal balloon inflation and double BACE with both proximal and distal balloon inflation.

Results

Single BACE was performed in 4 patients. Double BACE was performed in 3 patients. All embolizations were completed safely. The median VER was 12.1% (single BACE; mean 11.7% and double BACE; mean 12.4%). There was no statistically significant difference in VER between the two groups (t-test). The median first coil diameter ratio was 1.82 in both groups.

Conclusion

Coil embolization was safely performed by BACE. We achieved sufficient friction to prevent coil migration by choosing detachable microcoils with a median diameter 1.82 times larger than that of the target vessel and VER $\geq 12\%$, allowing us to embolize short vascular segments.

P-175

Comparison of complications and treatment results between the first and last decade in the 20-year endovascular treatment of body and extremity arteriovenous malformations (AVMs)

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Purpose

To investigate the complication rate and treatment result in the first and the last decade of AVM treatment.

Material and methods

In this study, 306 patients with body and extremity AVMs who were treated from 1996 to 2016 were analyzed for complications and clinical results. In total, 912 sessions of embolization were performed for 306 patients (M: 137, F: 169 patients). The first decade included 107 patients (group A) and the last decade included (group B) 199 patients. AVMs were classified according to the angiographic findings. Complication rates, number of treatment sessions, and treatment results were compared between the two groups.

Results

Angiographic types of 306 AVMs were as follows: type 1 (n=6), type 2 (n=83), type 3a (n=16), type 3b (n=117), type 3a + 3b (n=48), type 2 + 3 (n=35), and complex (n=1). Complications in groups A and B were similar with respect to minor (group A: 22% and group B: 19.6%) and major complications (group A: 2% and group B: 2%). However, the number of treatment sessions was 4.6 for group A and 2.3 for group B, which was reduced by 45%. The rate of treatment failure was 9.3% for group A and 1.5% for group B. Cure or markedly improved results were observed in 54% patients in group A and 63% patients in group B.

Conclusion

With the accumulation of AVM treatment experience, the number of treatment sessions and rate of treatment failure were significantly reduced.

P-176

Prostatic artery embolization for benign hyperplasia: outcome after the 1-year follow-up in 25 consecutive cases performed at a single center

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Purpose

To present the outcome observed after a 1-year follow-up of a series of 25 patients with benign prostate hyperplasia treated consecutively with prostatic artery embolization as an alternative to surgery.

Material and methods

Between January and December 2015, 25 patients (mean age 65.4 years) with lower urinary tract symptoms due to benign prostatic hyperplasia and refractory to medical therapy underwent prostatic artery embolization. All patients were evaluated with specific questionnaires to determine the severity of symptoms and impact on quality of life and erectile function, pelvic ultrasound and MRI, urinary flowmetry, and PSA before the procedure (baseline) and 30 days and 1 year after the procedure. Procedures were performed in an outpatient condition with local anesthesia and mild sedation through the right femoral vascular access. Tris-acryl gelatin microspheres in the range of 300–500µm were used as an embolic agent in all cases.

Results

Embolization was successful in all patients; in 23 cases, embolization was achieved bilaterally and in 2 cases, only one side was embolized. The average time for completion of the procedure was 75 minutes, and the average radiation time was 32.4 minutes. The mean amount of contrast medium used was 135 ml. The most frequent origin of the prostatic artery was the common trunk with the vesical artery but various anatomical variations were found. Cone-beam CT was used in 16 cases whether to confirm or to discard the right vessel to deliver the embolic agent.

At 30 days, a mean reduction of 24.6% in prostate volume, 5.6 point improvement in IPSS, 2 point improvement in QOL, and 3 point improvement in IIEF was observed. The peak urinary flow improved 51% and PSA dropped 39%. No major complications that resulted in unscheduled hospitalization or that needed additional surgical procedure were observed. Minor adverse events were verified and easily resolved in 10 patients. Four patients (16%) needed to continue their medication and were considered unsuccessful cases. At the 1-year follow-up, there were no significant changes in clinical parameters in comparison to those observed after 30 days. At this time, 8 patients (32%) needed to continue or needed reintroduction of their medication.

Conclusion

Prostatic artery embolization as an alternative treatment to surgery for patients with BPH and LUTS was safe and effective in improving symptoms. Most clinical improvement was observed during the initial 30 days post procedure and remained for 1 year in approximately 70% patients.

P-177

Left gastric artery embolization in 4 obese patients: results after a 6-month follow-up

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Purpose

To report the 6-month data of a feasibility study (having safety as a primary endpoint) of left gastric artery (LGA) embolization in obese patients.

Material and methods

Four obese patients, including two males, with an average age of 38.5 years accepted to participate in the IRB-approved clinical study and underwent LGA embolization. Average weight was 130.25 kg and the average BMI was 40.24 kg/m². Changes after the procedure were assessed with upper endoscopy, SF36 for QOL, and blood assays. Procedures took place under local anesthesia and mild sedation via the right femoral (2), left radial (1), or right radial (1) access. Tris-acryl gelatin microspheres in the range of 300–500 µm were used. Procedure time and radiation time were recorded. Time to recovery, adverse events (AE), change in weight, and QOL were tracked after the procedure.

Results

Procedure time was 120 minutes (range 55–140) and radiation time was 48 minutes (range 32–74). Only minor adverse events were reported by 3 patients. P1 referred acute gastric pain 7 days after the procedure. P2 had a vomiting crisis 8 hours after the procedure that improved with oral medication. UE performed 1 week later revealed a gastric ulceration Forrest III that healed with medical treatment. P4 implied gastric discomfort. UE showed small erosions in the gastric mucosa. After 6 months, the average weight loss was 8.75 kg. QOL assessed 6 months after the procedure showed no significant changes.

Conclusion

LGA embolization in obese patients seems to be safe, but its role as an alternative for weight loss in obese patients should still be investigated.

P-178

When the prostatic artery does not originate from hypogastric branches, what to do for attaining good results in prostatic artery embolization?

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Purpose

The angiographic pelvic anatomy has a high variability, and its knowledge is crucial for PAE. The prostatic artery does not always originate from internal iliac artery branches (type-I–IV-USP classification) and can have less common origins (type-V). The purpose of this study is to assess, through a multicentric evaluation, the prevalence of type-V prostatic arteries and the technical changes and results of PAE.

Material and methods

Angiographic prostatic arteries (USP classification) were used to retrospectively assess type-V arteries in 444 PAE procedures. PAE was performed according to the PERFeCTED technique with 100–300 or 300–500 µm Embosphere microspheres in patients with BPH and LUTS. Cone-beam CT was used in every case.

Results

The prevalence of type-V was 15/441 (3.4%). When re-embolization was considered, type-V was observed in 21/444 (4.7%). One case was due to agenesis of the right internal iliac artery (0.2%) and the prostatic artery originating directly from the external iliac artery. In 6 patients, type-V arose from the accessory internal pudendal (1.4%), in 4 patients, from the inferior epigastric artery (0.9%), in 2 patients, from the inferior gluteal artery (0.4%), in 1 patient, from the inferior mesenteric artery (0.2%), and in another patient, from the trifurcation of the internal iliac anterior trunk (0.2%). In cases of re-PAE, type-V was observed in 5 (1.3%) cases from the accessory internal pudendal and in 1 case (0.2%) from the inferior gluteal artery.

Conclusion

The knowledge of angiographic anatomy is imperative to PAE success. Not recognizing type-V prostatic artery can lead to unnecessary catheterization of multiple vessels, which increases the procedure time and use of mdc and radiation exposure. Cone-beam CT should be used to confirm prostate vascularization and evitate non-target embolization. Good clinical results can be obtained through expert hands.

P-179

Cholangiocarcinoma tumor burden prior to TACE: the value of 3D quantitative analysis to predict survival

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Purpose

To evaluate the role of 1D, 2D, and 3D tumor burden and enhancement measurement techniques on the overall survival (OS) rate in patients with cholangiocarcinoma (CC) before transarterial chemoembolization (TACE).

Material and methods

Seventy-three patients with intrahepatic cholangiocarcinoma and follow-up after conventional TACE were retrospectively enrolled into this study from 2000 to 2014. 1D and 2D measurements were performed on baseline MRI. Additionally, 3D quantitative tumor analysis was performed by assessing enhancing tumor volume [ETV (cm³)] and enhancing tumor burden [ETB (%)] and ratio between ETV (cm³) and total liver volume [(TTV) (cm³)]. Patients were divided into low tumor burden (LTB) or high tumor burden (HTB) groups based on receiver operating characteristic curve (ROC) cut-offs, and hazard ratios (HR) and Kaplan–Meier plots were then analyzed for these groups.

Results

Survival curves revealed good separation for ETV and TTV ($p < 0.05$). OS in the LTB group based on ETV, TTV, and ETV was 1.7, 1.8, and 1.3 times, respectively, longer than those in the HTB group ($p < 0.05$). Survival curves for maximum cross-sectional area demonstrated a 1.6 times longer OS in the LTB group (16.0 vs. 9.7 months). OS in the LTB group based on maximum enhancing tumor area, overall tumor diameter, and enhancing tumor was 1.6, 1.5, and 1.3 times, respectively, longer than those in the HTB group.

Conclusion

Good separation of survival curves between LTB and HTB patients could be achieved using ETV, TTV, and maximum tumor cross-sectional area. 3D volumetric-based measurements of the lesions provide stronger OS predictors in patients with cholangiocarcinoma.

P-180

Non-alcoholic direct puncture sclerotherapy for patients with venous malformation: discrepancy between patient-based and MRI-based evaluation

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Purpose

The aim was to evaluate the safety and efficacy of non-alcoholic direct puncture sclerotherapy (STS and polidocanol) in patients with venous malformation (VM) and to clarify the benefits and limitations of non-alcoholic direct puncture sclerotherapy.

Material and methods

We treated 127 patients. Under fluoroscopic guidance, lesions were directly punctured using a 23-gauge needle, and 3% STS or 3% polidocanol mixed with the contrast media in foam style was injected. Therapeutic responses were classified by patient- and MRI-based evaluation into excellent, good, and poor.

Results

Results by patient-based evaluation were significantly better than those by MRI-based evaluation ($p < 0.01$). Non-alcoholic direct puncture sclerotherapy was judged to be significantly more beneficial in patients with pain indication than in those with cosmetic indication ($p < 0.01$).

Conclusion

Non-alcoholic direct puncture sclerotherapy was judged to be beneficial in 62% patients by MRI-based evaluation and in 82% patients by patient-based evaluation. Patient satisfaction was greater than imaging improvement, particularly in the treatment of painful VMs.

P-181

Aspiration thrombectomy of fulminant pulmonary embolisms in patients primarily unsuited for conventional intravenous anticoagulation treatment

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Purpose

Review of interventional treatment of high-risk patients with acute pulmonary artery embolism by aspiration thrombectomy as an alternative to standard i.v. thrombolysis and surgical embolectomy (Trendelenburg procedure).

Material and methods

Six high-risk patients with acute pulmonary artery embolism and contraindications for i.v. thrombolysis were treated with local aspiration thrombectomy using the Indigo mechanical thrombectomy system (CAT8 aspiration catheter and SEP8 guidewire) by Penumbra Inc.

Results

All patients exhibited a decrease in pulmonary artery pressure, a reduction in catecholamine requirement, normalization of heart rate (< 100 bpm) and systolic blood pressure (> 100 mmHg), an increase in peripheral oxygen saturation ($paO_2 > 96\%$), and a reduction in the required inspiratory oxygen fraction (FiO_2) of the respirator unit. It has become apparent that clinical, therapeutic, and local parameters are indicative for planning, exercising, and evaluating the success of the interventional procedure as opposed to mere imaging results.

Conclusion

Interventional treatment of high-risk patients with acute pulmonary artery embolism by aspiration thrombectomy presents a viable and low-risk alternative as well as a potent addition to standard i.v. treatment and surgical embolectomy. In patients with contraindications to either of the standard treatments, particularly in neurosurgical patients and patients who have responded poorly to i.v. thrombolysis, it warrants special consideration. Surgical treatment, in turn, has a high risk of mortality. Current literature merely shows small cohort studies and case reports. Further studies will be necessary as present data does not permit a broader analysis.

P-182

Transcatheter coil embolization of the pancreaticoduodenal artery aneurysms: a single-center experience

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Learning Objectives

We evaluated the safety of transcatheter coil embolization (TCE) of pancreaticoduodenal artery aneurysms (PDAA).

Background

High flow through the pancreaticoduodenal arcade in patients with celiac artery stenosis or occlusion may elicit peripancreatic artery aneurysms.

Clinical Findings/Procedure

We coil embolized 23 patients with PDAA (size range 12–32 mm, average 16 mm). Celiac axis stenosis was due to median arcuate ligament compression (MALC, n=20) or segmental arterial mediolysis (SAM, n=3). Three patients suffered PDAA rupture; in 2, it was due to SAM, and in 1, it was due to MALC. When the aneurysmal neck size was less than half the aneurysmal short axis, we used packing only, and when it was more than half the short axis, we embolized vessels distal and proximal to PDAA (isolation). Nine patients underwent coil packing of the aneurysmal sac only to preserve the native arterial circulation; 6 of the remaining 14 underwent isolation with simultaneous stenting of the stenotic celiac axis. Antiplatelet administration was stopped in 2 patients with celiac stent occlusion due to varicose veins of the lower extremities or hypermenorrhea. All PDAA were successfully excluded. Two patients with isolation of the transverse or dorsal pancreatic artery developed acute pancreatitis; 1 who underwent coil packing developed coil compaction after 6 months and underwent a 2nd coil embolization. There were no other complications.

Conclusion

TCE is an effective alternative treatment for patients with PDAA. Coil packing of saccular aneurysms is particularly effective, and isolation with metallic stent angioplasty is useful in patients with celiac axis stenosis.

P-183

US-guided direct puncture embolization of the inferior epigastric artery: an extreme salvage technique in the treatment of rectus sheath hematoma

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Learning Objectives

Direct puncture embolization of the epigastric artery has been suggested to represent an effective alternative to transfemoral arterial embolization in patients who require treatment for rectus sheath hematoma. The objective of this report is to present an innovative and extreme technique for recurrent rectus sheath hematoma with a previous failed embolization.

Background

Recurrent rectus sheath hematoma was treated by coil-assisted embolization of the inferior epigastric artery using sonography-guided direct puncture because the artery was inaccessible via the endovascular route due to a prior partial embolization.

Clinical Findings/Procedure

Recurrent rectus sheath hematoma was treated by coil-assisted embolization of the inferior epigastric artery using sonography-guided direct puncture because the artery was inaccessible via the endovascular route due to a prior partial embolization.

Post-embolization control Doppler imaging revealed total closure of the artery. There was no recurrence in the first week, and almost complete resorption of the hematoma was observed at the 1-month follow-up examination.

Conclusion

Endovascular coil-assisted embolization of the inferior epigastric artery is a safe and effective technique for the treatment of rectus sheath hematoma. Under the circumstances of failed catheterization of the artery, direct puncture of the artery may be considered as an alternative to surgery. Furthermore, lower fluoroscopy time and minimal usage of contrast medium are the advantages of this new technique, possibly making it the first choice for access in pregnancy. Its disadvantage is the necessity of experience with probe-needle cooperation.

P-184

Rare intra-abdominal haemorrhage from omental lipoma: review of 3 cases

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Background

We describe 3 cases with clinical signs and symptoms of intra-abdominal bleeding. All patients were male, with their age ranging from 50 to 71 years. CT mesenteric angiogram demonstrated fat-containing omental masses displacing the bowel loops. Active haemorrhage was noted in 2 cases. Conventional angiography confirmed aberrant foregut arterial supply from branches of the splenic artery and superior mesenteric artery.

Clinical Findings/Procedure

All 3 patients clinically presented with cardiovascular shock. Active contrast extravasation on the arterial phase and pooling on the delayed phase were noted to arise from lipomatous omental lesions on CT mesenteric angiograms performed for cases 1 and 2. No active contrast extravasation was noted for case 3.

Conventional angiography and selective catheterisation of the celiac trunk revealed an aberrant gastroepiploic vessel arising from the terminal branch of the splenic artery, terminating blindly within the lipomatous omental masses. Super-selective embolisation, which halted extravasation, was performed.

Histological analysis of 1 patient confirmed the diagnosis of omental lipoma.

Conclusion

Omental lipoma is rare. We report a series of cases with active extravasation from omental lipoma. The source of haemorrhage was the branches of the foregut arteries (the terminal branches of the splenic artery and a branch of the superior mesenteric artery) supplying the omental lesions. Super-selective embolisation achieved the cessation of haemorrhage and led to full recovery.

P-185

Spontaneous psoas muscle hemorrhage in anticoagulated patients: superselective transcatheter arterial embolization technique

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Background

Spontaneous psoas muscle hemorrhage in anticoagulated patients could be a life-threatening condition. The hematomas originate

from tears in muscle fibers and are rarely bilateral. Patients with a hemodynamically unstable condition and MD-CT signs of active bleeding require urgent medical and invasive treatments. In these cases, surgical intervention is limited by the inability to localize the bleeding vessel(s). Nowadays, superselective transcatheter arterial embolization is considered the first-line treatment procedure.

Clinical Findings/Procedure

In patients with anticoagulation-related spontaneous psoas muscle hemorrhage, MD-CT is the gold standard imaging technique because it identifies the location and number of active bleeding sites. In this poster, we 1) illustrate the arterial anatomy of psoas muscles, selective angiography of the lumbar and posterior branch of the internal iliac artery, and the reason for superselective catheterization and 2) discuss the technical aspects of the embolic materials used to stop active bleeding in the feeding artery of psoas muscles.

Conclusion

Superselective transcatheter arterial embolization of spontaneous psoas muscle hemorrhage in anticoagulated patients is safe and feasible, with a satisfactory efficacy if performed using the correct technique.

P-186

Sorting out vascular lesions and understanding their treatment concept

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WITHDRAWN

P-187

Endovascular management of ruptured/unruptured true pancreaticoduodenal arcade aneurysms caused by median arcuate ligament syndrome

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Learning Objectives

To discuss the safety and efficacy of the endovascular approach for ruptured/unruptured true pancreaticoduodenal arcade (PDA) aneurysms caused by median arcuate ligament syndrome (MALS).

Background

We retrospectively reviewed 12 consecutive patients from January 2010 to April 2016 who had ruptured/unruptured true PDA aneurysms due to MALS. These patients were treated with transcatheter embolization, although the celiac stenosis itself was not treated. We discuss the embolization procedure used, the imaging findings, the success rate of embolization, and the follow-up outcomes.

Clinical Findings/Procedure

We identified six ruptured and six unruptured aneurysms (mean size 4 mm, maximum 12 mm) located on the anterior PDA (n = 5), posterior PDA (n = 3), inferior PDA (n = 3), and dorsal pancreatic artery (n = 1). Computed tomography revealed compression of the celiac artery, and all the ruptured cases had peripancreatic hematomas. Embolization with coil/glue was successful in all the ruptured cases; the unruptured aneurysms were treated by coil embolization using the neck preservation/isolation technique. Postprocedural angiography revealed the severity of the hemodynamic changes via the non-embolized vessels, excluding those treated by the neck preservation technique. No complications were observed during the follow-up (mean 14 months).

Conclusion

Complete occlusion must be rapidly achieved for ruptured PDA aneurysms. Unruptured aneurysms were treated by preserving the native arterial circulation as far as possible, which should always be

considered with any aneurysmal size. Embolization for PDA aneurysms is a safe procedure. A long follow-up period is essential post-embolization in case of possible new, flow-related aneurysmal formation.

P-188

Use of ultrasound with microbubbles as a control imaging method after prostatic artery embolization for benign prostatic hyperplasia

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Learning Objectives

To describe the importance of contrast-enhanced ultrasound as a control imaging method after prostatic artery embolization.

Background

The use of microbubble contrast has been expanding everyday in interventional radiology for procedures such as collection drainages, biopsies, and ablation. In the field of endovascular intervention, it has been used with increasing frequency in the evaluation of endoleaks and arteriovenous fistulas. The embolization of prostatic arteries is an interventional technique used to treat benign hyperplasias, the indications of which have become progressively more frequent. In this context, contrast-enhanced ultrasound is a non-invasive imaging method that is useful for the evaluation of prostatic ischemia.

Clinical Findings/Procedure

Microbubble ultrasound is a simple, minimally invasive procedure. Venous injection of 1.0–1.5 cc of sulfur hexafluoride 8 µL/mL (SonoVue, Bracco, Milan, Italy) is followed by transabdominal prostatic ultrasound. Normal prostate is highly vascularized, although embolized glands present as totally or almost totally ischemic, with the absence of the contrast media in prostatic tissues.

Conclusion

The use of contrast-enhanced ultrasonography is safe and effective. This minimally invasive procedure can be used for the evaluation of the efficacy of prostate artery embolization procedures, adequately identifying the reduction of glandular vascularization, with a potential application in the follow-up of individuals submitted to this transarterial technique.

P-189

Detachable coil embolization of visceral artery aneurysms using adjunctive techniques: a pictorial review

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Learning Objectives

To describe the devices, technical preferences, and tips for embolization of visceral artery aneurysms (VAAs).

Background

Since its first introduction in the field of aneurysm treatment, coil embolization has increasingly been used with good outcomes in most intracranial aneurysms with the use of detachable coils. Unlike intracranial aneurysms, most VAAs are large and have a wide neck.

Some aneurysms, which originate at the bifurcation and have a few efferent branches near the neck of the aneurysm are more challenging; however, as various devices such as neck-protecting devices, steerable microcatheter, and brand new detachable coils are becoming available, these aneurysms are no longer a contraindication for sac packing.

Clinical Findings/Procedure

We present a pictorial review of various kinds of devices, adjunctive techniques, and tips for procedures. The main objective is to review standard techniques and focus on adjunctive techniques, including balloon neckplasty technique, stent-assisted technique, double microcatheter technique, double balloon technique, and combination of adjunctive techniques. Tips for procedures, such as how to place the microballoon catheter across the neck, reshaping of the microcatheter, barrel view, and how to select the coils, will also be addressed. Utilizing cases, adjunctive techniques will be reviewed to provide a detailed understanding of strategies.

Conclusion

In the treatment of VAAs, a firm understanding of adjunctive techniques and various tips is critical to achieve tight packing of aneurysms and prevent coil compaction. Coil embolization of VAAs is a safe and feasible treatment option.

P-190

Pulmonary artery pseudoaneurysm: CT and angiography findings and treatment

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Learning Objectives

We will show patients' presentation and their CT and angiography findings. We will review treatment methods and clinical outcomes for various types of pulmonary artery pseudoaneurysms.

Background

Hemoptysis is a potentially life-threatening condition. CT is very useful for the initial assessment of hemoptysis. CT shows the underlying lung parenchyma abnormality and the abnormally dilated systemic arteries that may require embolization. In addition, CT can also be useful in the evaluation of hemoptysis of the peripheral pulmonary artery origin. Despite the fact that pulmonary artery pseudoaneurysms are uncommon, an awareness of pulmonary artery pseudoaneurysm is important because its treatment is different from that of hemoptysis originating from bronchial or non-bronchial systemic collateral arteries.

Clinical Findings/Procedure

Underlying lung abnormalities of the patients were tuberculosis, mycetoma, necrotizing pneumonia, and lung cancer on radiation therapy. CT finding was analyzed by means of axial, MPR, and MIP images. Pulmonary artery and/or bronchial or non-bronchial systemic collateral arterial angiographies were performed. Endovascular treatment was performed by direct embolization of pulmonary artery pseudoaneurysm or embolization of bronchial or non-bronchial systemic collateral arteries using microcoils, n-butyl cyanoacrylate, or PVA particles. Immediate hemostasis was successfully achieved, and pulmonary artery pseudoaneurysms disappeared on follow-up CT scans.

Conclusion

The treatment of hemoptysis from the peripheral pulmonary artery pseudoaneurysm can be different from that of hemoptysis originating from the bronchial or systemic artery. Familiarity with CT findings of the pulmonary artery pseudoaneurysm is necessary to facilitate appropriate and prompt diagnosis and treatment of patients with hemoptysis.

P-191

Standard and alternative embolisation techniques in hepatic artery lesions: an iconographic essay

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Learning Objectives

1. To illustrate different modalities of endovascular treatment of lesions in the vascular tree of the hepatic artery.
2. To illustrate possible pitfalls in the treatment of these injuries.
3. To discuss endovascular treatments, including different materials and techniques.

Background

Hepatic artery aneurysm and pseudoaneurysm are rare but important entities with a high morbimortality. They are the second most common visceral aneurysms and account for approximately half the pseudoaneurysms. Endovascular treatment is the first line treatment for such lesions. Different materials and techniques have been used depending on the characteristics and location of the lesions. Currently, the standard treatment for visceral pseudoaneurysms is the exclusion of the lesions by coils along the pseudoaneurysm and aneurysm necks (sandwich technique). Other techniques and materials have been used to preserve parent vessel permeability.

Clinical Findings/Procedure

We present an iconographic essay with different lesions and techniques, with emphasis on the preservation of hepatic circulation. Fibered coils, bare platinum coils, hydrocoils, and glue were used. We presented a review of the literature and discussion in relation to our case series.

Conclusion

Hepatic artery aneurysm and pseudoaneurysm are uncommon lesions, and endovascular treatment is the preferred option. Good results can be obtained using the appropriate technique. Materials and different options and pitfalls must be known and have been exposed in this iconographic essay.

P-192

Role of interventional radiology in the management of pelvic vascular emergencies

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Learning Objectives

1. To understand the role of interventional radiology in managing pelvic vascular emergencies.
2. To understand the role of various embolic agents in various emergent situations.

Background

Pelvic vascular emergencies can occur in a wide range of conditions, ranging from pelvic trauma to postpartum states. Whilst some cases can present as emergencies, others have a more insidious onset, thus presenting as a semi-emergency. Their early recognition is important to ensure that the appropriate treatment is instituted at the right time, thus improving patient outcomes. Sound knowledge of various interventional techniques is essential to achieve this.

Clinical Findings/Procedure

We will discuss the presentation of various emergencies, including a brief description of their diagnosis on imaging. Images from both cross-sectional and angiographic studies will be provided to illustrate various important points pertinent to their management. This

will include various embolization techniques, and the use of various embolic agents, which are commonly used, such as coils, gelfoam, and glue. Various practical tips and tricks will be discussed, which will be instructive to both beginner and advanced interventionalists.

Conclusion

Early recognition and management of pelvis vascular emergencies is of paramount importance to reduce both mortality and morbidity. This requires the interventionalist to be aware of various techniques and equipment to successfully undertake the cases.

P-193

Investigation of the artery responsible for hemorrhage after prostate cancer robotic surgery

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Learning Objectives

To investigate the artery responsible for hemorrhage after prostate cancer robotic surgery.

Background

Unlike general prostatectomy, in robotic surgery, the arm reaches the retroperitoneal cavity via the peritoneal cavity. The peritoneum is not sutured; thus, communication between the two cavities is maintained. Therefore, postoperative hemorrhage may become lethal. The prostate is mainly supplied by the internal pudendal artery and the inferior vesical artery, but these arteries are carefully ligated during the surgery. On the other hand, during lymphadenectomy, the obturator artery (OA) may be damaged. Because of OA anastomoses with the inferior epigastric artery (IEA), sometimes hemorrhage cannot be identified by angiography through the internal iliac artery.

Clinical Findings/Procedure

We experienced two cases of transarterial embolization of intrapelvic arterial hemorrhage after prostate cancer robotic surgery. Extravasation was observed on CT in both cases, but the responsible artery was not identified. In the first case, angiography through OA revealed no extravasation. Cone-beam CT from the external iliac artery revealed extravasation from the pubic branches of IEA. In the second case, extravasation was confirmed by angiography through OA. In both cases, NBCA was injected into the responsible artery and hemostasis was achieved.

Conclusion

After obturator lymphadenectomy under robotic surgery, branches of the external iliac artery may become responsible for pelvic hemorrhage; therefore, it is important to grasp the details of anastomosis of the pelvic artery. We will review our experiences of two cases anatomically and study the potential arterial network in the pelvis that we should know before performing embolization.

P-194

Direct percutaneous puncture embolization of a short gastric artery pseudoaneurysm using ultrasound-guided injection of an ethylene vinyl alcohol copolymer: a case study and technical note

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Learning Objectives

We describe a novel technique involving direct stick and visualization of the ethylene vinyl alcohol (EVOH) copolymer (Onyx; ev3 Endovascular, Inc., Plymouth, Minnesota, USA) embolization

for achieving hemostasis under real-time ultrasound guidance using an 18-gauge needle for treating a rare short gastric artery pseudoaneurysm.

Background

Short gastric artery pseudoaneurysms are infrequently reported. Endovascular access and embolization can be technically challenging because of hostile anatomy and small vessel size.

The EVOH copolymer is a non-adhesive liquid embolic agent most commonly used for endovascular embolization, with delivery using a microcatheter under fluoroscopic guidance. It is used in the embolization of endoleaks, AVMs, aneurysms, and pseudoaneurysms amongst other lesions.

To our knowledge, the use of direct percutaneous needle puncture for delivery of the EVOH copolymer and direct ultrasound observation of the embolization endpoint have not been previously described.

Clinical Findings/Procedure

Direct puncture of the pseudoaneurysm was performed under ultrasound guidance using an 18-gauge needle. On injection of the EVOH copolymer, a cascade of hyperechoic particles was observed swirling within the aneurysmal sac. Under direct observation, hemostasis was gradually achieved. The 18-gauge needle was removed without resistance. Immediate upper-abdominal CT revealed the EVOH copolymer within the aneurysmal sac and no non-target embolization. Follow-up imaging 4 months postembolization demonstrated no flow within the aneurysm.

Conclusion

Visceral artery pseudoaneurysm embolization with the EVOH copolymer using the direct puncture technique under ultrasound guidance and observation is technically feasible. This technique may allow embolization in technically challenging situations in a safe and controlled manner.

P-195

Successful treatment of chylothorax after esophagectomy by ultrasound-guided intranodal lipiodol lymphangiography from the groin in two cases

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Learning Objectives

Chylothoraces after esophagectomy are critical complications that might be treated by lipiodol lymphangiography.

This can be safely and easily performed by ultrasound-guided inguinal intranodal lipiodol administration.

For persisting chylothorax, a direct puncture of the lipiodol-filled cisterna chyli should be attempted. This will potentially stop further chylous leakage (needle disruption technique) or allow further treatment options (e.g., thoracic duct embolization).

Background

Postoperative chylothoraces are infrequent complications after esophagectomy (incidence ~3%). Surgical repair is difficult because of the complex postoperative situs and anatomical topography. Therefore, an interventional treatment is preferable.

Minimally invasive lipiodol lymphangiography by inguinal lymph node cannulation may be a direct therapeutic approach, and in case of persistent chylothorax, it allows an image-guided puncture of the cisterna chyli for further treatment options.

Clinical Findings/Procedure

Two patients suffering from refractory chylothorax after esophagectomy received ultrasound-guided administration of 5–7 ml lipiodol into an inguinal lymph node.

In one patient, chylous leakage stopped right after lymphangiography without a need for further intervention. The other patient

showed persisting leakage; therefore, cone-beam CT-guided needle disruption of the lipiodol-enhanced cisterna chyli was performed. Again, chylous leakage reduced and stopped 3 days after intervention. Selective probing and embolization of the thoracic duct were not necessary. During these procedures, no complications were encountered.

Conclusion

For postoperative chylothorax, ultrasound-guided inguinal intranodal lipiodol lymphangiography is a minimally invasive and easily performed procedure with a high diagnostic and therapeutic value. If chylous leakage persists after lymphangiography, an image-guided direct puncture of the cisterna chyli is possible, which may also resolve the chylous leakage and allow further treatment options.

P-196

Endovascular treatment of hepatic artery aneurysm by detachable coils and self-expanding stents

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A 68-year-old non-smoking man with hypertension and sarcoidosis had a 2.4 cm aneurysm in the hepatic artery, as observed on CT. Detachable microcoils and uncovered self-expanding nitinol stents were used. The aneurysm was excluded, and all visceral arteries stayed open.

P-197

World's largest AVM

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A 40-year-old female presented with SOB, cardiac failure, a massive AVM covering her entire thorax, and numerous arterial feeding vessels and outflows. She was not amenable to surgery. After 5 staged interventions using innumerable coils, plugs, and liquid embolics, the patient now is asymptomatic and has a normalized cardiac function.

P-198

Preoperative embolization of a giant neurofibroma of the chest in a patient with neurofibromatosis type II

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Giant plexiform neurofibromas are difficult to manage surgically as they are extensively infiltrative and highly vascularized. A giant chest-wall neurofibroma in a patient with neurofibromatosis type II was successfully treated by preoperative intravascular embolization followed by surgical resection.

P-199

Giant iatrogenic femoral artery pseudoaneurysm treated with a percutaneous thrombin injection

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A 77-year-old woman presented with a 10-cm femoral artery pseudoaneurysm following balloon valvuloplasty for aortic stenosis. Using ultrasound guidance, 1200 I.U. of thrombin was injected, causing complete obliteration of the pseudoaneurysm with no complications.

P-200

Successful embolization of arteriovenous malformation secondary to chronic subclavian venous thrombosis after central venous catheter insertion

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Chronic venous thrombosis rarely develops subsequent to arteriovenous malformation (AVM). We report a case of AVM associated with chronic subclavian venous thrombosis. Initial venous sac of AVM was successfully embolized by direct puncture using coil, glue, and alcohol.

P-201

Embolisation for hepatic rupture secondary to the HELLP syndrome

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Hepatic rupture is a rare complication of the haemolysis, elevated liver enzymes, and low platelets syndrome. This case report describes the clinical and radiological features of this complication and the important role of hepatic artery embolisation in non-operative management.

P-202

Isolated pancreaticoduodenal vein injury from blunt abdominal trauma successfully treated by endovascular treatment

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A 33-year-old man who met with a motorcycle accident underwent a CT scan showing hemoperitoneum with pseudoaneurysm at the anterior side of the pancreas. Transhepatic superior mesenteric venography showed pancreaticoduodenal vein pseudoaneurysm. The patient was treated by coil embolization of the pancreaticoduodenal vein.

P-203

Percutaneous, transthoracic, ultrasound-guided embolization of a bronchial artery aneurysm

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A 71-year-old male with hemoptysis. Aneurysm lung left lower lobe. Bronchial angiogram, unable to catheterize the feeders of aneurysm. Percutaneous, transthoracic ultrasound-guided (collapsed lung) approach targeted with a 21-G Chiba needle. Embolization done with 25% NBCA/lipiodol under fluoroscopic guidance through a needle.

P-204

Emergency percutaneous glue embolization of a large iatrogenic pulmonary pseudoaneurysm

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A large iatrogenic pulmonary pseudoaneurysm developed during mitral valve replacement. Neither pulmonary angiogram nor bronchial arteriography showed viable vessels for endovascular embolization. An unusual direct percutaneous puncture of the lung was thus performed for successful embolization with coils and n-butyl-2-cyanoacrylate.

P-205

A ruptured bronchial artery aneurysm with an ectopic origin

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Spontaneous rupture of a right bronchial artery (RBA) aneurysm caused a large mediastinal pseudoaneurysm in an 82-year-old man. An emergent embolization of the RBA originating ectopically from the left thyrocervical trunk was successfully performed with the use of cyanoacrylate and coils.

P-206

Coil protrusion to the duodenum after embolization for a dissected common hepatic aneurysm

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A 46-year-old man who had a dissected common hepatic aneurysm underwent coil embolization. One-year later, he had abdominal pain, and coil protrusion to the duodenum was observed.

Conservative treatment was performed, and all coils were discharged spontaneously in 6 months.

P-207

Two cases of femoral skin necrosis after TAE for multiple trauma

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It is well known that gluteal skin necrosis is one of the major complications after TAE for pelvic trauma and that there is no report on femoral skin necrosis. It is crucial for interventional radiologists to know this complication.

P-208

Multiple enlarged aneurysms in primary racemose haemangioma of the bronchial artery: successful transcatheter arterial embolisation using n-butyl-2-cyanoacrylate and coils

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A 48-year-old man showed five enlarged aneurysms in primary racemose haemangioma of the right bronchial artery that were similar to the beans of a pagoda tree. All the aneurysms were successfully embolised with n-butyl-2-cyanoacrylate and coils.

P-209

Treating a complicated post-traumatic bleeding pelvic aneurysm: a dilemma

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A patient presented with a post-gunshot bleeding pelvic wound with an underlying aneurysm. Iliac stentgraft failed to stop the bleeding, and emergency laparotomy was performed. Three months later, endovascular embolization followed by percutaneous glue injection was performed to achieve hemostasis.

P-210

Emergency embolization of a ruptured pseudoaneurysm in a small bowel gastrointestinal stromal tumor with massive intra-abdominal hemorrhage

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WITHDRAWN

P-211

Percutaneous direct puncture embolization with n-butyl cyanoacrylate for an enlarged profunda femoris aneurysm after surgical ligation of the proximal artery

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We present a case of a profunda femoris artery aneurysm that showed continuous enlargement after proximal arterial ligation. The aneurysm was successfully treated with ultrasound-guided percutaneous direct puncture embolization of the distal artery and with n-butyl cyanoacrylate.

P-212

Successful superselective glue embolization of a ruptured omental artery aneurysm in a patient with fibromuscular dysplasia

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WITHDRAWN

P-213

Delayed hemothorax due to inferior phrenic artery injury after a blunt thoracic trauma

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WITHDRAWN

P-214

Severe complications following preoperative transarterial embolization of a giant retroperitoneal tumor: a case report

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A 54-year-old man presented with a giant left retroperitoneal tumor. He did not have high serum levels of adrenaline, noradrenaline, and dopamine. We performed preoperative transarterial embolization for the prevention of bleeding. This report describes severe complications following this procedure.

P-215

Median arcuate ligament syndrome complicated with celiac trunk occlusion and gastropancreatic arterial aneurysm

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Angiography performed in a patient with median arcuate ligament syndrome after surgical intervention showed occlusion of the celiac

trunk and an aneurysm arising from the division of the gastropancreatic arteries. Embolization was performed with coils and an uncovered stent.

P-216

Emergency treatment of ruptured pseudoaneurysm as a complication of necrotizing pneumonia

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Chest CT revealed necrotizing pneumonia of the right inferior lobe as well as an aneurysmatic arterial structure in the right inferior lobar artery. Angiography showed rupture of the pseudoaneurysm during the procedure, demanding emergency endovascular embolization with the Amplatzer device.

P-217

Hepatic vein injury treated with modified anchor technique embolization

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We discuss the management of the inadvertent injury of the right hepatic vein during chest drain insertion. The drain was exchanged for a sheath and the peripheral hepatic vein was successfully embolized with coils anchored into the liver parenchyma.

P-218

Preliminary experience with an MVP microcatheter-compatible vascular plug for immediate vascular occlusion

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Preliminary experience with MVP in Scotland. Ten MVP plugs were successfully deployed in pulmonary AVMs and main mesenteric vessels with a challenging anatomy. Excellent performance, immediate vessel occlusion with a high clinical success, and a significant cost benefit in comparison with coils were obtained.

P-219

Traumatic shattered horseshoe kidney managed with embolization: a review of anatomic variants

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A patient was injured in a motor vehicle accident. CT demonstrated complete laceration of a horseshoe kidney. Angiography demonstrated a feeding branch from the common iliac artery, which was embolized. We plan to discuss variant arterial anatomy of horseshoe kidneys.

P-220

A 4-D phase contrast MRI evaluation of portal vein velocity before and after splenic artery embolization in the setting of post liver transplant refractory ascites

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A 4-D phase contrast MRI is described as a technique for measuring portal vein velocity before and after splenic artery embolization in the setting of post-liver transplant refractory ascites. Additionally, concepts in splenic artery steal syndrome/portal vein hyperperfusion are reviewed.

P-221

Esophageal cancer patient with bronchial artery pseudoaneurysm resulting in an arterial-esophageal fistula treated with emergent embolic therapy

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A patient presented with massive hematemesis, shock (Hb 5.4 g/dL), and esophageal cancer. On gastroscopy, the bleeding point could not be identified, and on CT, a 1–2 cm mediastinal pseudoaneurysm was observed. Angiography showed direct connection between the right bronchial artery and esophageal lumen. Embolization was performed using NBCA–Lipiodol, and the patient was hemodynamically stabilized with an uneventful recovery.

P-222

Congenital pulmonary venolobar syndrome: embolization of an anomalous systemic artery

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A 47-year-old man had right-sided PAPVR draining into IVC and a right lower lobe supplied by the anomalous systemic artery from the abdominal aorta. We performed embolization of the anomalous systemic artery for decreasing the volume of the left–right shunt and preventing hemoptysis.

P-223

Balloon-occluded retrograde glue embolization for intractable lymphorrhea from bilateral iliac lymphatics following surgery for rectal cancer

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A 75-year-old male developed massive lymphorrhea after rectal resection. Because of multifocal leaks from multiple lymphatics, antegrade embolization of the feeding lymphatics was deemed technically difficult. The leakages were successfully treated by balloon-occluded retrograde embolization with n-butyl cyanoacrylate via the transperineal approach.

P-224

Micro-balloon-occluded retrograde transvenous obliteration via the left inferior phrenic vein for recurrent gastric varices

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A 71-year-old woman who underwent balloon-occluded retrograde transvenous obliteration had recurrent gastric varices with less developed outflow vessels. These varices were successfully treated using micro-balloon-occluded retrograde transvenous obliteration via the left inferior phrenic vein.

EVAR and TEVAR

P-225

Endovascular treatment of acutely ruptured thoracic dissections and aneurysms

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Purpose

To evaluate the efficacy of endovascular treatment of an acutely ruptured thoracic aorta.

Material and methods

From January 2010 to January 2017, a total of 21 patients (15 men, median age 69 years) with an acutely ruptured descending thoracic aorta were treated endovascularly. Nine patients had aortic dissection and the rest had aneurysm ruptures.

Results

The procedure was successful in all patients with percutaneous access in 18 patients (85.7%; Prostar-XL Device) and surgical exposure of femoral vessels in 3 patients. Twelve patients (57.1%) received a single endograft, 8 (38%) received 2 endografts, and 1 received 3 endografts. The endograft diameters ranged between 28 and 46 mm. The median coverage length was 167 mm (range: 150–328 mm). Two patients with dissection received additional distal extension with bare metal true lumen stents. The 30-day mortality in the group was 19% (4/21). Nine patients required drainage of thoracic hematoma. No type I endoleak was observed. One patient exhibited a possible type II endoleak from an intercostal artery, which thrombosed at a further follow-up. Three primary percutaneous sites required surgical revision. No stroke or spinal cord ischemic complications were observed.

Conclusion

Endoluminal repair of acute rupture of the descending thoracic aorta shows a 30-day mortality of 19% and can be performed percutaneously.

P-226

Radiation dose reduction in EVAR using low-dose protocols: initial results at a single center

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Purpose

To assess patient radiation dose reduction by low-dose protocols (LDP) during endovascular aortic repair (EVAR) at a single center.

Material and methods

We studied a sample of 32 consecutive EVAR procedures (median age, 77 years; range, 51–89 years), which were performed between June 2015 and January 2017. From March 2016 onward, Siemens X-CARE protocols were available as LDP. Parameters, including dose-area product (DAP), fluoroscopy time (FT), and body mass index (BMI), were analyzed. All procedures with more than 1/3 of FT using LDP were classified as belonging to the low-dose group (LDG), and all procedures with less than 1/3 of FT using LDP were classified as belonging to the normal-dose group (NDG). Procedural and follow-up data were analyzed for the presence of endoleaks.

Results

Eighteen cases were classified as NDG and 14 cases as LDG. Mean DAP differed significantly between NDG and LDG with $5789 \pm 8025 \mu\text{Gy}\cdot\text{m}^2$ vs. $2523 \pm 2540 \mu\text{Gy}\cdot\text{m}^2$ ($p=0.037$). Mean FT and mean BMI did not differ between NDG and LDG with 30 ± 15 min vs. 31 ± 8 min and $25 \pm 4 \text{ kg/m}^2$ in both groups. Post-procedural DSA endoleaks were seen in 6 cases of NDG and 4 cases of LDG. Endoleaks persisting through follow-up (median follow-up 113 vs. 12 days) were seen in 2 cases of NDG and LDG.

Conclusion

The use of LDP significantly reduces radiation dose in EVAR procedures without prolonging FT or impeding the success of the procedures.

P-227

Endovascular repair in abdominal aortic aneurysm with a hostile proximal neck anatomy: a single-center experience

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WITHDRAWN

P-228

Embolization of type II endoleaks with an ethylene-vinyl alcohol copolymer (EVOH, Onyx®): technical and clinical outcomes

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Purpose

To review the technical evolution and clinical outcome of endoleak embolization of type II endoleaks with EVOH.

Material and methods

A retrospective review of consecutive patients undergoing embolization of type II endoleaks with EVOH from 2009 to 2016 was performed. The approach used to access the endoleak nidus depended on its location and source. Retrograde branch catheterization was performed for the inferior mesenteric artery (IMA) and lumbar artery (LA). In the event of failed retrograde transarterial catheterization or if additional access to the endoleak was required, a direct approach was employed, including translumbar (TL), transabdominal (TA), and transarterial perigraft approaches. Patients were followed up for persistent/recurrent endoleaks and progression of the AAA cross-sectional area.

Results

Thirty-four consecutive patients (26 male, mean age 81 years) were enrolled. Access success rates by approach included 11 of 11 (100%) transarterial IMA, 12 of 20 (60%) transarterial LA, 12 of 12 (100%) direct TL/TA, and 14 of 15 (93%) transarterial perigraft attempts. No major adverse events were recorded. In total, 23 of 35 (65.7%) cases showed resolution of endoleak on follow-up imaging. There were 4 recurrent type II and one type I endoleaks (mean 7 months); 61% patients showed stability ($\pm 5 \text{ cm}^2$) or decrease ($\geq 5 \text{ cm}^2$) in the cross-sectional AAA area.

Conclusion

EVOH embolization is a safe and effective method for the treatment of type II endoleaks. We found a trend over time of abandoning the cumbersome TLA catheterization and direct TL approaches and in favor of the more efficient perigraft and direct TA approaches.

P-229

Endovascular treatment of limb occlusion after endovascular aneurysm repair

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Purpose

Limb thrombosis and subsequent occlusion of iliac arteries is a known and common complication after endovascular aneurysm repair (EVAR), reaching up to 5% in some series. The aim of this study is to demonstrate the safety, efficacy, and feasibility of endovascular recanalization of occluded iliac arteries after EVAR.

Material and methods

We performed a retrospective, observational analysis of 6 consecutive patients treated between the years 2010 and 2016 in two different medical centers. During this period, we performed 167 EVARs.

Results

We treated 5 men and 1 woman, with a mean age of 73 years (67–81). All the symptoms appeared within 6 and 12 months after EVAR. The clinical presentation was intermittent claudication in 67% (4 patients) and acute rest pain in 33% (2 patients). The devices implanted were 4 Zenith, 1 Endologix, and 1 Hercules. We used a direct stent with homolateral 6 F femoral accesses in 100% of cases, but the humeral access was also required in 1 patient. In all cases, a nitinol stent was implanted and post-dilation was performed. No lytic agents were used. All the patients received dual antiplatelet therapy after the procedure. Follow-up between 6 and 24 months showed no re-occlusion of the treated branch.

Conclusion

Limb occlusion is a common complication after EVAR. The endovascular treatment with direct stenting of the occluded iliac branch is safe and feasible and showed complete patency at the 6-month follow-up.

P-230

Efficacy of preoperative planning for TEVAR using the greater curvature measurement

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Purpose

To assess the accuracy of preoperative planning for TEVAR using the greater curvature (GC) measurement.

Material and methods

From January 2012 to December 2016, patients treated at our institution were retrospectively analyzed. Patients who were treated with more than two devices, those treated for aortic dissection, those treated for descending aortic pathologies, and those without proper preoperative and postoperative CT data were excluded. From preoperative CT data, virtual stentgraft images were created based on the center lumen line (CLL) and GC measurements. These virtual stentgraft images were superimposed on the postoperative CT to measure the misalignment between these virtual images and the actual stentgraft position. A statistical comparison using paired t-test was performed.

Results

A total of 15 cases were analyzed. Eleven were men. The average age of the patients was 76.4±5.6 years. The gap between the virtual stentgraft based on CLL and the actual stentgraft position was 27.8±9.6. The gap between the virtual stentgraft based on GC measurements and the actual stentgraft position was 3.9±6.5. There was a statistically significant difference ($p=0.00086$).

Conclusion

The aortic length based on GC measurement was extremely accurate.

P-231

In situ laser fenestration of aortic stentgrafts for complex aortic aneurysm using CTA image overlay: feasibility study

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Purpose

We investigated the feasibility, safety and effectiveness of performing laser-assisted in situ fenestration of the aortic stentgrafts (ISFAS) using CTA image overlay in endovascular repair of complex aortic aneurysm (complex-EVAR).

Material and methods

Between September 2016 and March 2017, thirteen patients were prospectively included for ISFAS in complex-EVAR. All interventions were performed using the same angiographic system and the same image fusion software by overlying the pre-operative arterial phase computed tomography on the per-operative fluoroscopy for a 3D road-mapping displaying the ostium of target vessels, except one for which image fusion was not feasible. Clinical, biological and imaging parameters were recorded.

Results

Aortic aneurysms were para-renal ($n=11$) and thoraco-abdominal ($n=2$). The median age was 69[Q1=67.5;Q3=70.75]years and aneurysm diameter was 57[54;60]mm. ISFAS was feasible in all patients with 1, 2 and 3 target vessels stented in respectively 3, 5 and 4 patients. We had one immediate complication (renal stent occlusion) and one fenestration failed. The median ischemic time per artery was 35[29;43]min for the superior mesenteric artery, 72[58.5;81]min

for the right renal arteries and 85[56;100]min for left renal arteries. The median times of intervention and fluoroscopy were respectively 180[142;187]min and 71[62;92]min. The median contrast volume injected was 95[60;110]mL and X-ray exposure was 278[193;552]Gy.cm². The median hospitalization stay was 9[7;13]days. Post-procedure creatinine and lactate levels remain stable. Two deaths occurred during the hospital stay.

Conclusion

ISFAS using CTA image fusion was feasible, safe and effective for complex-EVAR in this preliminary study.

P-232

Does endovascular aneurysm sealing (EVAS) affect postoperative follow-up results compared with endovascular aneurysm repair (EVAR)

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Purpose

The purpose of this study was to evaluate the risk of post-implantation syndrome (PIS) with endovascular aneurysm sealing (EVAS) and endovascular aneurysm repair (EVAR) in patients with abdominal aortic aneurysm (AAA).

Material and methods

Between January 2011 and December 2015, a total of 104 patients were treated at a single-center with EVAS ($N=41$) or EVAR ($N=63$) and were retrospectively compared for changes in metabolic activity as determined by changes and duration in body temperature, C-reactive protein (CRP) levels, white blood cell (WBC) count, and thrombocyte levels as an indication of PIS. The aneurysmal volume, sac size, and thrombus volume were measured on preoperative CT. Patients with suspected infections, ruptured aneurysms, or major vessel surgery were excluded from the analysis as were patients on medication that could influence CRP levels. Primary endpoints included elevated temperature, CRP levels, WBC count, and thrombocyte levels within 72 h post-procedure and 30-day mortality, endoleak, major adverse events (MAEs), and cardiovascular events.

Results

The incidence of PIS was 4.9% with EVAS and 20.6% with EVAR ($p=0.04$). The EVAS group also had lower perioperative body temperature ($p=0.04$), WBC count ($p<0.001$), and CRP levels ($p<0.001$). Clinical outcomes through 30 days tended to favor EVAS, including MAEs (12.2% vs. 22.2%, $p=0.30$), cardiac MAEs (0% vs. 11.1%, $p=0.04$), endoleak (0% vs. 12.7%, $p=0.02$), and mortality (0% vs. 1.6%, $p=1.0$). Significant changes could also be demonstrated in EVAR subgroups with polyester and PTFE fabric compared with that demonstrated by Nellix.

Conclusion

Compared with EVAR, EVAS was associated with lower PIS incidence, blunted inflammatory response, and lower cardiac complication and endoleak risks.

P-233

Use of a live 3-dimensional catheter navigation tool during EVAR: a single-center result assessing its beneficial role in reducing contrast-induced nephropathy and radiation hazard

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Purpose

This study aimed to evaluate the feasibility and potential benefit of using a live 3-dimensional (3D) catheter navigation tool during endovascular aneurysmal repair (EVAR) for the treatment of abdominal aortic aneurysms.

Material and methods

From 11.2015 to 12.2016, data on a total of 28 EVAR procedures were retrospectively collected and categorized into 2 groups: control group (EVAR performed without using the 3D navigation tool) vs. experimental group (EVAR performed using the 3D navigation tool). To evaluate the potential benefit of the 3D navigation tool, changes in the renal function between pre EVAR and post EVAR, amount of radiation during EVAR, and the results of EVAR were analyzed.

Results

Sixteen patients undergoing EVAR procedures were categorized into the control group and 12 patients undergoing EVAR procedures were categorized into the experimental group. There was no significant difference in the change in the renal function, amount of radiation, and time for EVAR. However, the change in the serum creatinine level after EVAR was slightly lower in the experimental group (-0.017mg/dl vs. -0.058mg/dl). The total amount of radiation dose in the experimental group was also lower than that in the control group (air-kerma: 382.86mGy vs. 190.55mGy and dose area product: $137223.0\text{mGy} \cdot \text{cm}^2$ vs. $53709.42\text{mGy} \cdot \text{cm}^2$). The total fluoro time (21min vs. 19min) and procedure time (76min vs. 59min) were also slightly shorter in the experimental group. Incidental occlusion of the internal iliac artery was observed during follow-up CT in 2 patients in the experimental group.

Conclusion

Although this preliminary result with a small patient sample size has failed to prove statistically significant advantage, we noticed that there would be a potential benefit of the 3D navigation tool in reducing the risk of contrast-induced nephropathy and radiation hazard.

P-234

Analysis of predictive factors for type Ia endoleaks and target vessel occlusion after chimney graft endovascular aneurysm repair

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Purpose

Complications after chimney graft endovascular aneurysm repair (CG-EVAR) remain a critical issue. Our aim was to identify predictive factors of 2 main major outcomes: type Ia endoleaks (ELs) and CG occlusions.

Material and methods

Between 2010 and 2016, 44 patients who underwent CG-EVAR were included (mean age 77.1 ± 6.4 years). Morphological variables were measured on CT using a dedicated workstation. After initial selection of predictors by univariate analysis using Fisher's exact test, outcomes with effectiveness >10 and predictive factors with $p < 0.2$ were included for multivariate analysis with logistic regressions.

Results

During 13.6 ± 14.9 months, 16 type Ia ELs and 6 CG occlusions were analyzed. On univariate analysis, significant associations were found of type Ia ELs and CG overlap with aortic covered stentgrafts $\leq 10\text{mm}$ (OR 6.48, 95% CI 1.49–25.68, $p=0.02$); of CG occlusion with the length of CG $\leq 60\text{mm}$ (OR 0.04, 95% CI 0.003–0.42, $p=0.02$) or $\geq 80\text{mm}$ (OR 27.00, 95% CI 2.39–393.00, $p=0.02$); and of CG overlap with aortic free-flow stentgrafts $\leq 10\text{mm}/\geq 26\text{mm}$ (OR infinity, 95% CI 1.33–infinity, $p=0.02$). On multivariate analysis, significant associations were found between type Ia ELs and neck angulation $> 45^\circ$ (OR 1.64, 95% CI 1.29–799.47, $p=0.03$), CGs' reinforcement with second self-expanding stent (OR 1.57, 95% CI 1.00–465.06, $p=0.049$) and CG overlap with aortic covered stentgrafts $\leq 10\text{mm}$ (OR 2.14, 95% CI 6.66–29644.52, $p=0.004$).

Conclusion

This study shows that neck angulation $> 45^\circ$, CGs' reinforcement with self-expanding stents, and CG overlap with aortic covered

stentgrafts $\leq 10\text{mm}$ represent risk factors for type Ia ELs, whereas CGs' patency can be influenced by their length and the length of their overlap with aortic free-flow stentgrafts.

P-235

Concurrent N-butyl cyanoacrylate embolization and endovascular aneurysm repair (EVAR) can reduce the risk of endoleak and reintervention compared with conventional EVAR

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Purpose

Type Ia or II endoleak (Ia, II-EL) is one of the common complications after EVAR, which eventually results in reintervention. The purpose of this retrospective study is to compare the outcomes of EVAR concurrently performed NBCA embolization (NBCA-EVAR) with those of conventional EVAR (C-EVAR).

Material and methods

From January 2014, 62 patients (NBCA-EVAR; men 50, mean age 79.0 years) underwent simultaneous NBCA injection into the aneurysmal sac with EVAR procedure. A 4-Fr angiographic catheter was placed in the aneurysmal sac just before the contralateral limb deployment for NBCA injection. NBCA was mixed with iodized oil at a ratio of 1:4 to control its polymerization time and to render it radiopaque. As a control, 196 patients (men 149, mean age 77.6 years) who performed C-EVAR were enrolled. The incidence of Ia or II-EL 1 week after EVAR was assessed at first. In addition, 49 patients in the NBCA-EVAR group with more than 6-month follow-up were compared with those in the C-EVAR group in terms of sac growth and reintervention.

Results

The incidence of EL in the NBCA-EVAR group was lower than that in the C-EVAR group (9.7% vs. 34.7%, $P < 0.001$). During the follow-up, the rate of patients with sac growth was significantly lower in the NBCA-EVAR group (4.1% vs. 19.9%, $P = 0.003$). Moreover, reintervention was unnecessary in the NBCA-EVAR group, where the difference was statistically significant (0% vs. 19.4%, $P < 0.001$).

Conclusion

NBCA-EVAR reduced the risk of EL and reintervention. Long-term follow-up is mandatory to demonstrate the efficacy of this technique.

P-236

Post-implantation syndrome following endovascular aneurysm sealing

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WITHDRAWN

P-237

Perfusion index for evaluating the blood flow in the approached arteries during endovascular aneurysm repair

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Purpose

To evaluate the usefulness of the perfusion index (PI) in evaluating the blood flow of the approached arteries during endovascular aneurysm repair (EVAR).

Material and methods

Sixty-two patients (52 men and 10 women) with a median age of 80 years (range, 60–89 years) underwent EVAR for abdominal aortic aneurysm (n=59), common iliac artery aneurysm (n=2), or internal iliac artery aneurysm (n=1). In all patients, EVAR was approached from both femoral arteries. PI was monitored before and immediately after EVAR on both feet. When the PI decreased immediately after EVAR, imaging examination (ultrasound, angiography, and/or contrast-enhanced CT) was performed for evaluating the blood flow. When PI was normal, the ankle brachial index (ABI), which is the ratio of the systolic blood pressure measured at the ankle to that measured at the brachial artery, was measured on the next day for evaluating the blood flow. We determined whether PI evaluation agrees with clinical evaluations, such as imaging examination and ABI.

Results

In total, 124 arteries were evaluated and 3 of them showed a decrease in PI. In these 3 arteries, the decrease in the blood flow was confirmed by image examination, and surgical repair was performed immediately. In the 121 arteries without decrease in PI, ABI on the next day was at the same as that before EVAR. Therefore, the agreement rate between PI and clinical evaluations was 100%.

Conclusion

PI monitored immediately after EVAR appears to be useful for evaluating the blood flow of the approached arteries.

P-238

Vascular application of the “Destino” Twist unidirectional steerable guiding sheath: an initial single-center experience

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WITHDRAWN

P-239

Endovascular fenestration for type B dissection with degenerative aneurysmatic disease: a single-centre long-term follow-up

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WITHDRAWN

P-240

Women and men derive similar benefits after EVAR with the ultra-low profile Ovation AAA stentgraft: mid-term results in a multicenter European post-market registry

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Purpose

In many clinical trials and registries, women have limited eligibility for and worse outcomes after endovascular aneurysm repair (EVAR). This analysis was to determine the performance of the Ovation stentgraft in women versus men for elective abdominal aortic aneurysm (AAA) repair.

Material and methods

From May 2011 to December 2013, 501 patients (men, 86%) from 39 sites were prospectively enrolled in the Ovation European post-market registry and electively treated with EVAR. Patient returned for clinical and imaging follow-up at 1 month, 6 months, and annually. A post-hoc analysis was performed to assess the influence of sex on patient outcomes.

Results

Women were older than men (77 vs. 73 years, $p<0.01$), although men reported a higher frequency of ASA class III/IV (54% vs. 34%). Women had more severe proximal and distal morphology than men, including minimum external iliac diameter of <7 mm (65% vs. 38%, $p<0.001$) and neck length of <10 mm (12% vs. 4%, $p=0.02$). Technical success was 100% in women and 99.5% in men. Freedom from type I endoleak was 94% in women versus 97% in men ($p=0.003$). Freedom from reintervention for occlusion was similar in women and men (2.9% and 2.5%, $p=0.03$). No women experienced rupture or aneurysm-related mortality during 3 years.

Conclusion

This prospective European post-market registry demonstrated that women and men derive similar benefits during 3 years after EVAR with the Ovation stentgraft.

P-241

Large-diameter (≥ 29 mm) proximal aortic necks are associated with increased complication rates after EVAR for AAA

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Purpose

To investigate the impact of proximal aortic neck diameter on the outcome of endovascular repair of infrarenal abdominal aortic aneurysms.

Material and methods

This was a case-control (1:1) retrospective analysis of prospectively collected data of two university centers (925 patients) from May 2003 to November 2016. Patients with an infrarenal neck diameter of 29–32 mm (study group) were compared with patients with a neck diameter of $26\leq 29$ mm (control group) matched for age, sex, and maximum sac diameter. Freedom from neck-related adverse events (endoleak Ia, migration, and neck-related re-interventions) was the primary endpoint.

Results

Sixty-four matched patients in each group (study vs. control) were compared. There were no significant differences at baseline between groups, including demographics, comorbidities, neck length, angulation, and stentgraft fixation type. Median stentgraft oversizing was not different between the two groups (study group median 18% vs. control group 14.3%, $p=0.106$). Overall, median available follow-up was 24 months (range 1–84 months) (study group: 24 months vs. control group: 18.5 months, $p=0.943$). Primary endpoint was recorded in 8 patients (12.5%) in the study and 2 patients (3.1%) in the control group. On multiple regression analysis, the presence of a proximal aortic neck ≥ 29 mm was the only independent risk factor for neck-related adverse events (OR 7.4; 95% CI 1.2–47.1).

Conclusion

EVAR in patients with proximal aortic neck diameter ≥ 29 mm seems to be associated with higher adverse event rates. Close surveillance of those patients after EVAR in the long term appears to be mandatory.

P-242

Single-centre mid-term use of the Ovation stentgraft

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Purpose

UHSM repairs 100 AAA annually, with 80% repaired by EVAR. Increasingly more patients cannot undergo EVAR because of the hostile neck anatomy. Current evidence suggests increased long-term EVAR success when stentgrafts are deployed according to IFU. UHSM introduced the Ovation system in 2012 to increase the number of patients undergoing EVAR within IFU.

Material and methods

Inclusion criteria for this study was patients with infrarenal AAA undergoing elective EVAR using the Ovation system as per IFU at UHSM, with a minimum of 3 months of follow-up.

Results

A total of 54 patients met the inclusion criteria. The average age was 78.3 years, 44 (81.5%) patients were males, and the average aneurysm size was 64.3 mm (range 53–105 mm).

Only 10 patients met IFU criteria for Medtronic Endurant or Cook Zenith stentgrafts.

Operative complications: one type 1 endoleak treated by Palmaz stents 3 days later. There were two episodes of twisted limbs, one treated by additio iliac limbs and the other resulted in limb graft occlusion which was explanted during open surgery.

There were no procedure-related deaths; 30- and 90-day mortality was 0%.

The 90-day freedom from type I/III endoleaks was 100% with stable aneurysm size and no stentgraft migration.

One patient with CLI underwent combined femoro-distal bypass and tibial angioplasty and further underwent an above knee amputation 3 weeks later.

No aneurysm-related deaths were observed in the follow-up period.

Conclusion

Our mid-term experience with the Ovation system demonstrates that this device provides safe durable treatment of infrarenal AAA with hostile neck anatomy and small iliac vessels.

P-243

The role of intraoperative carbon dioxide automated angiography in the detection of type II endoleaks during EVAR

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Purpose

Traditional iodinated contrast angiography (ICA) may underestimate type II endoleaks (ELII) during endovascular aortic repair (EVAR); therefore, contrast-enhanced ultrasound (CEUS) is currently the gold standard for the detection of ELII during EVAR follow-up. Carbon dioxide (CO₂) automated angiography (CO₂A) may be a valuable alternative in this setting; however, no comparative studies with CEUS are available. We investigated the accuracy of a new automated CO₂A system in the detection of ELII (in comparison with ICA and CEUS).

Material and methods

A consecutive series of patients with aneurysms underwent EVAR under ICA and CO₂A control. The contrast media was automatically injected in the suprarenal aorta through a regular pigtail catheter and CO₂ was delivered by a specific automatic injector through a 10-F, 11-mm-long introducer in the external iliac artery. All patients were blindly evaluated by CEUS on postoperative day 1. The ability of ICA and CO₂A to detect ELII was compared with that of CEUS using the Cohen's concordance index (K).

Results

Twenty-one patients were included in the study. One (5%), 7 (33%), and 4 (19%) ELII were detected by ICA, CO₂A, and CEUS, respectively. ELII detected by ICA was also confirmed by CO₂A and CEUS. Three cases of ELII that were detected by CO₂A were not detected by CEUS. In no case was an ELII detected by CEUS not detected by CO₂A. The agreement between CEUS and ICA was poor (Cohen's K: 0.35), whereas CEUS and CO₂A showed a substantial agreement (Cohen's K: 0.65) in detection of ELII.

Conclusion

CO₂A is a safe and reliable method for the detection of ELII in EVAR, with a significantly higher agreement with CEUS than with ICA.

P-244

The short- and mid-term results of the fenestrated Anaconda™ endograft in patients with previous EVARs

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Purpose

Fenestrated endovascular abdominal aortic aneurysm repair (FEVAR) is being used in patients who have previously undergone infrarenal endovascular aneurysm repair (EVAR) complicated by aneurysm degeneration or type IA endoleak. We present a series of nine patients who underwent FEVAR using a custom-made Anaconda™ graft. The technical success rate, short- and mid-term morbidity and mortality, as well as lessons will be discussed.

Material and methods

Retrospective analysis of patients with type IA endoleaks/aneurysm degeneration who underwent FEVAR from 2010 to 2016. Multiple factors including technique, technical success, vessel patency, reintervention, and clinical and imaging follow-up were evaluated.

Results

Nine patients (eight male; mean 80 years, ASA grade $\geq$ III) were diagnosed with type IA endoleaks/aneurysm enlargement. Five patients were treated with fenestrated cuffs, while four underwent fenestrated realignment; 30 vessels were treated with success in 93% (28) patients. The technical success rate was 88%. The mean hospital stay was 7 days with no 30-day mortality. Two patients underwent reintervention related to endoleaks from renal fenestrations. There were no type I endoleaks following FEVARs. Three mortalities occurred, two at 6 and 18 months because of septicemia and myocardial infarction, respectively, and one patient was lost to follow-up who died from ruptured aortic aneurysm at 51 months. The remaining patients continue to be followed-up with essentially a stable aneurysmal sac size.

Conclusion

Custom-made FEVAR shows promising short- and mid-term technical and clinical outcomes in patients with pre-existing EVAR despite common challenging anatomy.

P-245

Comparison of long-term sequela between open and percutaneous access EVAR

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Purpose

Percutaneous access for EVAR has been shown to have high success rates and shorter operating times and length of stay compared with open access. However, there exists a lack of long-term follow-up data on these patients and questions remain as to whether there are any benefits of percutaneous access in the longer term. This study compares the long-term sequela and complications between open and percutaneous groin access in a large tertiary centre.

Material and methods

Overall, 223 consecutive cases over 9 years were analysed; 107 open and 279 percutaneous approaches were included. Vessel depth, diameter, extent of calcification, pseudoaneurysm formation and thrombus load were reviewed at the final follow-up CT. Follow-up clinic letters were reviewed for groin infections and nerve injury from access.

Results

Mean patient age was 75.7 years. CT images were reviewed at a mean follow-up time of 1023 days. In both groups, on last CT scan, no pseudoaneurysms were present. The percutaneous group had significantly ($p=0.0005$) fewer cases of nerve injury (2) compared with the open group (10). There was no significant difference between open (2) and percutaneous (1) groups in the number of groin infections.

Conclusion

These results show that percutaneous EVAR is safe and effective in the longer term. Percutaneous access is associated with lower medium-term complications of nerve injury compared with open access and on long-term follow-up has no difference with respect to open access on pseudoaneurysm formation. We would propose a greater uptake and usage of percutaneous access worldwide and a move away from open access when there is no contraindication to percutaneous access.

P-246

An angiographic classification of type II endoleaks from lumbar arteries after endovascular aneurysm repair and its correlation with technical outcomes of transarterial embolization

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Purpose

The aims of this study were to classify type II endoleaks based on the anastomoses between the iliolumbar and lumbar arteries and to evaluate differences among groups with respect to the accessibility of a microcatheter and the success rate of transarterial embolization.

Material and methods

Thirty-two lumbar arteries in 20 patients who underwent transarterial embolization via the iliolumbar artery for type II endoleaks were classified into five groups: G1 ($n=4$), single communication with the fourth lumbar artery; G2 ($n=5$), single communication with the fourth lumbar artery but with a significant tortuous or narrow segment; G3 ($n=11$), multiple communications or communications with fenestration with the fourth lumbar artery; G4 ($n=4$), direct communication with the third lumbar artery; and G5 ($n=8$), communication with the third lumbar artery through the fourth lumbar artery. Technical success was defined as successful advancement of a microcatheter to the ostium of the lumbar artery, and clinical success was defined as successful embolization of the ostium of the lumbar artery using microcoils or cast formation of n-butyl cyanoacrylate (NBCA) irrespective of the microcatheter position.

Results

The technical success was 100% in G1 and G2, 55% in G3, 25% in G4, and 0% in G5. The clinical success was 100% in G1, 100% in G2, 81.2% in G3, 75.0% in G4, and 37.5% in G5. The advancement of a microcatheter was impossible in G5, resulting in insufficient filling of NBCA because of proximal injection.

Conclusion

Our proposed classification showed good correlation with technical outcomes. G5 type II endoleaks are the most difficult to treat with transarterial embolization.

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Utility of CEUS in the characterization of complex type II endoleaks in patients who underwent failed endoleak repairs

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Purpose

Early reports on contrast-enhanced ultrasound (CEUS) have demonstrated favorable results with sensitivities and specificities non-inferior to CTA. This retrospective review aimed to evaluate the use of CEUS in patients undergoing re-intervention post-endoleak repair.

Material and methods

Between April 2010 and December 2015, a retrospective review was conducted on 98 patients in 2 major tertiary hospitals undergoing CEUS imaging for the evaluation of type II endoleaks post EVAR. Inclusion criteria selected patients who underwent a failed endoleak repair post-EVAR. CEUS was subsequently applied to further characterize the endoleak ($n=14$) in comparison with the characterization by recent CTA examinations. The efficacy of CEUS was subsequently evaluated.

Results

Fourteen patients met the inclusion criteria, and CEUS further characterized the endoleak in 12 (86%) patients compared with that

by CTA, ultimately contributing to future management. In 7 (50%) patients, CEUS altered management, including specifying feeding vessels to type II endoleaks or modifying the eventual approach used for future embolization. In 1 (7%) patient, CEUS findings were discordant with CTA findings; therefore, was performed. Technical success was eventually achieved in 13 (93%) patients despite difficult anatomy/persistent leaks, with 1 case failing secondary to patient body habitus. CEUS discovered endoleaks missed by a follow-up CTA in 3 (21%) patients at various stages of surveillance.

Conclusion

CEUS is an effective imaging modality to supplement CTA findings, particularly in patients with complex endoleaks, for further characterizing leaks and delineating aneurysmal morphology, thereby helping in altering treatment approaches.

P-248

Aortodigestive fistula: state of Art

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Background

FAD represents a wide range of rare conditions that could be fatal in a short time. the radiologist has to initially recognize if FAD is the primary condition or not. Primary FAD is caused by a direct and spontaneous rupture of the aorta in the digestive tract. Secondary FAD could be a consequence of infections, traumas, or surgeries. Furthermore, according to the localization of FAD, the radiologist has to determine if this condition originates from the digestive system or from the vascular one.

Clinical Findings/Procedure

Despite being an emergency, in 75% of cases, FAD does not have a clinically evident beginning. Consequently, the correct use of imaging is basic not only from the diagnostic point of view but also for clinical management. Melena and hematemesis could be very important clinical signs that could guide the radiologist in the differential diagnosis. CT angiography is the gold standard in case of FAD, with a sensibility of 94% and specificity of 85%.

Conclusion

FAD represents a rare condition, accounting for 0.5%–2% of digestive bleeding cases. A correct diagnosis could save a patient's life, guiding the surgeon in the correct management of the situation.

P-249

Undersized embolic devices for emergency occlusion of an aneurysmatic common iliac artery

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Learning Objectives

Aneurysmatic common iliac artery may be endovascularly occluded with undersized embolic devices during acute endovascular aortic repair (EVAR) with aorto-uniliac (AUI) stentgrafts.

Background

None of the commercially approved endovascular embolic devices are available in sizes large enough for blood vessels more than 24 mm in diameter.

Clinical Findings/Procedure

An 85-year-old man, who 9 years earlier had undergone the aorto-aortic bypass for an abdominal aneurysm, presented with dehiscence at the distal anastomosis and retroperitoneal hematoma. The diameter of the aneurysm sac was 13 cm, but it had been almost 16 cm 8 months earlier. Because the aortic conduit was only 20 mm in diameter, emergency endovascular placement of an AUI graft,

occlusion of the contralateral common iliac artery, followed by femoro-femoral crossover bypass was considered to be the best minimally invasive treatment option. The iliac artery was however 25 mm in diameter, and an iliac plug of appropriate size was not available. Therefore, we decided to use an undersized vascular occluder (AMPLATZER Vascular Plug II, St.Jude Medical) instead. Simultaneous deployment of a 16 mm and a 14 mm occluder alongside each other led to rapid occlusion of the artery, and the patient could successfully be treated as planned.

Conclusion

Occlusion of aneurysmatic common iliac artery with multiple undersized embolic devices is feasible in acute settings.

P-250

Use of an iliac side-branch such as that in EVAR for AAA in a patient with an anerysm height of 1.34 mm

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We described a case of symptomatic abdominal aortic aneurysm in a female patient aged 78 years with an aneurysm height of 1.34 mm that was treated with an iliac side-branch endovascular prosthesis such as that used in the EVAR technique.

P-251

EVAR for aortoduodenal fistula

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The patient was a 65-year-old male. During examination for intestinal hemorrhage, hematemesis and cardiac arrest occurred. On IABO, hemorrhage was caused by an aortoduodenal fistula arising from the proximal end of a stentgraft placed 2 years ago. EVAR was performed.

P-252

Active shield of Najuta for aortic arch aneurysm

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The length of the proximal landing zone is occasionally <20 mm in TEVAR for aortic arch aneurysm of the lateral wall. In this case, the active shield of Najuta that decreases the number of debranched aortic arch branches is effective.

P-253

Recovery from accidental bilateral leg placement into one gate during EVAR with Endurant IIs due to short distance between both gates

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A male in his 80s was treated by EVAR with Endurant IIs. During wire advancing into the contralateral gate, the wire accidentally passed the ipsilateral gate, resulting in bilateral leg deployment into the same gate. Kissing stent placement and contralateral gate embolization successfully resolved this situation.

P-254

Carotid occlusion during thoracic aortic stentgraft placement

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We present two very unusual cases of inadvertent occlusion of the left common carotid artery during TEVAR. These cases highlight certain important points for preprocedural evaluation and periprocedural technique and describe two different ways of tackling such an emergency.

P-255

Onyx embolisation of an acute type II endoleak causing recurrent haemorrhage post-emergency EVAR for a ruptured abdominal aortic aneurysm

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WITHDRAWN

P-256

Acute aortic occlusion secondary to maldeployment of TEVAR: my worst nightmare

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Pseudoaneurysm of the suprarenal aorta and surrounding mass coiling were unsuccessful at the first stage of a hybrid procedure. At the second stage, TEVAR was deployed inside the bypass graft. Axillobifemoral bypass was performed. Subsequently, the stent was extracted using the Mattox maneuver.

P-257

Esophageal rupture as a late complication of hybrid repair of a ruptured thoracoabdominal aortic aneurysm

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A 56-year-old man presented with a ruptured TAAA. He underwent hybrid repair. Postoperatively, he developed bilateral empyema, which required bilateral thoracotomies and decortication. Subsequently, he developed esophageal necrosis and perforation secondary to esophageal ischemia requiring esophageal resection and gastric pullup.

P-258

Endovascular treatment for acute thrombosis of abdominal aortic aneurysm

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Acute abdominal aortic aneurysm (AAA) occlusion is an uncommon disorder that is usually treated by open repair or extra-anatomical bypass. We present a case of AAA with acute aortoiliac occlusion successfully treated by balloon thrombectomy and endovascular aneurysm repair.

P-259

Transpulmonary embolization of a thoracic endoleak

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A 21-year-old man with Marfan syndrome presented with a thoracic type Ia endoleak. The patient previously had undergone a thoracic endovascular aortic repair. He underwent a successful transpulmonary embolization of the aneurysmal sac with onyx. Procedure and outcomes are presented.

P-260

A case of paraplegia after elective endovascular aortic repair of an infrarenal aortic aneurysm

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We encountered a rare case of infrarenal abdominal aortic aneurysm associated with postprocedure immediate paraplegia in a 74-year-old man. His paraplegia improved on treatment. Postoperative magnetic resonance imaging showed spinal cord ischemia.

P-261

A 6 fenestrated endovascular aneurysm repair

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A 72-year-old male was treated with a 6 fenestrated Anaconda endovascular graft. At the 6-week CTA follow-up, all target vessels were patent. This is the first reported case of such a procedure.

P-262

Endovascular fenestration and endograft placement to rescue malperfusion after inadvertent surgical false lumen pressurization

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A type A aortic dissection repair was complicated by the inadvertent placement of a frozen elephant trunk endograft into the false lumen, causing limb and visceral ischemia. Successful endovascular repair was performed, with fenestration and endograft extension into the true lumen.

P-263

Two cases of endovascular aortic repair for abdominal aortic branch avulsion caused by blunt trauma

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Inferior mesenteric artery and lumbar artery avulsion due to blunt abdominal trauma are very rare. We report two cases that could have been treated successfully by endovascular stent grafting in combination with coil embolisation of the lacerated artery.

P-264

Abdominal aortic aneurysm involving bilateral iliac arteries ruptured to IVC causes acute right heart failure

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A 65-year-old man with an abdominal aortic aneurysm suffered acute right heart failure. CTA showed a leak between the right common iliac artery and IVC, causing early enhanced IVC. DSA confirmed the diagnosis, and emergence EVAR was performed successfully. The patient fully recovered.

P-265

Hemoptysis: aortic diseases should not be ignored

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A 62-year-old man suffered massive hemoptysis and hypovolemic shock. Pseudoaneurysm at the descending aorta, which led to this symptom, was diagnosed by CTA and DSA. Emergency TEVAR was performed successfully, and hemoptysis was resolved.

P-266

Endovascular repair of an ascending aorta-penetrating ulcer with a custom-made thoracic stentgraft: a case report

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A 71-year-old high surgical risk patient with a penetrating ulcer of the ascending thoracic aorta was operated with use of a custom-made thoracic stentgraft (Bolton, Relay). Implantation of the graft was achieved under rapid pacing. A 30-day follow-up CT examination confirmed excellent apposition of the graft.

P-267

Hypogastric type-2 endoleak embolization via transgluteal artery approach using onyx embolic agent

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A 78-year-old man with right hypogastric aneurysm previously treated with a stentgraft showed type-II endoleak from the gluteal arteries. Gluteal artery puncture and embolization of the sac were performed. One-month later, CT revealed complete exclusion of the aneurysm.

P-268

Transradial coil and liquid embolization of complex type II endoleaks

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An 84-year-old male presented with type II endoleak from bilateral ilio-lumbar arteries. Transradial catheterization across the endoleak from the right ilio-lumbar artery to the left ilio-lumbar artery allowed for coil and liquid (onyx) embolization. Clinical and technical considerations will be reviewed.

P-269

Treatment of type II endoleak after TEVAR causing hemoptysis via direct transthoracic puncture

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We present a case of an 81-year-old woman with hemoptysis due to type II endoleak after TEVAR. We successfully treated the endoleak of the aortic arch with CT-guided direct transthoracic sac puncture and embolization using n-butyl-2-cyanoacrylate.

Experimental work in IR

P-270

Monitoring non-invasive aneurysm sac pressure after endovascular aortic aneurysm repair

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Purpose

In vitro testing of a prototype stentgraft with integrated pressure sensors capable of wireless digital data transmission for non-invasive array measurement of aneurysm sac pressure following endovascular aortic aneurysm repair (EVAR).

Material and methods

Five EVAR stentgrafts (85 × 16 mm) were designed including an array of 16 pressure sensors within layers of polytetrafluorethylene (PTFE). The prototypes were mounted on a 26-F delivery sheath and mono-iliacly placed in an infrarenal aortic aneurysm model. Digital data conversion was performed using an integrated microcontroller (ASIC) between sensors within the PTFE membrane providing energy and data transfer by inductive coupling. Measurements were continuously taken from all sensors inducing reference pressures within the demonstrator.

Results

After successful placement of the stentgraft, wireless energy and data transmission could be successfully performed up to a distance of 10 cm. All 16 sensors delivered reliable and continuous pressure measurements, providing an accuracy of ±1.4 mmHg and creating three-dimensional pressure profiles outside the stentgraft.

Conclusion

We demonstrated a successful stent design for non-invasive pressure monitoring after EVAR using integrated sensors within a PTFE membrane. Acquisition of 3D-pressure profiles outside a stentgraft may detect regional pressure elevation and endoleakage development after EVAR.

P-271

Development of a perfusion system using indwelling catheter to reserve hepatic arterial flow after coil embolization of CHA for the treatment of postoperative hemorrhage after pancreaticoduodenectomy

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Purpose

Postoperative hemorrhage by the rupture of pseudoaneurysms (PAs) after pancreaticoduodenectomy (PD) is a life-threatening condition. Endovascular treatment with covered stent placement or transcatheter arterial embolization (TAE) has been accepted as the treatment of choice for PAs after PD. However, there are some issues in stent placement because of technical difficulties and in TAE because of the risk of hepatic ischemia. To resolve the issue of hepatic ischemia after TAE, we have developed a perfusion system using indwelling catheter to reserve hepatic arterial flow after coil embolization of CHA. The aim of this study was to evaluate the efficacy of this perfusion system in vitro.

Material and methods

Both 5 and 6 Fr sheaths, including a pump and a catheter, which connected to the blood circulation, were placed in temperature-controlled artificial blood. Actual flow from the catheter tip and pressure of the circulation system for the 5 and 6 Fr sheaths were measured with a pump flow rate of 50, 100, 150, 200, 250, and 300 ml/min.

Results

The actual flow from the catheter tip in the circulation system with the 5 Fr sheath was 35, 71, 106, 138, 163, and 174 ml/min at the respective pump flow rates, and it plateaued at a pump flow rate of ≥250 ml/min. On the other hand, the actual flow from the catheter tip in the circulation system with the 6 Fr sheath was proportional. The pressure in the circulation system with the 5 Fr sheath was higher than that with the 6 Fr sheath.

Conclusion

The pump-based perfusion system using an indwelling catheter can reserve hepatic arterial flow and is useful for the treatment of postoperative hemorrhage of PD.

P-272

Paclitaxel quantification and transmural distribution in three different types of arteries: carotid, iliac and coronary

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Purpose

Most studies related to drug deposition in the arteries from drug-coated devices are focused on the coronary area. Experimental data from coronary arteries is usually extrapolated to the peripheral area, not taking into account differences in the structure and nature of the arteries.

The purpose of this study was to compare ex-vivo paclitaxel (PTX) deposition and its transmural distribution across the wall among three different arteries (carotid, iliac and coronary).

Material and methods

Carotid, iliac and coronary arteries from four different pigs were used in this study. All arteries were incubated in a Krebs-Henseleit buffer with radiolabeled PTX (2 µCi/ml) until equilibrium. The arterial tissues were digested and samples were separated in two different groups: group 1 to quantify the total concentration of the drug in the tissue and group 2 to study transmural distribution. Samples

from group 2 were embedded in OCT to be cryosectioned into 10 μm slices parallel to the lumen. PTX quantification was performed by liquid scintillation spectroscopy. A statistical analysis of these variables was also performed.

Results

Carotid, iliac and coronary arteries showed significant differences in PTX concentration (6269.7 ± 2026.6 , 3380.2 ± 1112.8 , and 9274.9 ± 3967.2 CPM/mg, respectively; $p=0.001$), with the highest concentration in the coronary arteries. In coronary arteries, most of the drug was deposited in the intima, whereas in the iliac and carotid arteries, it was mainly deposited in the media. Transmural distribution profiles showed that there are significant differences on drug distribution through the wall in all arteries, which points out differences in the drug affinity depending on the type of artery.

Conclusion

PTX deposition and transmural distribution profiles are significantly different among the carotid, iliac and coronary arteries.

P-273

Toward a new animal model of critical limb ischemia

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Purpose

Several in vivo animal models of critical limb ischemia (CLI) present several limitations in proving the actual efficacy of stem cell treatment. We evaluated the efficacy of a new model of rabbit hindlimb ischemia created via percutaneous transarterial distal femoral artery embolization with calibrated particles.

Material and methods

Distal limb vessels were embolized using a mixture of 300–500 calibrated microparticles (Embosphere, Merit medical), saline solution, and iopamidol via the percutaneous transarterial artery approach and selective catheterization of the superficial femoral artery with a 2.7mm microcatheter. Clinical and US blood flow evaluation were performed before embolization and during follow-up. A sacrifice and histological evaluation was performed 14 days after the procedure.

Results

The model was successfully created in 10 rabbits. One rabbit experienced sudden death at 8 days post procedure. The 9 surviving rabbits developed hind ulcers. All rabbits had a higher pain score in the follow-up compared with the baseline value ($p<0.001$). The blood flow in the saphenous artery decreased significantly after the procedure and in the 14-day control [baseline value 238.5 ± 46.03 $\mu\text{l}/\text{min} \times \text{HR}$ vs 32.8 ± 19.4 $\mu\text{l}/\text{min} \times \text{HR}$ post procedure ($p=0.0013$) and 32.0 ± 28.4 $\mu\text{l}/\text{min} \times \text{HR}$ in 14-day control ($p=0.0015$)]. Histological samples showed signs of chronic limb ischemia in all rabbits.

Conclusion

The rabbit hindlimb ischemia model created by percutaneous transarterial distal femoral artery embolization with calibrated particles may overcome some of the limitations of existing animal models. This model could prove useful for assessing therapies designed to improve arterial perfusion and collateral growth.

P-274

In vitro evaluation of radiopacity of contrast-loaded superabsorbent polymer microspheres (SAP-MSs)

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Purpose

Superabsorbent polymer microspheres (SAP-MSs) have a property of absorbing fluids to swell. Therefore, contrast-loaded SAP-MSs will become visible on X-ray imaging. The purpose of this in vitro study was to evaluate radiopacity and visibility of contrast-loaded SAP-MSs.

Material and methods

1) SAP-MSs were suspended in nonionic contrast material (iodixanol) and a change in the diameter was observed using a stereomicroscope. 2) Contrast-loaded SAP-MSs were mixed with diluted contrast and change in the diameter was observed sequentially. 3) Radiography of the contrast-loaded SAP-MSs was taken using an angiographic system, and visibility was evaluated quantitatively by contrast-to-noise ratio (CNR) and qualitatively by multiple reader scoring.

Results

1) In a pure contrast material, the diameter of SAP-MSs increased for approximately 15 minutes and reached an equilibrium. Finally, the diameter was 4.5–5.0 times greater than its original size. 2) When contrast-loaded SAP-MSs were mixed with diluted contrast material, the diameter further increased by 10%–40% in several minutes and then returned to the previous size in approximately 30 minutes. 3) Contrast-loaded SAP-MSs were visualized under X-ray imaging. However, CNR decreased in approximately 30 minutes, and finally, they became invisible.

Conclusion

Contrast-loaded SAP-MSs are visible on X-ray imaging. Because their diameter and visibility will change with time, the manner of dilution and timing of injection should be considered.

P-275

A 6.5-Fr guiding catheter to carry a multiple microdevice system using a single access route: an experimental study

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Purpose

During coil embolization of the abdominal visceral artery, there are situations where multiple microdevices are necessary. However, by creating multiple access routes, the procedure tends to become complicated and patients are more stressed as 2 sheaths are placed via separate groin sites. We developed a 6.5-Fr Shephard hook-type guiding catheter (Parent Plus45) with a lumen (0.074 inch) large enough to carry a multiple microdevice using a single access route. Passage and resistance tests were performed to confirm the available combination of microdevices that could be used through Parent plus45.

Material and methods

The inner/outer diameter lumen of Parent Plus45 and of 8 microdevices, including high-flow and microballoon catheters, were measured. The microdevice was inserted into Parent plus45 with the aid of a microguide wire. The possibility of insertion of a second device was studied. When the guiding catheter allowed the introduction of 2 microdevices, the maximum resistance while pulling out one of the devices was measured using a digital force gauge.

Results

The insertion of microdevices through Parent Plus45 was possible without difficulty when the total outer lumen diameter of 2 microdevices was under 1.80 mm and they were removed with low resistance (0.30 N). Most of the combinations, including high-flow catheter + microballoon catheter, microballoon catheter + microballoon catheter, were successfully inserted and removed without difficulty.

Conclusion

Various combinations of microdevices can be inserted into Parent Plus45; therefore, intravascular treatment of the abdominal visceral artery region with multiple devices using a single route is possible. This device may be less stressful for the operator and the patient, and furthermore, it may provide another treatment option for the procedure.

P-276

A common woodchuck (*Marmota monax*) as a model for hepatic embolization

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Purpose

Hepatocellular carcinoma (HCC) can be treated by a variety of local and regional interventional therapies, but we may benefit from a more predictive preclinical model to better understand, study, and treat HCC. This study clarifies the value of utilizing woodchucks with HCC for the study of hepatic embolotherapies.

Material and methods

Animal Model

Woodchuck neonates commonly infected with woodchuck hepatitis virus develop neoplasms similar to human HCCs associated with hepatitis B. Woodchucks with and without tumor were provided by Northeastern Wildlife, Inc. (Harrison, ID). The animal study was approved by the NIH Clinical Center IACUC and performed in accordance with US regulations.

Embolic Procedure

Animal livers were examined via ultrasound and CT prior to instrumentation. A 3-F introducer sheath was placed in the femoral artery, and 1.7–2.8-F microcatheters were guided by fluoroscopy to select hepatic arteries for diagnostic angiography.

Results

Embolic particles (40–150- μ m radiopaque spheres, Biocompatibles UK LTD) were deployed until angiographic stasis was observed. uCT of the explanted liver was conducted. Analysis of segmented arteries provided a 3D geometric and anatomic definition of the tumor-negative and -positive liver. Gross pathology and histology was described. CT and US showed a solid hypervascular tumor without major pools of necrosis, as is common in other IR preclinical medium-sized animal models for liver tumors.

Conclusion

These data may help guide future studies using a more predictive HCC model for hepatic embolization. Additional research is needed to refine the methods and validate the model; however, a more realistic HCC model than previously described could be an informative surrogate for clinical research and may be more realistic than rodent or rabbit models.

P-277

Ozonated saline is effective in treating VX2 tumor in rabbits

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Purpose

To investigate the effectiveness of ozonated saline injected directly into the tumor for treatment of VX2 tumors.

Material and methods

Ninety rabbits bearing VX2 tumors were randomly divided into three groups (saline group, 20ug/ml and O₃/O₂ ozonated saline groups, 40ug/ml). Pre- and post-treatment serum IL-6 and TNF- α were measured. Several milliliters of saline and ozonated saline were directly injected into tumors. At the fourth, eighth, and twelfth days, 10 rabbits were randomly selected from each group for collecting blood in order to measure serum IL-6 and TNF- α , and the maximal and vertical diameters of VX2 tumors were measured so as to calculate the tumor growth rate (TGR). All selected rabbits were sacrificed and their tumors, livers, and lungs were removed for pathological examination. The intra-tumoral necrotic area was recorded to calculate the tumor necrosis rate.

Results

The average tumor volume of three groups increased at each time point, and TGRs of groups B and C were significantly lower than those of group A. TGRs between groups B and C showed no statistical difference. At each time point, the serum IL-6 and TNF- α of all the three groups increased and those of groups B and C also increased but without statistical significance. Though the diameters of the necrotic area of groups B and C were longer than those of the area of group A, the statistical difference was only seen between groups A and C at the fourth and twelfth days.

Conclusion

Direct injection of different concentrations of ozonated saline into VX2 tumors significantly increases the intra-tumoral necrosis and reduces the TGR. Increasing IL-6 and TNF- α in the serum might be part of the mechanism.

P-278

Parameters for stable water-in-oil Lipiodol®-based emulsion for liver transarterial chemoembolization

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Purpose

Water-in-oil type and stability are two crucial properties required for Lipiodol®-based emulsions during cTACE. Our purpose is to evaluate the influence of 3 technical parameters on these properties.

Material and methods

The Lipiodol®-based emulsions have been formulated by repetitive pumping of two 10-ml syringes through a 3-way stopcock. Three parameters were compared: Lipiodol®/doxorubicin ratio (2/1 vs. 3/1), doxorubicin concentration (10 vs. 20 mg/ml), and speed of incorporation of doxorubicin in Lipiodol® (single bolus vs. slowly infused at 1 ml/min). The experiment was reproduced 4 times for each modified parameter (32 emulsions total). The primary endpoint was to report the emulsion type (water-in-oil or oil-in-water) obtained according to the 3 parameters evaluated with the drop test. The secondary endpoint was to compare the duration for complete coalescence of water-in-oil emulsions using static light scattering technique (Turbiscan®).

Results

Seventeen emulsions (53%) were water-in-oil. The slowly-infused incorporation of doxorubicin in Lipiodol® resulted in a significantly higher rate of water-in-oil type compared with the single-bolus incorporation (100% vs. 6.25%, $p < 0.0001$). Emulsion type was not influenced by Lipiodol®/doxorubicin ratio ($p = 0.7232$) or by doxorubicin concentration ($p = 0.07232$). Mean duration for complete coalescence of water-in-oil emulsions was 297 ± 298 min (from 10 to 1000 min). The 3/1 Lipiodol®/doxorubicin ratio resulted in a significant increase in the duration for complete coalescence compared with the 2/1 ratio (525 ± 265 min vs. 70 ± 47 min, $p = 0.0008$). The duration for complete coalescence was not influenced by the doxorubicin concentration ($p = 0.6854$).

Conclusion

Slowly-infused incorporation of doxorubicin in Lipiodol® results in a highly predictive water-in-oil emulsion type. An increase in Lipiodol®/doxorubicin ratio results in longer stability.

P-279

Development of a radiopaque thermoresponsive hydrogel for intratumoural drug delivery

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Purpose

Intratumoural injection of chemotherapy using image guidance permits high local drug concentrations with reduced off-target toxicity. Success may be limited by poor distribution within the tumour and rapid clearance from the tumour. Thermoresponsive hydrogels (thermogels) consist of novel hydrophilic polymers, which undergo a phase transition (liquid to gel) in response to a physiological temperature increase. This allows for the administration of a liquid at room temperature via minimally invasive techniques that solidifies at the body temperature, permitting localisation and retention. This holds promise as a chemotherapy-delivery solution.

Material and methods

Iodixanol (Visipaque®)-labelled thermogels in various concentrations (0%–30%w/w) were assessed for gelation temperature, structural integrity and injectability. Radiopacity of the thermogels was evaluated using computed tomography (CT). Distribution of the thermogel following injection (18G, 7cm needle) into an ex vivo tissue model was visualised under CT and ultrasound (US).

Results

Iodinated contrast-labelled thermogels at a variety of concentrations demonstrated clinically relevant thermoresponsiveness and maintained injectability. The contrast-labelled thermogel demonstrated satisfactory radiopacity on CT and echogenicity (without speckling) on US. Increased contrast concentration was associated with increased radiopacity. Time-lapsed imaging revealed that 45% of iodinated contrast was released from the solidified gel at 24 hours. Injection into animal liver demonstrated that the contrast-labeled thermogel was readily injectable and moulded into the shape of the target tissue.

Conclusion

Radiopaque thermogels, which are injectable liquids at room temperature and solidify at body temperature, were successfully formulated. Presented preclinical experimentation suggests that this is a promising drug-delivery platform that demonstrates favourable imaging qualities.

P-280

Radiofrequency ablation with cisplatin infusion through an internally cooled perfusion electrode: an in vitro experimental study in bovine liver

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Purpose

Cisplatin is effective against many malignant tumors and administered through the intra-arterial or intravenous route. Internally cooled perfusion electrode allows interstitial solution infusion during radiofrequency ablation (RFA). The purpose of this study was to evaluate whether RFA with cisplatin infusion through an internally cooled perfusion electrode can make the ablation zone suitable for liver tumor ablation.

Material and methods

Using a 200 W generator and a 17-gauge internally cooled perfusion electrode (group A, $n = 10$) and a 17-gauge monopolar internally cooled electrode (groups B, $n = 10$), RF was applied to the explanted bovine liver for 12 minutes. During RFA, cisplatin was injected into the tissue at a rate of 0.5 mL/min through the internally cooled perfusion electrode using an injection pump. Dimensions of the ablation zone and technical parameters were compared between the two groups.

Results

RFA with cisplatin infusion through the internally cooled perfusion electrode achieved a larger ablation size, which represents the width of the longitudinal section and volume, than that through the monopolar internally cooled electrode: 3.88 ± 0.32 cm² and 36.45 ± 5.46 cm³, respectively, in group A and 3.39 ± 0.22 cm² and 26.55 ± 4.62 cm³, respectively, in group B ($p < 0.05$). The mean impedance of RFA with cisplatin infusion through the internally cooled perfusion electrode was higher than that of RFA with cisplatin infusion through the monopolar internally cooled electrode: 93.4 ± 4.8 Ω in group A and 92.2 ± 6.1 Ω in group B ($p > 0.05$).

Conclusion

RFA with cisplatin infusion through the internally cooled perfusion electrode created a larger size and volume of ablation than RFA with cisplatin infusion through the monopolar internally cooled electrode.

P-281

Irreversible electroporation of the liver tissue near the gallbladder wall: histopathologic changes and imaging findings in a pig model

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Purpose

To characterize imaging findings and histopathologic changes in the gallbladder wall of pigs when liver ablation with irreversible electroporation (IRE) was performed in close proximity to the gallbladder.

Material and methods

IRE of the liver tissue abutting the gallbladder was performed in three pigs. Two monopolar electrodes were placed perpendicular to the gallbladder within 5 mm of the gallbladder wall under sonographic guidance. Ablations were performed with the Nanoknife® system with standard settings. Imaging was performed with ultrasound and contrast-enhanced MRI. Animals were sacrificed 24h after ablation. Microscopic changes in the ablation zone and the adjacent gallbladder wall were analyzed on HE-stained slides.

Results

Changes in the gallbladder wall adjacent to the ablation zone were observed with ultrasound (loss of mucosal reflex and edema) and MRI (loss of contrast enhancement). On gross examination, ulceration-like defects of the gallbladder mucosa were found. Histopathology showed necrosis of the liver tissue adjacent to the gallbladder and different grades of gallbladder wall necrosis ranging from loss of the mucosal layer to transmural cell death. Damage to the gallbladder was more pronounced in close proximity to the electrodes. The non-cellular connective tissue seemed to be intact. Perforations were not observed.

Conclusion

IRE effectively ablates the liver tissue up to the gallbladder wall but leads to different grades of gallbladder wall necrosis. The effects on the gallbladder wall can be visualized with ultrasound and MRI. Whether the observed damage to the gallbladder wall might pose a risk of perforation or cholecystitis has to be further analyzed in experiments with a prolonged survival time.

P-282

Intraoperative high-resolution ultrasound, including CEUS (I-HRUS-CEUS), before, during, and after microwave ablation (MWA) of the liver: value in treatment planning and control

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Purpose

To analyze the value of intraoperative high-resolution ultrasound, including CEUS (I-HRUS-CEUS), before, during, and after microwave ablation (MWA) of the liver.

Material and methods

Twelve pigs underwent laparotomy. High-resolution B-mode ultrasound (HR-B-MODE) was used to define the thickest parts of the liver (target regions) included in optimal access. High-resolution CEUS (HR-CEUS) of the target regions was performed according to a standardized protocol (e.g., 2.0-ml contrast material and 5-min acquisition time). Subsequently, 14- or 17-G MWA applicators were positioned into the target regions under HR-B-MODE. During MWA, HR-B-MODE was used to document the morphological changes in the treatment zone. Directly and 15-min after MWA, I-HRUS-CEUS was repeated. Treatment zones defined using I-HRUS-CEUS and pathology were compared.

Results

Before MWA, I-HRUS-CEUS was highly effective in defining target regions and optimal access and in guiding the ultrasound-visible applicators into the target regions. During MWA, HR-B-MODE was effective in documenting the progress of the treatment zone since the evolution of gas bubbles. Directly after MWA, HR-B-MODE overestimated the treatment zone compared with HR-CEUS. Fifteen minutes after MWA, HR-B-MODE identified two different treatment zones: a larger central hypoechogenic oval zone surrounded by a thin hyperechogenic rim. Both the hypoechogenic oval zone and the hyperechogenic rim lacked contrast enhancement when HR-CEUS was used. Compared with pathology, the hyperechogenic

rim corresponded to a hemorrhagic rim infiltrate and the hypoechogenic oval zone corresponded to a white coagulation necrosis.

Conclusion

I-HRUS-CEUS before, during, and after MWA of the liver is highly valuable in treatment planning and control.

P-283

Evaluation of a novel needle placement system for CT-guided liver ablation using an anthropomorphic phantom

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Purpose

To determine the value of a novel table-mounted needle placement system (NPS) for CT-guided liver ablation.

Material and methods

NPS (DEMCON, Enschede, the Netherlands) was tested using an in-house developed 3D-printed anthropomorphic phantom containing the ribs and lungs, filled with gelatin, placed in a torso, and covered with chamois leather skin. It contained 12 hyperdense point targets at a mean depth of 9 cm (range: 5–17 cm). Two experts approached all targets twice with a microwave ablation antenna: once using regular CT guidance and once using NPS.

The distance between needle tip and target was measured as accuracy. The needle was not repositioned when within 5 mm of the target or after 5 needle manipulations. The median (range) accuracy, number of needle manipulations, number of CT scans acquired, and time required to reach the target were determined for the NPS and free-hand groups and compared using the Mann-Whitney U test.

Results

NPS could adequately reach all targets. For the NPS and free-hand groups, the median accuracy was 2.3 mm (0.9–4.4) and 4.8 mm (1.2–33.8; $p < 0.001$), the median number of needle manipulations was 1 (1–1) and 2 (1–5; $p < 0.001$), the median number of CT scans was 2 (1–3) and 4 (1–8; $p < 0.001$), and the median procedural time was 9 min (6–25) and 13 min (5–44; $p = 0.080$), respectively.

Conclusion

The use of NPS increases the accuracy of needle placement and reduces the number of repositioning attempts and CT scans. It has the potential to reduce complications and patient radiation in CT-guided liver ablation.

P-284

Preoperative portal vein embolization and percutaneous intrahepatic split by ablation: feasibility and safety of radiological stage 1 ALPPS

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Purpose

To assess feasibility and safety of radiological stage 1 ALPPS by combining portal vein embolization (PVE) and percutaneous intrahepatic split by ablation (PISA).

Material and methods

Three patients (M/F 1/2; mean age 65.0±7.3 years) underwent PVE and PISA. The aim of PVE was to achieve complete occlusion of the

right portal tree to prevent portoportal shunts. PVE was performed using a mixture of 70% iodized oil and 30% cyanoacrylate. PISA was performed 21 days after PVE by microwave ablations (14 G antenna, 4.1 cm active tip, at 60 W); multiple access sites were used to allow sequential overlapping of ablation fields. Abdominal CT exams were performed before and after PVE and PISA. The future liver remnant (FLR) volume was calculated by semiautomatic segmentation, and increase was reported as a percentage of the preprocedural volume. The FLR/body weight ratio was calculated; a ratio greater than 0.8% was considered sufficient for guaranteeing adequate liver function after surgery.

Results

No procedure-related complications were recorded. The FLR volume increase in each patient was 42.0%, 33.1%, and 30.4% within 21 days of PVE and 109.3%, 68.1%, and 71.7% within 10 days after PISA. The FLR/body weight ratios were 0.76, 0.66, and 0.63 and 1.13, 0.83, and 0.83 after PVE and PISA procedures, respectively. Two patients underwent successful right hepatectomy, whereas in one patient, surgery was not performed because the patient refused to undergo blood transfusion.

Conclusion

Radiological stage 1 ALPPS is a feasible and safe option that may overcome the major drawbacks of conventional ALPPS.

P-285

Microwave ablation combined with direct current application: influences on ablation temperature and volume in an ex-vivo study

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Purpose

The combination of radiofrequency ablation (RFA) with additional direct current (DC) application is a known strategy for enhancing the efficiency of RFA. The aim of this study was to evaluate influences of DC application to MWA with respect to the ablation temperature as well as the size and shape of the ablation volume in an ex vivo bovine liver model.

Material and methods

A DC circuit was combined with a commercially available MWA system using a standard ablation protocol. The negative pole of DC was placed next to the MWA probe and the positive pole was placed distant to the ablation zone. DC was applied for 15 min prior to ablation and continued during MWA using various DC currents from 0 to 10 V including reversed DC poles. A total of 20 ablations were performed. The coagulation volume and shape and ablation temperatures at a distance of 3, 6, 9, and 12 mm from the MWA probe and applied energy were assessed.

Results

There were no significant changes in coagulation volume or shape as well as applied energy with or without DC application. A significantly faster increase from 37°C to 80°C was observed in the 10 V continued MWA group compared with that in the control group (21 vs. 14 sec., $p < 0.039$). In all cases of applied DC, there were signs of electrolytic tissue scarring at the distant DC pole.

Conclusion

DC application to MWA results in a significantly faster temperature increase in the ablation zone, but does not help in modulating the ablation shape or volume. Furthermore, DC application might cause electrolytic injuries at the distant DC pole.

P-286

Thermoablation of sarcomatous metastases in the liver: a case series

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Purpose

Thermoablative techniques are being increasingly used in the treatment of hepatic metastatic disease. The benefits of these minimally-invasive procedures are well documented in literature with studies highlighting the advantages in colorectal metastases in particular. However, little has been written about the use of radiofrequency ablation in sarcoma metastases and even less about microwave ablation. We present a series of patients who underwent thermoablation for sarcoma metastases with an introduction to the technical success and outcomes following these procedures.

Material and methods

A retrospective review of patients who had undergone radiofrequency or microwave ablation for sarcomatous metastases between 2006 and 2015. Multiple factors were evaluated including technical success, recurrence, reintervention as well as follow-up.

Results

A total of 17 patients (average age 55 years, male 58%) were referred. Primary tumours included gastrointestinal stromal tumours, leiomyosarcomas and myxofibrosarcomas with a total of 25 lesions. All lesions were situated in the right lobe of the liver (52% in segments VIII or IVA) with an average size of 18mm × 25mm; 17 lesions underwent 17 radiofrequency ablations, whereas 8 lesions underwent 11 microwave ablations. The technical success rate was 96.5% with only one procedural complication. Recurrence at the ablation site occurred in 43% RFA lesions and 12.5% MWA lesions following one or two ablations. The average time of recurrence was 14 months. The average survival following ablation was 40 months.

Conclusion

Thermoablation of sarcomatous metastases is a technically successful procedure with a favourable role in curative and palliative management algorithms. Early results are promising for microwave ablation.

P-287

The transradial versus transfemoral approach for hepatic chemoembolization: inpatient prospective single-center pilot study

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Purpose

To perform an intra-patient comparison between the transfemoral and transradial approach in a population of patients undergoing hepatic chemoembolization in terms of safety; feasibility; and procedural variables, including fluoroscopy time, radiation dose, and patient preference.

Material and methods

A single-center prospective intra-patient comparative pilot study was conducted enrolling patients with hepatic malignancies admitted to our Institution to receive two consecutive treatment sessions

of unilobar hepatic chemoembolization with a 4-week interval over a 4-month period. All procedures were performed by one interventional radiologist who assessed the eligibility of patients for inclusion in the study. Primary endpoints were access site complications and intraprocedural conversion rates. Secondary endpoints were angiographic, procedural variables, and evaluation of patient discomfort and preferences.

Results

Twenty consecutive patients were included in the study. A technical success of 100% and a crossover rate of 0% were registered. The transradial approach required a longer preparation time for the procedure with no significant differences for other procedural variables. Greater postprocedural discomfort at the access route and patient inability in performing basic activities were registered for the femoral approach. Eighty-five percent patients preferred the transradial approach for potential future transarterial procedures. There were no major vascular complications with a similar rate of minor complications (5%), that were self-limited and without any clinical sequelae.

Conclusion

The transradial approach was safe and feasible for hepatic chemoembolization, with high technical success; low overall complication rate; improved patient comfort and confidence; and no increase the fluoroscopy and total procedural time, radiation dose, and total amount of contrast medium administered to the patient.

P-288

Imaging of woodchucks (*Marmota monax*) with hepatocellular carcinoma and normal woodchucks: foundation for image-based therapy development

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Purpose

Define the imaging appearance and methodologies for normal woodchucks and woodchucks with hepatocellular carcinoma (HCC).

Material and methods

Animal Model

Neonatal woodchucks (*Marmota monax*) infected with woodchuck hepatitis virus (WHV) develop HCC that is similar in pathology and natural history to those associated with human hepatitis B. Woodchucks (2–6kg) with and without tumors were provided by Northeastern Wildlife (Harrison, ID). Animals that cleared the virus did not develop HCC and were used as non-tumor animals. All animal procedures were approved by the animal care and use committee of the NIH clinical center and performed in accordance with applicable federal regulations.

Imaging

Under anesthesia, ultrasound, multi-detector CT (MDCT), microCT, and MRI were performed demonstrating normal anatomy and mass lesions. For MDCT, the contrast was injected via the jugular vein with bolus tracking to initiate triple phase. After cut-down, a 3-F introducer sheath was placed in the femoral artery and 1.7–2.8-F microcatheters were used for visceral angiography focusing on the liver. Analysis of the segmented arteries provided a 3D geometric and anatomic description of the liver and tumor. Gross pathology and histology description were also obtained.

Results

Mass lesions were detectable under ultrasound and MRI. With triple phase MDCT, early-enhanced lesions were identified in the arterial phase. With larger lesions, extensive vascularity was observed. The explant pathology correlated with the imaging findings. Normal imaging anatomy was defined. 3D segmentation yielded vessel diameters and angles.

Conclusion

Imaging parameters and methodology for normal woodchucks and woodchucks with HCC are defined providing a guide for image-based interventions and evaluation as models of human therapies.

P-289

Effective dose calculations for fluoroscopy-guided pediatric abdominal interventions using Rando-Alderson phantoms

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Purpose

To calculate the effective dose during fluoroscopy-guided pediatric interventional procedures of the liver in a phantom model before and after adjustment of preset parameter settings.

Material and methods

Organ doses were measured in three anthropomorphic Rando-Alderson phantoms representing children at various ages and body weights (newborn 3.5kg, infant 10kg, child 19kg). Collimation was performed focusing on the upper abdomen representing mock interventional radiology procedures such as percutaneous transhepatic cholangiography and drainage placement (PTCD). Fluoroscopy and digital subtraction angiography (DSA) acquisitions were performed in a posterior–anterior geometry using a flat-panel detector system. Effective dose was measured directly from multiple incorporated thermoluminescent dosimeters (TLDs) using two different parameter settings.

Results

Effective dose values for each pediatric phantom were below 0.1 mSv per minute fluoroscopy and below 1 mSv for 1 minute DSA acquisition with a frame rate of 2/s. Lowering the values for the detector entrance dose enabled a reduction of the effective dose from 12% to 27% for fluoroscopy and from 22% to 63% for DSA acquisitions. Similarly, organ doses of radiosensitive organs could be reduced by over 50%, especially when close to the primary X-ray beam.

Conclusion

Modification of preset parameter settings enabled to decrease the effective dose for pediatric interventional procedures, as determined by effective dose calculations using dedicated pediatric Rando-Alderson phantoms.

P-290

Improvement of AAV-mediated liver transduction efficacy by regional administration in *Macaca fascicularis*

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Purpose

To improve the transduction efficacy of the liver by conveying the vector [recombinant adeno-associated virus (AAV)] directly to the hepatic tissue.

Material and methods

Interventional radiology procedures were used to administer an AAV5 vector expressing a secreted form of human embryonic alkaline phosphatase (hSEAP) to an animal model. Balloon occlusion of the hepatic venous flow was performed while injecting the vector either into the hepatic artery (HA) (3 animals) or via the suprahepatic vein (SHV) (3 animals). In both cases, the vector was injected into the right lobe and the two routes were compared to the intravenous (IV) administration (2 animals). Serum samples were obtained for the analysis of biochemical parameters, viral shedding, and transgene expression. Nasal secretion, saliva, urine, and feces samples were also collected in order to analyze viral shedding. Animals were sacrificed on day 120. The liver was dissected and samples of 8 regions were obtained.

Results

Hematological analysis revealed no acute hematological toxicity. All groups tested positive for vectors in all fluids analyzed. The HA group eliminated more vector via the urine and saliva shortly after administration, while the SHV group had the highest number of vector genome copies in the feces. Higher hSEAP levels were obtained when the vector was administered via SHV or HA than those when it was intravenously administered. Higher expression levels correlated with a higher number of vector genomes in the injected lobes.

Conclusion

Direct administration of AAV vectors with simultaneous balloon occlusion of the hepatic outflow increases the liver transduction efficacy.

P-291

Fiber optic sensors for temperature monitoring during radio-frequency liver ablation: in vivo animal trials

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Purpose

This study aimed to assess the feasibility of a designed needle-like probe for temperature measurement during percutaneous ablation procedures in an in vivo animal model.

Material and methods

A needle-like probe based on optical fibers (3 fiber Bragg gratings) housed within a 21 Gauge needle has been specifically designed for temperature monitoring during radiofrequency ablation (RFA). A 6-month-old healthy female pig has been adopted as the animal model; an ultrasound-guided RFA procedure has been performed on healthy liver parenchyma under free breath conditions. The RFA needle (Star Electrode Fixed type, STARMed®, Korea) measures 17 Gauge, with an active length of 20 mm.

Results

After positioning the RFA needle into the liver parenchyma, the needle-like probe was inserted at a distance of 11mm from the RFA needle tip in order to measure the temperature distribution in the surrounding tissues. The ablation process lasted for 350s, with a power of 80W. The temporal temperature evolution was measured by fiber optic sensors. After a short time of overall temperature increase (from 0s to 30s), the sensors experienced a regular change of temperature (consecutive decrements and increments) due to the power roll-off of the RF energy delivering. The measurement error induced by breathing movements of the liver was <3°C.

Conclusion

Fiber optic sensors seem to be a valuable system to monitor tissue temperature in course of RFA procedures; this gives a real-time

feedback to the interventionalist concerning the temperature distribution, with a consequent safer approach to the lesion and healthy tissues.

P-292

Thermometry based on computed tomography images during microwave ablation: ex vivo trials on porcine liver

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Purpose

Temperature knowledge may be beneficial to improve the outcomes of thermal treatments for tumor ablation. Among several thermometric methods, contactless approaches based on diagnostic imaging techniques are attractive in this field. Computed tomography (CT) images are sensitive to temperature; thus, some groups of researchers are working on the assessment of the feasibility of CT-based thermometry for monitoring the effects of thermal treatments.

The aim of this study is to assess the feasibility of CT-based thermometry during microwave ablation (MWA) in an ex vivo animal model.

Material and methods

Healthy porcine livers were heated with two 2.45 GHz cooled-shaft MW antennas for 4 minutes at 65 W for each probe. Livers were scanned before heating 16 times during the ablation (for 15 s each). Liver temperature was measured at two points by two thermocouples.

Results

The relationship between the CT number (Hounsfield Unit, HU) and tissue temperature was investigated using linear regression analysis; thermal sensitivity of the CT number was estimated as the slope of the best fitting line. Results showed that CT number in liver tissue decreases during heating. The relationship between CT number and temperature is well described by a linear model ($R^2=0.91$), and the thermal sensitivity is $-0.52 \pm 0.02 \text{ HU}^\circ\text{C}^{-1}$.

Conclusion

CT-based thermometry is feasible during MWA in ex vivo porcine livers. This technique is particularly attractive due to its non-invasive nature and can be used to monitor three-dimensional temperature distributions in heated tissues. Therefore, it may provide a powerful new tool during MWA or other thermal ablation procedures.

P-293

The effect of TIPS on platelet clearance in patients with liver cirrhosis

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Purpose

Intensive platelet clearance plays a major role in platelet count decline in cirrhotic patients. Platelet clearance in vivo involves removal by hepatocytes and macrophages and thrombosis subsequent to platelet activation. The purpose of this study was to evaluate the effect of TIPS on platelet clearance in patients with liver cirrhosis.

Material and methods

Overall, 31 cirrhotic patients who underwent TIPS placement were included in this study. Peripheral venous blood samples were obtained before and 1 week after TIPS and at the 3–6 month

follow-ups. Platelet surface expression of β -Gal and β -GlcNAc, which specifically bind to the receptors of liver cells and macrophages, was labeled by FITC-sWGA and FITC-RCA-1, respectively, and detected by flow cytometry. Platelet surface expression of GPIIb/IIIa was labeled by PAC-1. Platelet count and MPV were investigated before and after TIPS and during follow-up.

Results

TIPS placement was successful in all patients. Platelet counts before TIPS, after TIPS, and during follow-up were $97.0 \pm 86.3 \times 10^9/L$, $87.2 \pm 50.6 \times 10^9/L$, and $89.6 \pm 45.2 \times 10^9/L$, respectively, with no significant difference. The platelet surface expression level of β -Gal significantly increased after TIPS placement ($8.5\% \pm 8.2\%$ vs. $13.9\% \pm 14.6\%$, $P=0.01$), but it decreased to the baseline during follow-up ($9.6\% \pm 9.9\%$). There was no significant difference in the platelet surface expression level of β -GlcNAc among before TIPS, after TIPS, and during follow-up ($11.5\% \pm 12.7\%$, $14.6\% \pm 14.5\%$, and $12.2\% \pm 8.0\%$, respectively, $P>0.05$). TIPS induced a constant and significant decrease in the platelet surface expression level of GPIIb/IIIa ($37.1\% \pm 25.3\%$, $9.4\% \pm 17.5\%$, $5.5\% \pm 15.0\%$, respectively, $P<0.05$). MPV significantly decreased after TIPS placement ($11.7 \pm 0.9 fL$ vs. $11.1 \pm 0.9 fL$, $P<0.05$).

Conclusion

TIPS has no effect on platelet clearance by hepatocytes and macrophages but can decrease platelet activation and platelet turnover.

P-294

Effects of transjugular intrahepatic portosystemic shunts on platelet activation and change in platelet count

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Purpose

Platelets play a key role in liver homeostasis and pathobiology. Patients with cirrhosis and portal hypertension are commonly associated with thrombocytopenia. Transjugular intrahepatic portosystemic shunt (TIPS) placement has poor effect on increasing platelet count. However, TIPS placement can reduce the serum lipopolysaccharide (LPS) level which may impact platelet activation. Therefore, we investigated if TIPS placement has an effect on platelet activation.

Material and methods

Thirty-five patients who had undergone TIPS placement were enrolled. Platelet activation was detected by the PAC-1 expression level. PAC-1 expression levels and serum lipopolysaccharide (LPS), platelet microparticles (PMPs), vascular endothelial growth factor (VEGF), and thrombospondin 1 (TSP-1) levels were investigated before and after TIPS placement. The effect of LPS on platelet activation was studied in vitro.

Results

PAC-1 expression levels were significantly decreased after TIPS placement ($37.09\% \pm 25.35\%$ vs. $19.40\% \pm 17.50\%$, $p<0.05$). Serum LPS ($44.80 \pm 26.35 pg/ml$ vs. $28.02 \pm 10.16 pg/ml$, $p<0.05$), PMPs ($301.40 \pm 77.35 \times 10^5/ml$ vs. $132.80 \pm 43.48 \times 10^5/ml$, $p<0.05$), and TSP-1 ($7.14 \pm 2.04 \mu g/ml$ vs. $5.34 \pm 1.25 \mu g/ml$, $p<0.05$) levels were significantly decreased. No significant change was observed in VEGF levels ($20.17 \pm 4.51 pg/ml$ vs. $24.21 \pm 5.64 pg/ml$, $p>0.05$) after TIPS placement. The in vitro study showed that LPS at a level equal to the mean level before TIPS placement amplified platelet response to the agonists. LPS changed the profile of platelet secretion; compared with the control, LPS stimulated platelets released higher TSP-1 and lower VEGF.

Conclusion

TIPS placement decreased the serum LPS level and attenuated platelet activation, simultaneously changing the profile of platelet secretion.

P-295

Endovenous laser ablation: a new strategy for treatment of varicoceles

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Purpose

Our study aim was to show the potency of endovenous laser ablation for the treatment of varicoceles.

Material and methods

Thirteen patients (with Bahren type I varicoceles) were percutaneously treated by our team using a radial 1470-nm laser fiber right after cannulating the gonadal vein. Our approach started from the right basilic vein in 10 cases and through the right common femoral vein in 3 cases. The laser fiber was inserted coaxially into a 5-French 70- or 90-cm-long sheet till the distal portion of the spermatic vein. As per the company protocol, we applied an energy/cm between 40 and 50 J at 5 Watt (power) in a continuous wave manner at three different positions on the left spermatic vein just below L3. This procedure does not require general anaesthesia, and we could manage patients under conscious sedation in day surgery modality. We considered the occlusion of the spermatic vein under venographic control as our target for technical success. We also evaluated pain for 2 consecutive days postoperatively and performed color Doppler ultrasound (CDUS) 1 week, 1 month, and 3 months thereafter.

Results

With respect to technical success, we achieved good results in stopping the flow in all 13 cases. CDUS showed no varicocele recurrences at the 1st and 3rd month. We encountered two small vein lacerations, asymptomatic and without sequelae.

Conclusion

According to our experience, EVLA in patients with Bahren type I varicoceles can be considered as a safe and achievable treatment.

P-296

Use of radial access in the Thiel cadaveric flow model for training in endovascular interventions

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Learning Objectives

To introduce a human cadaveric model for training in endovascular interventions through the radial access (RA).

Background

Interest in RA is gradually increasing with mounting evidence of its clinical benefits, particularly the lower incidence of bleeding and vascular complications. However, RA requires a steep learning curve and is technically challenging because of anatomical complexities, such as subclavian artery tortuosity and radioulnar loops. More catheter exchanges are requested, with a consequent increase in procedure and radiation time and volume of contrast used. Recent data suggest that the exposure time using RA approaches that using transfemoral access with an increase in the experience of the operator.

Clinical Findings/Procedure

Proof of concept was demonstrated using a Thiel-embalmed human cadaver with extracorporeal arterial flow. The extracorporeal circuit was prepared by inserting ports into the right auxiliary and femoral arteries and connected to a heart-lung bypass machine to provide continuous retrograde flow of up to 1 L per minute. Left RA was gained through ultrasound guidance using a 5-F sheath. Aortic and coronary angiogram, coronaroplasty, renal and lower limb angiography, and angioplasty were performed by a senior interventionalist, showing the patency and accessibility of vessels through RA. All endovascular procedures were conducted under fluoroscopic guidance using contrast.

Conclusion

Thiel cadavers have the potential to provide a robust and realistic training model for fellows and consultants who want to improve or practice interventions. Using the Thiel-embalmed human cadaver for training in endovascular peripheral intervention through RA is feasible and could reduce the learning curve for endovascular procedures.

P-297

Paediatric interventional management of a primary aortoenteric fistula (PAEF)

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Following responsive chemotherapy cycles, a 16-year-old testicular cancer patient presented with ongoing herald haematemesis. CT aortogram revealed a subtle aortic beaking encased by a chronic para-aortic soft-tissue mass. Urgent aortic endovascular repair of PAEF ensured survival. This was published into local news.

P-298

Simulation of endovascular embolization for visceral artery aneurysms with 3D-printed hollow models

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We simulated embolization of visceral artery aneurysms using 3D-printed models with catheters and embolic agents before treatment and successfully treated patients. Preoperative simulation with 3D-printed models is useful for establishing the treatment plan and improving safety.

P-299

Absolute ethanol ablation of a hepatocellular carcinoma tumor using intracardiac echo (IVUS/ICE) monitoring

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A 58-year-old male with cirrhosis and HCC treated by surgical resection presented with recurrence along the surgical margin that was ablated using percutaneous ethanol infusion and monitoring using an intracardiac echo probe. This is the first described case of PEA using intracardiac echo monitoring.

P-300

Covered endoprosthesis to re-establish patency of a neo external auditory canal

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A patient with reconstructed external auditory canal (EAC) with a temporal flap and marsupialization presented with hearing loss due to an internal tube displacement. A covered stent was placed from the residual proximal EAC through the temporal flap onto the exterior.

P-301

First endovascular retrieval of the CardioMEMS Heart Failure System

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First described retrieval of the CardioMEMS Heart Failure System, a pulmonary artery pressure monitoring system used to assist the managing of patients with heart failure.

GI tract intervention

P-302

Endovascular management of pancreatitis-related bleeding: a single-center experience

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Purpose

To assess the outcome of endovascular interventions in the management of pancreatitis-related bleeding.

Material and methods

Retrospective analysis of patients referred for endovascular management of pancreatitis-related bleeding from January 2009 to December 2016 was performed. Patient demography, angiography findings, details of endovascular procedure, technical outcome, clinical outcome, and complications were assessed.

Results

Overall, 105 patients (99 male and 6 female) with a mean age of 37 years (range, 7–73 years) were included in the study. Splenic artery (41.7%) was the most commonly involved vessel. Middle colic, left colic, SMA, jejunal, left inferior phrenic, and left renal subcapsular arteries were the uncommonly involved vessels. Embolization was done using coil in 68.5% patients, N-butyl cyanoacrylate (NBCA) in 20% patients, and both coil and NBCA in 7.6% patients and four patients underwent stentgraft placement. Technical success was achieved 98% patients (n=103). Hemostasis was not achieved in two patients who underwent surgery. Clinical success was achieved in 93.2% patients (n=96). Rebleeding was seen in 6.8% patients (n=7). Six patients with rebleeding were managed by reintervention. Four patients had rebleeding from same vessel, and 2 patients had bleeding from different vessel. One patient died due to massive

rebleeding. Minor complications were seen in 14.2% (n=15), and major complications were seen in 3.8% (n=4). Mortality rate was 0.9% (n=1).

Conclusion

Endovascular treatment is effective in management of pancreatitis-related bleeding and is associated with a low rebleeding rate and a low mortality rate.

P-303

Direct percutaneous puncture and embolization of visceral pseudoaneurysm: safety and clinical efficacy

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Purpose

To assess the safety and clinical efficacy of direct percutaneous puncture and embolization in the treatment of visceral pseudoaneurysms.

Material and methods

Retrospective analysis of all patients undergoing direct percutaneous puncture and embolization between January 2007 and December 2016 was performed. The study included 22 patients (18 males and 4 females) with a mean age of 34.6 years (range 10–71 years). Indications for direct percutaneous embolization were difficult catheterization of the feeding artery or previous embolization of the proximal artery and inability to access the distal artery across a large pseudoaneurysm. Patients demography, details of the endovascular procedure, procedure-related complications, and clinical outcomes were evaluated. Patients were followed up for recurrence or rebleeding from the pseudoaneurysm (median follow-up was 15 months).

Results

Twenty-one patients had pancreatitis related pseudoaneurysm and 1 patient had postoperative pseudoaneurysm. The splenic artery was the most commonly involved vessel (n = 14). Six patients had undergone prior embolization of the feeding artery and 16 patients had difficult catheterization. N-butyl cyanoacrylate (NBCA) was used in 14 (63.6%) patients, a coil was used in 1 (4.5%) patient, and both coil and NBCA were used in 7 (31.8%) patients. Embolization of the pseudoaneurysm was successful in all cases. No procedure-related complication was observed. Follow-up showed no recurrence of pseudoaneurysm or rebleeding. Self-limiting splenic infarct was observed in 5 (22.7%) patients.

Conclusion

Direct percutaneous puncture and embolization is safe and effective for the treatment of visceral pseudoaneurysms and can be considered as an alternative in patients with failed endovascular approach.

P-304

Arterial embolization before reconstructive gastropasty

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Purpose

Esophageal neoplasia elective surgery is associated with a 20% morbidity and mortality. The main cause of complications was anastomotic leakage because of ischemia of the fundus. To minimize this complication, gastric arterial preconditioning was performed prior to surgery by embolization of the right gastric arteries (RGA), left

gastric arteries (LGA), and splenic artery (SA) with the aim of hypertrophying the right gastroepiploic artery.

The aim of this study was to demonstrate the safety of gastric arterial preconditioning prior to reconstructive gastropasty in patients with esophageal neoplasia.

Material and methods

A retrospective study of a series of 50 patients diagnosed with esophageal cancer with indication of surgery in whom gastric splenic arterial embolization was performed between January 2011 and December 2016. Embolized arteries, materials used, and associated complications were analyzed.

Results

A total of 40 men and 10 women were treated (mean age, 61 years). All three arteries were embolized in 15 cases (30%), SA and LGA were embolized in 31 cases (64%), and only SA was embolized in 3 cases (6%). Eighty-nine arteries with coils and 21 with vascular blockage were embolized. Four complications were observed in four patients: two postoperative hematomas, one pancreatitis, and one LGA dissection.

Conclusion

Gastric artery conditioning is a safe technique prior to reconstructive gastropasty in patients with esophageal neoplasia.

P-305

Complications following radiologically inserted gastrostomy in patients with head and neck cancer

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Purpose

Patients with head and neck cancer frequently require enteral tube feeding due to the disease location and/or treatment-related side effects. The optimal route for delivering enteral nutrition remains controversial. At our tertiary cancer centre, we place nasogastric and gastrostomy feeding tubes. This study assesses the complications associated with radiologically inserted gastrostomies (RIG) in this patient population.

Material and methods

Outcomes were collected prospectively for all patients diagnosed with head and neck cancer who had a gastrostomy tube placed between January 2015 and June 2016. Complications were classified using the Grant et al. (2009) criteria and were analysed and compared to those described by Grant et al. using a chi-squared test with a 2x2 contingency table.

Results

In this cohort of 207 patients, 194 patients received RIG. Two procedure-related mortalities were recorded (1%); there were 6 major complications (2%) and 11 minor complications (6%). Our mortality rate was not significantly different from that reported by Grant et al.; however, our major and minor complication rates were significantly better (p < 0.05).

Conclusion

Although our RIG-related mortality rates were comparable to the literature, both major and minor complication rates were significantly lower than the reference rate. We speculate that our comparatively low complication rate may be accounted for by careful patient selection using a multi-disciplinary approach and the relatively high volume of RIGs placed. Therefore, we suggest that RIG insertion is best performed in centers with a high case load where multi-disciplinary support is readily available.

P-306

Usefulness of the vascular closure device for closure of the gastrostomy opening

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Purpose

To evaluate the feasibility and usefulness of applying Perclose ProGlide vascular closure device (PPVCD) for closure of gastrostomy opening in swine stomach.

Material and methods

Gastrostomy was performed within 12 hours after extirpation and serially dilated to 18 F. There were 4 experimental groups: one manual suture (n=10), two manual suture (n=10), one PPVCD suture (n=10) and two PPVCD suture (n=5). In the two PPVCD suture group, the 'pre-closure' technique was used. The pressure to leakage was measured, and statistical analysis was performed to compare the pressure to leakage between the experimental groups.

Results

The gastrostomy openings were successfully closed in both manual and PPVCD suture groups. The median (range) values of pressure to leakage (mmHg) for each experimental group were as follows: one manual suture group, 86.0 (75.0–110.0); two manual suture group, 98.5 (44.0–130.0); one PPVCD suture group, 96.5 (56.0–119.0) and two PPVCD suture group, 98.0 (66.0–104.0). Mann-Whitney U test showed no statistically significant difference in the values of pressure to leakage between the manual (n=20) and PPVCD suture groups (n=15). Kruskal-Wallis test showed no statistically significant difference in the values of pressure to leakage between the four experimental groups. Bonferroni post hoc test also showed that there was no statistically significant difference between every two-group pair comparisons.

Conclusion

Application of suture-mediated vascular closure device for closure of gastrostomy opening in swine stomach is a feasible and useful method.

P-307

Percutaneous closure for gastrostomy opening using suture-mediated vascular closure device in a swine model

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Purpose

To evaluate the feasibility and safety of Perclose ProGlide vascular closure device (PPVCD) application for percutaneous closure of gastrostomy opening in a swine model.

Material and methods

A 2-week survival study was performed. Percutaneous gastrostomy was created in a usual manner, and a 13-Fr opening was closed using one PPVCD (n = 3) and a 20-Fr opening was closed using two PPVCD with a pre-closure technique (n = 3). The condition of all pigs was observed with periodic measurement of body weight and temperature. Blood sampling for CBC, ESR, and CRP was also performed. After 2 weeks, autopsy was performed to check for healing of the

closed gastrostomy opening, status of the suture, and any possible complications. Microscopic examination of the closed gastrostomy opening was also performed.

Results

During the 2 weeks of survival, all pigs showed usual weight gain and no symptom or signs of peritonitis. On the autopsy, all pigs showed unremarkable suture and healing of the gastrostomy opening. One pig which had a 20-Fr gastrostomy showed scanty fluid in the peritoneal cavity. However, fever was not developed and weight gain and laboratory findings were normal. En bloc tissue samples of all pigs demonstrated complete wound healing.

Conclusion

Percutaneous application of PPVCD is feasible and safe to close a percutaneous gastrostomy in a swine model.

P-308

Disconnected pancreatic duct syndrome: occlusion with n-butyl-cyanoacrylate

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Purpose

Disconnected pancreatic duct syndrome (DPDS) is a clinical entity consisting of the absence of continuity of the pancreatic duct caused by inflammatory pathology (pancreatitis) or iatrogenesis. The functioning parenchyma of the disconnected pancreatic tail continues its exocrine secretion without being drained to the papilla, producing a persistent fistula that has difficulty in spontaneous resolution. Treatment options include endoscopy (insertion of a transpapillary stent covering the fistula) or surgery (caudal pancreatectomy). Studies on percutaneous occlusion for DPDS are very scarce in literature. The aim of this study was to describe the percutaneous occlusive technique used for DPDS and present the results in subsequent clinical controls.

Material and methods

Retrospective studies were performed in seven patients diagnosed with DPDS (five caused by iatrogenesis and two caused by inflammation) with drainage catheter of peripancreatic collections associated with the fistula. Selective catheterization of the distal pancreatic duct was performed from the percutaneous drainage of the collection. The duct was occluded by injecting n-butyl-cyanoacrylate with lipiodol.

Results

Five men and two women were successfully treated (mean age of 51 years) with complete resolution of the fistula and permanent occlusion of the duct. A complication occurred in one patient, with pain requiring intravenous pharmacological management for 48 hr. Two patients had a residual cyst in front of the pancreatic body that underwent spontaneous resolution during follow-up.

Conclusion

Percutaneous occlusion is an effective treatment for DPDS that can be used as an alternative when endoscopic or surgical treatment fails.

P-309

Long-term outcome of retrieval stent filter for Budd-Chiari syndrome complicated with inferior vena cava thrombosis

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Purpose

To present long-term results of an 11.6-year followup of retrieval stent filter for Budd-Chiari syndrome (BCS) complicated with

inferior vena cava (IVC) thrombosis, and to evaluate the clinical value and applicability of this treatment.

Material and methods

Forty consecutive BCS patients complicated with IVC thrombosis (32 male and 8 female; average age, 51.1±10.3 years; age range, 28–76 years) were treated with retrieval stent during an 11.6-year period. The median duration of symptoms was 24 months. A retrieval stent was placed after predilation of the obstructed IVC, and then, agitation thrombolysis or catheter-directed thrombolysis of IVC was performed, retrieval stent was removed eventually after thrombus disappeared, and postdilation of IVC was performed if necessary. Clinical patency was defined as absence or improvement of symptoms. Patients were subsequently followed up by colour Doppler ultrasound, telephone calls, or both.

Results

Stent filter placement, balloon angioplasty, and thrombolysis were technically successful in all patients; stent filters removal was technically successful in 97.3% patients. The diameter of retrohepatic IVC and diaphragm IVC significantly increased, and the length and thickness of IVC thrombus decreased after treatment. A few serious related complications, including one acute pulmonary thromboembolism, one stent migration, one failure of retrieval, occurred. Patients were followed up for a median of 43.7 months. The long-term results were satisfactory in all except 2 patients who presented with a restenosis or reobstruction and underwent additional therapy. There were 5 deaths owing to PTE or underlying malignant disease.

Conclusion

Retrieval stent filter treatment is safe and effective for BCS complicated with IVC thrombosis, with a good long-term outcome.

P-310

Superselective endovascular embolization with “n-butyl 2-cyanacrylate” in acute gastrointestinal bleeding cases

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Background

Despite advances in medical management, acute gastrointestinal bleeding remains a major cause of morbidity and mortality. Multidetector computed tomography is the most accurate imaging modality to detect and localize the site of gastrointestinal bleeding. Interventional endoscopy and angiography are the quickest and least-invasive therapies for controlling acute gastrointestinal bleeding. Nowadays, many embolic materials are used to control acute gastrointestinal bleeding.

Clinical Findings/Procedure

The purpose of this poster is to illustrate 1) indications of, 2) methods of preparation of, and 3) methods of delivery of the liquid embolic material consisting of a combination of “n-butyl 2-cyanacrylate” and lipiodol in acute gastrointestinal bleeding cases.

Conclusion

Superselective endovascular embolization is a well-accepted treatment for acute gastrointestinal bleeding cases. The combination of “n-butyl 2-cyanacrylate” and lipiodol is considered as one of the embolic materials for the treatment of acute gastrointestinal bleeding owing to its safety and efficacy.

P-311

Acute post-pancreaticoduodenectomy hemorrhage: clinical presentation and endovascular management

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Background

Acute post-pancreaticoduodenectomy hemorrhage is a rare but potentially fatal condition and has to be treated in emergency settings. Multidisciplinary discussion of such patients is mandatory in the fields of interventional radiology, surgery, and anesthesiology. The most alarming arterial complication of post-pancreaticoduodenectomy is gastroduodenal artery or superior mesenteric artery branch vessel pseudoaneurysm formation, with its possible rupture and consequent acute hemorrhage. In these possible settings, interventional radiology may play a significant role in endovascular treatment.

Clinical Findings/Procedure

The aim of this poster is to describe the i) pathophysiological mechanisms leading to pseudoaneurysm-related arterial complications, ii) imaging modalities (MD-CT and DSA), and iii) interventional radiology endovascular treatment of acute post-pancreaticoduodenectomy hemorrhage.

Conclusion

Acute post-pancreaticoduodenectomy hemorrhage is a rare complication; when it occurs, emergency endovascular treatment is mandatory. The use of interventional radiology in such cases offers effective and minimally invasive endovascular therapeutic options.

P-312

Technique of intra-arterial transcatheter embolization in acute gastrointestinal bleeding: indications and limitations based on experiences at our center

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Learning Objectives

1. To review and emphasize the role of interventional radiologists in the management of arterial gastrointestinal hemorrhage.
2. To illustrate several cases of embolization of gastrointestinal hemorrhage performed at our institution in the last five years.

Background

Between January 2012 and January 2017, 57 patients (30 males and 27 females, median age 60 years) with active upper GI bleeding underwent urgent angiographic evaluation; in 45 patients, endovascular treatment with embolization was followed, and in remaining 12 patients, no active bleeding was recognized during angiography. Abdominal pain and upper gastrointestinal bleeding occurred in all patients with active hematemesis. All patients were hemodynamically unstable and previously subjected to unsuccessful endoscopy. A CT angiography for identifying the cause and area of bleeding was performed prior to intra-arterial transcatheter embolization.

Clinical Findings/Procedure

Superselective catheterization of active bleeding vessels was achieved with the use of a microcatheter. Embolization was performed with the use of microspheres in 31 patients and microcoils

in 14 patients. The technical success rate was 100%. Bleeding was stopped in all patients during the initial angiographic evaluation, and only 3 patients required re-embolization. No major complications occurred.

Conclusion

According to our experience, intra-arterial transcatheter embolization is a safe and effective treatment in all patients with upper GI bleeding and unsuccessful endoscopy. Surgery should be reserved for hemodynamically unstable patients in whom the embolization procedure unsuccessful or not available.

P-313

Transcatheter arterial embolization with n-butyl cyanoacrylate-lipiodol for acute colonic diverticular hemorrhage

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Learning Objectives

To retrospectively evaluate the efficacy and safety of transcatheter arterial embolization (TAE) with n-butyl cyanoacrylate-lipiodol (NBCA-Lip) for acute colonic diverticular hemorrhage.

Background

The study included 19 patients (9 women and 10 men; mean age, 69 years) with acute colonic diverticular hemorrhage who were treated by embolization with NBCA-Lip alone from December 2006 to September 2016. Eight patients (42%) received anticoagulant or antiplatelet therapy and sixteen patients (84%) developed hemodynamic instability before TAE. NBCA-Lip was chosen as the embolic agent when the microcatheter reached the vasa recta corresponding to the bleeding point. The mixing ratio was decided depending on the blood velocity and distance between the microcatheter tip and target. Almost all patients underwent colonoscopy within 1 month after TAE, and ischemic complications (ulcer, scar, and necrosis) were evaluated.

Clinical Findings/Procedure

The embolization was successfully performed in all cases. There was no rebleeding from the same diverticula during the follow-up period. NBCA-Lip ratios used in TAE were 1:1 (n=1), 1:1.5 (n=5), 1:2 (n=8), 1:3 (n=3), 1:5 (n=1), and 1:7 (n=1). One patient underwent right hemicolectomy for necrosis of terminal ileum after undesired embolization of five vasa recta. Ischemic changes were observed endoscopically in eight patients (33%); however, no additional treatment was needed.

Conclusion

TAE with NBCA-Lip for acute colonic diverticular hemorrhage is safe and effective and seems especially useful in cases with hemodynamic instability or coagulopathy.

P-314

Gastrointestinal fistulas: clinical findings and interventional management

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Learning Objectives

1. To discuss fistulas in the digestive tract, including their clinical and therapeutic features and imaging modalities.
2. To provide an overview of the various interventional management methods of fistulas in the digestive tract.

Background

Postoperative gastrointestinal (GI) fistula represents a major complication of GI surgery, leading to increased postoperative morbidity; it is the foremost cause of mortality after intestinal resection. Identification of risk factors is essential for its prevention. GI fistula can present with various clinical features, ranging from the absence of symptoms to life-threatening septic shock. As an alternative to surgery, recent technical advances in interventional radiology and percutaneous techniques have been shown to be advantageous in lowering the morbidity and mortality rates and allowing superior accessibility to the fistulous tracts via the use of fistulography.

Clinical Findings/Procedure

- 1) Introduction
- 2) Clinical Features of GI Fistulas
- 3) Imaging Modalities of GI Fistulas
- 4) Interventional Management of GI Fistulas

Conclusion

Interventional management of GI fistulas is a valuable non-surgical therapy for seriously ill patients and a comprehensive treatment option.

P-315

Biodegradable stents in benign biliary strictures: safety, feasibility, and short-term results

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Learning Objectives

1. To review the current literature regarding the treatment of benign biliary strictures.
2. To investigate feasibility, safety, and efficacy of biodegradable resorbable stents (BRSs) in a group of patients with benign biliary stenosis refractory to other treatments.

Background

Benign biliary strictures are mainly iatrogenic, resulting in vascular or direct injury during laparoscopic cholecystectomy and other biliary procedures or after liver transplantation. Patients may experience pain, jaundice, and pruritus or may present liver function test alterations. If untreated, benign biliary strictures may lead to secondary biliary cirrhosis. First-line treatment includes ERCP sphincterotomy or repeated balloon dilatation with percutaneous biliary drainage placement.

Clinical Findings/Procedure

In our department, patients with benign biliary strictures are managed with cholangioplasty and biliary drainage placement as the first-line treatments. If the stenosis persists, patients become candidates for BRS placement. In 2016, nine patients were treated with this technique: five cases with hepaticojejunostomy strictures secondary to cholecystectomy or DCP, two cases with strictures after liver transplant, and the remaining two with stenosis due to main bile duct inflammatory insult. At the six-month follow-up, no patient experienced any major complication or BRS displacement, with no cases of restenosis.

Conclusion

- Our data support the use of BRS as a safe, feasible, and successful treatment option, with no complications or restenosis at the six-month follow-up.

- Further studies are needed to estimate the long-term efficacy of BRSs.

P-316

The role of interventional radiologists in improving nutrition

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Learning Objectives

To describe various techniques by which an interventional radiologist can help in improving nutrition in patients who are unable to take nutritional supplements orally.

Background

Malnutrition in patients can result in increasing morbidity and mortality. It can also prolong the stay in hospital. Hence, in patients who are unable to take nutritional supplements orally, nutrition is provided through the parenteral or enteral route.

Clinical Findings/Procedure

Parenteral nutrition:

Total parenteral nutrition is usually administered through a central line or a peripherally inserted central catheter when the bowel function is abnormal or suboptimal or when the patient is critically ill. Indications include inadequate absorption resulting from short bowel syndrome, gastrointestinal fistula, bowel obstruction, and severe malnutrition with electrolyte imbalance. A single dedicated lumen should be used for parenteral nutrition.

Tube feeding:

Nasoenteric tube feeding

Through nasogastric, nasoduodenal, and nasojejunal tubes; nasojejunal tubes are inserted when there is high risk of reflux/aspiration of contents into the lungs.

Enterostomy tube feeding

This includes the radiological insertion of gastrostomy, fluoroscopically-inserted percutaneous endoscopic gastrostomy, and jejunostomy tubes.

Stents in cases of malignant obstruction:

Esophageal and gastroduodenal stents are deployed in cases of malignant obstruction as a palliative measure so that the subsequent oral or nasoenteric tube feeding can resume.

Success rate and complications are also discussed.

Conclusion

Nutrition of patients should not be ignored. Interventional radiologists can definitely play a role in improving the nutrition of patients.

P-317

Oesophageal stenting: factors affecting the choice of stent and tips to achieve best patient outcome

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Learning Objectives

1. To discuss various factors affecting the choice of endoprosthesis in stenting a variety of malignant and benign oesophageal pathologies.
2. To illustrate with examples, common pitfalls in oesophageal stenting and provide tips and tricks to achieve the best patient outcome.

Background

Oesophageal stents are commonly used either as means of palliation or as a bridge to definitive chemoradiotherapy or surgery for treating malignant oesophageal strictures. They are also used to treat a variety of benign conditions, including anastomotic leaks, perforations, fistulae and peptic and post-radiation strictures. Over 30 different types of stents are currently available, including self-expandable metal stents, which can be braided or knitted and fully

or partially covered, self-expandable plastic stents and biodegradable stents. Some of these have specific anti-migration features and many have an optional anti-reflux valve. Knitted stents provide superior conformability. Braided stents tend to expand faster but may cause more pain.

Clinical Findings/Procedure

Each of these stents has its advantages and limitations; a patient-tailored selection taking into account the pathology, anatomy and future plan of management is required to achieve the best patient outcome. Stent migration is a common problem across the cardia, occurring on an average in 18% of patients. Angulated anatomy is a challenging factor for rigid stents that may cause impaction of stent ends or increased pain. We illustrate a range of stents, their differing characteristics and patient factors which should indicated the choice of stents.

Conclusion

A large variety of oesophageal stents are available and an understanding of their different characteristics is essential for achieving the best patient outcome.

P-318

Diagnosis and management of transanastomotic portosystemic varices

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Learning Objectives

1. To recognise that portosystemic varices develop across surgical anastomoses in the presence of portal hypertension and pose a high risk of recurrent, life-threatening gastrointestinal haemorrhage.
2. To recognise that such varices are more common than generally expected and may easily be overlooked on cross-sectional imaging.
3. To understand that most varices are best managed via a transportal approach.

Background

Transanastomotic portosystemic varices develop in patients with portal hypertension. A well-recognised site of the former is around enterostomies, resulting in so-called stomal varices. A much less well-recognised site of involvement is across the jejunoduodenal anastomosis of a pancreatic transplant. Such varices pose a high risk of recurrent life-threatening gastrointestinal haemorrhage, and prognosis is extremely poor as they often go unrecognised.

Clinical Findings/Procedure

Transanastomotic portosystemic varices are best managed via a transportal approach with retrograde catheterization of the transanastomotic varices and sclerotherapy. In addition to describing the successful use of this technique for managing stomal varices, this educational poster reports the first successful management of varices related to a pancreatic transplant using the same approach.

Conclusion

Portosystemic varices develop across surgical anastomoses in the presence of portal hypertension and pose a high risk of recurrent, life-threatening gastrointestinal haemorrhage. Such varices are more common than generally expected and may easily be overlooked on cross-sectional imaging. They can be successfully managed by sclerotherapy via a transportal approach. This poster includes the first description of a successful management of pancreatic transplant varices using this technique.

P-319

Superior mesenteric artery thrombectomy: two acute cases treated in "neuroendovascular fashion" with dedicated aspiration catheters and carotid stenting

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Superior mesenteric artery thromboembolism is a severe acute life-threatening condition, while celiac trunk is chronically occluded. We are presenting two cases treated with neurodedicated aspiration catheters and then stabilized with carotid stenting. Both patients recovered well with a patent superior mesenteric artery.

P-320

Single-session coil embolization of multiple celiac axis, superior mesenteric artery, and gastroduodenal artery aneurysms

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A 69-year-old gentleman was admitted with severe abdominal pain following the rupture of the largest among several splanchnic aneurysms. Most of the aneurysms were treated successfully in a single session with a total of 39 coils.

P-321

Percutaneous accessory bilioenteric neoanastomosis creation aided by the use of cone-beam computed tomography

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To describe the creation of an accessory percutaneous transhepatic bilioenteric neoanastomosis with the aid of cone-beam computed tomography angiography with imaging fusion for real-time navigation in a patient with a postoperative bile leak from an aberrant bile duct.

P-322

Protein-losing enteropathy caused by chronic mesenteric venous thrombosis owing to antiphospholipid syndrome treated with angioplasty and stent placement

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This study reports the case of a male patient with protein-losing enteropathy caused by extensive chronic superior MVT and refractory to medical treatment. He was submitted to stenting angioplasty through portal venous access, with resolution of clinical symptoms and laboratory parameters.

P-323

Percutaneous puncture embolisation of a bleeding ectopic jejunal varix

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A middle-aged man with EHPVO and jejunal ectopic varices presented with haematochezia. Embolisation attempted from subcutaneous collateral veins and the left common iliac venous route was not successful. Hence, through ultrasound guidance, the varix was punctured percutaneously and successfully embolised with coils and NBCA.

Gynaecological intervention (including UFE)

P-324

A retrospective trial of uterine artery embolization prior to hysterectomy

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Purpose

To determine whether preoperative uterine artery embolization (UAE) decreases blood loss during abdominal hysterectomy for fibroid uterus.

Material and methods

Patients who underwent UAE and abdominal hysterectomy on the same day at a single institution were identified based on ICD-9 codes. Data collected included blood loss and complication rates. This data was then compared with historical data from a study on patients with fibroid uteri > 1000g who just underwent hysterectomy.

Results

During 2006–2014, a total of 59 women underwent preoperative UAE prior to hysterectomy for fibroid uterus. Historical data included 47 women as controls. The average uterine size was comparable between cases and controls (1537 ± 1285 g vs. 1658 ± 793.5 g). The estimated blood loss was significantly reduced in the preoperative UAE group when compared with that in controls, 360.6 ± 288.2 ml vs. 555.8 ± 386.5 ml ($p = 0.004$), respectively. Furthermore, women who underwent preoperative UAE had lower complication rates (21.7%) when compared with controls (61.7%, $p < 0.001$). Postoperative complications included blood loss of at least 500ml, intraoperative or postoperative blood transfusion, pelvic organ injury, postoperative antibiotic use, hospital readmission, and major systemic complications such as pneumonia, pulmonary embolism, and myocardial infarction.

Conclusion

Preoperative UAE decreases blood loss and complication rates in women undergoing abdominal hysterectomy for fibroid uterus.

P-325

Efficacy of uterine artery embolization using gelatin sponge particles alone for the treatment of retained products of conception with massive bleeding

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Purpose

To evaluate the efficacy of uterine artery embolization (UAE) for retained products of conception (RPOC) with massive bleeding using gelatin sponge particles (GS) alone.

Material and methods

Between 2007 and 2016, 14 patients (mean age, 33 years old) diagnosed as RPOC with massive bleeding received UAE using GS alone at our institution. The pregnancy outcomes were vaginal delivery (n=7), miscarriage (n=4), and termination (n=3). In four cases, the bleeding occurred after dilation and evacuation (D&E) for RPOC. The median time interval between the end of pregnancy and massive bleeding was 28.3 days (range 6–68). Technical success, clinical success, complications, angiographic features, and fertility after UAE were retrospectively assessed. Technical success was defined as embolization of the bilateral uterine arteries or unilateral uterine artery of the affected side achieving contrast stasis over five cardiac beats. Clinical success was defined as no rebleeding or hysterectomy during the follow-up period.

Results

Technical success and clinical success were achieved in all 14 patients after the mean follow-up period of 25 months (range 1–105). No major complications occurred. Angiographic features of RPOC were tortuous feeders flowing into the focal blush of contrast (n=14). Additional findings were pseudoaneurysm (n=6), early venous return (n=4), and extravasation (n=2). In seven cases followed up for more than 1 year after UAE, menstruation had restarted in all patients and conception was achieved in 5 patients.

Conclusion

UAE using GS is an effective and safe treatment for RPOC with massive bleeding as a fertility preserving option.

P-326

Fifteen years of uterine artery embolization in the treatment of myomas: lessons learned and questions remaining

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Purpose

Uterine artery embolization (UAE) in the treatment of myomas has been consolidated over the last two decades. In our 15-year experience of an uninterrupted UAE program, some questions have been resolved while others remain.

Material and methods

Between Dec 2002 and Jan 2017, we performed UAE in 288 consecutive patients with intramural myomas presenting with hypermenorrhea and/or dysmenorrhea. The multidisciplinary collaboration with gynecologists increased even further with the creation of the

Myomas Clinical Unit. Our decision making was based on the official protocol of Spanish Society of Gynecology and Obstetrics (SEGO), which had been recently published.

Results

Long-term results: control of symptoms at 5 years was >85% in hypermenorrhea and 100% in dysmenorrhea; tumor volume reduction of 65%–70% at 5 years; complications of 4% amenorrhea in women aged <45 years and 17% in those aged >45 years. Four cases of symptomatic expulsion of myoma, 1 labial necrosis, 1 gluteal abscess, and 1 uterine necrosis necessitating HT. There were 9.7% clinical failures (n=28); 11 HT, 12 myomectomies, 2 endometrial ablations, and 5 re-embolizations. Satisfaction index was 9/10. Close clinical and imaging follow-up at 5 years was >90%

Conclusion

The favorable outcomes of UAE obtained by us and other groups are unquestionable; nevertheless, the technique is not applied at many centers in our country. We hope that as a consequence of the SEGO protocol, the recent favorable review of the concept of damage in fertility and UAE, and the widest amplification of the criteria for UAE and gestation, this situation will be resolved.

P-327

Pre-procedural MRI features to predict intramural uterine fibroid migration following uterine artery embolization

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Purpose

To determine features of intramural uterine fibroids on T2-weighted MR images for predicting fibroid migration following uterine artery embolization (UAE).

Material and methods

This retrospective study included 64 patients referred for UAE for symptomatic fibroids at one institution over 1 year. All patients underwent MRI prior to and 6 months after UAE. The dimensions of each intramural fibroid as well as its shortest distance from the endometrial wall was documented using pre-UAE MR images and correlated with the post-UAE images. Only features of dominant fibroids in each patient were selected for statistical analysis initially, but non-dominant fibroids were later analyzed to test our initial findings.

Results

There were a total of 35 dominant intramural fibroids and of these, 13 (37%) underwent migration from their initial position. Comparison of pre-UAE features of migrating and non-migrating dominant intramural fibroids showed, with statistical significance (p<0.05), that in migrating fibroids, the mean distance from the endometrium was shorter and the mean maximum fibroid diameter was greater. These migrating fibroids also had a defining feature on pre-UAE images: a distance of less than 2.4 from the endometrium mm and a maximum fibroid diameter of greater than 5.1 cm. Analysis of the non-dominant intramural fibroids revealed four fibroids that migrated and all met the aforementioned characteristics.

Conclusion

Intramural uterine fibroids have a high likelihood of migrating toward the endometrial cavity if the fibroid has a minimum distance of less than 2.4 from the endometrium and a maximum fibroid diameter greater than 5.1 cm on pre-UAE MR images.

P-328

Predictors of clinical success in magnetic resonance-guided focused ultrasound surgery for treating uterine fibroids

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Purpose

This study aimed to investigate the possible factors influencing a favorable clinical outcome in patients with uterine fibroids who were treated with magnetic resonance-guided focused ultrasound surgery (MRgFUS) ablation.

Material and methods

In total, 90 women with uterine fibroids treated with MRgFUS ablation between March 2012 and December 2015 were retrospectively analysed. The ablation results were evaluated based on the non-perfused volume (NPV) on contrast-enhanced T1-weighted MR images acquired after the treatment; these data were coupled with clinical results evaluated using a questionnaire on uterine fibroid symptoms and health-related quality of life (UFS-QOL). The BMI and appropriate acoustic window of patients were also considered as a study parameter.

Results

Seventy of 90 (77.8 %) women were followed up (median follow-up: 2 years). The mean value of the NPV ratio was 68%, as assessed immediately after the treatment. In 77 patients (85.6%), an improvement of UFS-QOL of approximately 50% was observed; 64% of these patients were asymptomatic during the follow-up. Women with a higher NPV ratio, appropriate acoustic window and lower BMI were likely to achieve a clinical success.

Conclusion

MRgFUS ablation may be considered as an effective uterus-conserving treatment for symptomatic uterine fibroids that provides excellent success rates. Our experience demonstrated that favorable conditions, such as higher NPV ratio, appropriate acoustic window and lower BMI, may be related to a good clinical success.

P-329

Mid-term outcomes after percutaneous cryoablation of symptomatic abdominal wall endometriosis: comparison with surgery alone in a single institution

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Purpose

To compare the outcomes of percutaneous image-guided cryoablation of symptomatic abdominal wall endometriosis (AWE) with those of surgery alone.

Material and methods

From 2004 to 2016, cryoablation or surgery alone was performed for AWE at a single institution in 7 (mean age: 36.1y) and 13 (mean age: 31.9y) patients, respectively. Fifteen lesions were treated by cryoablation (mean size: 2.3cm; range 0.5–7cm) and 16 by surgery (2.5 cm; 1.1–3.4cm). Tolerance, efficacy, and patient and procedural characteristics were compared.

Results

Median follow-up was 22.5 (range: 6–42) months after cryoablation and 54 (14–149) months after surgery. The median procedure and

hospitalization durations were 41.5 (24–66) minutes and 0.8 (0–1) days after cryoablation and 73.5 (35–160) minutes and 2.8 (1–12) days after surgery (both $P=0.01$). Fifteen patients had general and 5 had local anesthesia (3 cryoablations and 2 surgery). Three patients (23.1%) had severe complications and 9 esthetic sequels (69.2%) after surgery, and no complications were observed after cryoablation ($P=0.05$). The median 12- and 24-month symptom-free survival rates were 100% and 66.7% (95%CI: 5.4 and 94.5) after cryoablation and 92% (55.3 and 98.9), respectively, after surgery at both time points ($P=0.45$).

Conclusion

Cryoablation an effectiveness similar to surgery alone for local control of AWE while reducing hospitalization duration and complications.

P-330

A regional review of the role of IR in severe post-partum haemorrhage

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Learning Objectives

1. To better understand the efficacy of obstetric interventional radiological procedures in severe post-partum haemorrhage (PPH).
2. To better understand and control potential complications and to improve future practice.

Background

Severe PPH is defined by the Royal College of Obstetricians & Gynaecologists as maternal blood loss of >2000 ml via the genital tract within 24 hours of the birth of a baby (1). An IR practitioner may use various types of interventions to achieve haemostasis in an attempt to avoid hysterectomy. Reported rates of complications are low; 5% of the patients report transient ischaemia or confirmed thromboembolic events (2). We have collated cases from Southwest Peninsula (UK) spanning 10 years, which show that thromboembolic complications are more frequent than hitherto perceived.

Clinical Findings/Procedure

We have collated the region-wide caseload of IR intervention in severe PPH, which includes cases from three district general hospitals and one tertiary referral centre. We report the total numbers of cases, rates of specific types of intervention (aortic/iliac artery balloon occlusion or embolisation) and rates of complications, particularly distal lower limb thrombosis and/or ischaemia (>16%). We have also examined the rates of vasopressor use in these patients.

Conclusion

Patients with severe PPH may be at an increased risk of thromboembolic events due to disordered coagulation. Based on our evidence, interventional radiologists and obstetricians need to be aware of the potential for thromboembolic complications in this high-risk group and appreciate the importance of post-procedure care to enable early detection and reversal of complications.

P-331

Uterine artery embolisation in the treatment of postpartum haemorrhage related to retained products of conception

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Learning Objectives

To review the endovascular treatment of postpartum haemorrhage (PPH) due to retained products of conception (RPOC).

Background

Postpartum haemorrhage remains the main cause of pregnancy-related maternal death worldwide. RPOC refer to intrauterine persistent trophoblastic tissues after the end of pregnancy. They represent a major cause of bleeding in the subacute postpartum setting. Hysterectomy is the most radical and efficient treatment of persistent PPH with the disadvantage that the patient becomes sterile. Dilatation and curettage as well as hysteroscopic resection are other therapeutic options, but they may lead to massive haemorrhage that may require a lifesaving hysterectomy. Uterine artery embolisation (UAE) is an alternative treatment with success rates for bleeding control in the order of 80% to 90%; using this, the uterus and patient fertility can be preserved. It is contraindicated in case of infection.

Clinical Findings/Procedure

We describe four cases of patients who presented with recurrent episodes of genital bleeding after delivery. Ultrasound examination revealed the presence of RPOC within the uterine cavity, with high vascularity in the Doppler study. After selective catheterisation of uterine arteries, we performed UAE with gelatin sponge, thus allowing surgical resection with a decreased risk of bleeding. Of the embolic materials available, gelatin sponge is most commonly used because of its availability, distal embolisation and temporary effect.

Conclusion

UAE is an alternative treatment for PPH due to RPOC that allows the preservation of fertility and may decrease the risk of bleeding prior to surgical treatment.

P-332

Clinical follow-up following uterine fibroid embolization

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Learning Objectives

This study aims to demonstrate follow-up patterns after uterine fibroid embolization (UFE), an area of interventional radiology (IR) in which cross-specialty communication is paramount to clinical success. This study evaluates the implementation and frequency of routine follow-up and the frequency of non-routine or urgent follow-up for patient status after the UFE procedure.

Background

The expanded clinical role of IR has increased the responsibility of coordinating excellent care for patients undergoing an UFE procedure. In this review of UFEs performed in our system within the past 10 years, we evaluated time to discharge; complications; level and frequency of follow-up at the IR department, gynecology (GYN) department, and emergency department (ED); and primary care.

Clinical Findings/Procedure

Eighty-six percent of UFE patients were discharged by post-procedure day 1. In total, 17% of patients contacted the IR department

following UFE and 10% of patients contacted the GYN department. There was a trend toward more patients receiving IR follow-up on telephone rather than in person. Eight percent of UFE patients took an additional IR appointment apart from the standard follow-up. Eleven percent of UFE patients typically presented to ED, typically within 3 weeks of the procedure. Ten percent of UFE patients took a non-routine GYN follow-up appointment.

Conclusion

The interdisciplinary nature of fibroid treatment wherein patients visit the GYN and IR departments for therapy can lead to unnecessary ED visits and patient confusion about follow-up. Patient education about post-procedural expectations and proactive and scheduled communications with patients, focusing on IR, will lead to a decrease in the often unneeded ED visits and GYN appointments.

P-333

Placental embolization of advanced abdominal pregnancy

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Abdominal pregnancy is rare, and its management is controversial. We performed extraction of a fetus by laparotomy, leaving the placenta; we also performed immediate uterine artery embolization with embolic particles and a gelatin sponge.

P-334

Superselective embolization of bleeding placental polyps

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We treated bleeding placental polyps by the embolization of small branches of the uterine artery. Superselective embolization for bleeding placental polyps is effective and safe in terms of preventing complications of uterine artery embolization.

P-335

Endovascular treatment of a complex pelvic varicocele in a female with inferior vena cava (IVC) duplication

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A 43-year-old female with chronic pelvic pain underwent MRI; right complex pelvic varicocele was diagnosed with IVC duplication. Venous angiography confirmed MR findings. A 2-time embolization was performed, first with a vascular plug and then with detachable coils, with remission of symptoms.

P-336

Successful embolization of an uterine artery pseudoaneurysm using thrombin and n-butyl-2-cyanoacrylate injection: a report of 2 cases

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We report two cases of a successfully embolized uterine artery pseudoaneurysm. Transvaginal ultrasound-guided thrombin injection after Shirodkar cervical suture and transcatheter n-butyl-2-cyanoacrylate injection wedged the catheter tip to the feeding artery using a triple coaxial (triaxial) system after intrauterine curettage was administered.

Imaging

P-337

Advanced monoenergetic reconstruction technique in dual-energy computed tomography for the evaluation of endoleaks after endovascular aneurysm repair

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Purpose

To evaluate the usefulness of the advanced monoenergetic reconstruction technique in dual-energy computed tomography (advanced monoenergetic image: AMI) for the evaluation of endoleaks after endovascular aneurysm repair.

Material and methods

For 25 patients who underwent endovascular aneurysm repair, follow-up dual phase (early and delay phase) enhanced CT was performed. AMI was reconstructed at 40 keV and compared to the standard 120-kVp images (SI). Signal-to-noise ratio (SNR) of the aorta and endoleak and contrast-to-noise ratio (CNR) of the aorta were measured. Two radiologists subjectively assessed the endoleak delineation based on the 5-point Likert scale (1: poor–5: excellent).

Results

SNRs of the aorta of AMI (early, 36.0 ± 11.4 ; delay, 11.8 ± 4.1) were higher than those of SI (early, 23.1 ± 6.2 ; delay, 8.7 ± 2.6) ($P < 0.05$). SNRs of the endoleak of AMI (early, 26.2 ± 7.3 ; delay, 11.6 ± 4.6) were higher than those of SI (early, 18.3 ± 5.0 ; delay, 9.1 ± 2.9) ($P < 0.05$). CNRs of AMI (early, 34.1 ± 10.9 ; delay, 9.2 ± 3.4) were higher than those of SI (early, 19.3 ± 6.2 ; delay, 4.7 ± 1.8) in both phases ($P < 0.05$). The endoleak delineation of AMI (4.9 ± 0.4) was higher than that of SI (3.6 ± 1.1) in the delay phase ($P < 0.05$). There was no difference in the early phase (AMI, 5.0 ± 0 ; SI, 5.0 ± 0 ; $P > 0.05$).

Conclusion

AMI appears to be useful in the evaluation of endoleaks after endovascular aneurysm repair.

P-338

Value of combined volumetric and computational fluid dynamic analysis in predicting rapid growth of abdominal aortic aneurysms

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Purpose

Abdominal aortic aneurysm (AAA) is a common pathology where the need for surgical intervention is mostly determined based on the maximal diameter despite some limitations. The purpose of this study was to identify volumetric and computational fluid dynamic (CFD) parameters for predicting the rapid growth of AAA.

Material and methods

In our multicentric and prospective study, we included 78 patients with an AAA between September 2012 and June 2014. Patients underwent two CT examinations separated by a 1-year interval to assess aneurysm growth. Fifty patients were eligible for CFD analysis. Based on a 10 ml threshold of total volume progression, we classified patients into slow and rapid growth groups. Initial aneurysm morphological and functional parameters were analyzed, including maximal diameter and surface, thrombus and lumen volumes, maximal wall pressure, and wall shear stress (WSS).

Results

There was a significant difference between the two groups regarding aneurysm lumen volume ($P=0.0051$) and mean WSS variation ($P=0.0240$) unlike maximal diameter ($P=0.71$). We found a significant correlation between lumen volume ($R=0.47$, $P=0.0015$), reduction of the mean WSS variation value ($R=-0.42$, $P=0.0062$), and total aneurysm volume growth. We further used these parameters to compute a model for predicting the growth of AAAs, displaying better area under ROC than only the measurement of the maximal diameter (0.75 vs. 0.52, $P=0.0037$). Depending on the threshold, our model yields either excellent sensitivity [95.00% (95% CI 75.1, 99.9)] or specificity [90.00% (95% CI 73.5, 97.9)].

Conclusion

Combined analysis of lumen volume and WSS provides better information than only the maximal diameter to assess the rapid volume growth risk.

P-339

Angiographic assessment of atherosclerotic load at the lower extremity in patients with diabetic foot and Charcot neuroarthropathy

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Purpose

Foot complications associated with diabetes have a prevalence of 15%–20% in all patients with diabetes and remain the most common cause of non-traumatic amputations of the lower extremity. Charcot neuroarthropathy (CN) is a progressive disease affecting the bones, joints, and soft tissues of the foot and ankle. Until today, a few studies have examined the prevalence of atherosclerotic PAD in diabetic patients with CN. Bollinger et al. described an angiogram scoring method for the assessment of lower limb atherosclerosis, including scoring for plaques, stenoses, and occlusions. In this study, we aimed to investigate the atherosclerotic load at the lower extremity using the Bollinger angiogram scoring method in patients with diabetic foot and chronic CN and compare the results with those in patients with diabetic foot without chronic CN. The aim of this study is to investigate atherosclerotic load at the lower extremity in patients with diabetic foot and CN and compare the results with those in patients with diabetic foot without CN.

Material and methods

This retrospective study consists of 78 patients with diabetic foot who underwent lower extremity angiography via an antegrade approach. All patients were classified into two groups: diabetic foot with CN (30/78) and without CN (48/78). Atherosclerotic load at the side of the diabetic foot was determined using the Bollinger angiogram scoring method. Comparison of atherosclerotic load between the two groups was performed.

Results

The mean of total and infrapopliteal level angiogram scoring of all patients was 33.3 (std ± 17.2) and 29.3 (std ± 15.6), respectively. The mean of total and infrapopliteal level angiogram scoring of the diabetic foot with CN group was 18.1 (std ± 11.6) and 15.7 (std ± 10.4), respectively. The mean of total and infrapopliteal level angiogram scoring of the diabetic foot without CN group was 42.8 (std ± 12.7) and 37.7 (std ± 12.0), respectively. There was a statistically significant difference between the two groups with respect to the mean total and infrapopliteal angiogram scoring ($p < 0.01$).

Conclusion

This angiographic study confirms that the atherosclerotic load in patients with diabetic foot and chronic CN is significantly less than that in patients with diabetic foot without chronic CN.

P-340

Comparison of vessel diameter measurements using pre-interventional computed tomography angiography-post-processing software and extravascular calibrated devices during digital subtraction angiography

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Purpose

To compare the accuracy of pre-interventional computed-tomography angiography-post-processing software (CTA-PPS) and extravascularly located calibrated devices used during digital subtraction angiography (DSA) with an intravascular scaled catheter (SC).

Material and methods

In 33 consecutive patients (28 males, mean age 72±11 years), an SC was used during DSA of the femoropopliteal territory. Simultaneously, one scaled radiopaque tape (SRT) was affixed to the lateral thigh and one scaled radiopaque ruler (SRR) was positioned on the angiography table. Diameters were measured on DSA images after calibration to the different scaled devices and using CTA-PPS. Diameters were compared to SC and to groups of non-obese (NOB) and obese (OB) patients. Unpaired t-test was used for comparison of methods and groups ($p < 0.05$).

Results

Compared with SC (standard of reference), SRT overestimated the diameter by 1.2% (range 10–12, SD 4.1%) ($p = 0.045$) and SRR and PPS underestimated it by 21.3% (range 1–47, SD 9.4%) ($p = 0.001$) and 3.2% (range 17–38, SD 9.7%) ($p = 0.048$), respectively. Underestimation using SRR was highest at the proximal superficial femoral artery (25%) and lowest at the P2 level of the popliteal artery (15%) ($p = 0.001$). In the NOB-group diameter, overestimation of the SRT was 0.8% (range 4–7, SD 4.2%), compared with the OB-group diameter (1.6%; range 7–4, SD 2.9%) ($p = 0.5$). Diameter underestimation of SRR was 17.3% (range 13–21, SD 3.1%) in the NOB-group and 23.3% (range 11–36, SD 6.6%) in the OB-group ($p = 0.003$).

Conclusion

For calibrated measurements, SRT and CTA-PPS proved accurate compared with the reference, whereas SRR did not. Obesity has a significant impact on the underestimation of the diameter if SRR is used.

P-341

Injury to branches of the external iliac arteries in pelvic fractures

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Purpose

We performed TAE aggressively for arterial injury in pelvic fractures, considering co-existing injuries, age, and coagulopathy. During this procedure, embolization is occasionally required, not only for injuries to areas around the internal iliac arteries but also for injuries to the branches of the external iliac arteries (EIA). This study aimed to investigate the frequency of injury to EIA branches in pelvic fractures, and the characteristics of related computed tomography (CT) findings.

Material and methods

We analyzed prospective observational data (04/01/2014–12/31/2016) of patients who underwent emergency angiography for pelvic fracture from the charts in our facility. Among these, we

sampled patients with EIA branch injuries. Moreover, we compared the pre-angiography CT findings to discover whether EIA branch injuries were present.

Results

Fifty of 153 pelvic fracture cases underwent emergency angiography. Of these 50 cases, 15 had EIA branch injuries (30%). Of these 15, 47% were pedestrians with lateral compression pelvic fractures, and the average ISS was 28.5. The main injured branch of EIA was the external pudendal artery (47%) and the medial and lateral femoral circumflex artery. When the pre-angiography CT findings of the 15 cases with EIA branch injuries were compared with those of 24 without such injuries, extravasations around the pubic or ischial bones were observed more frequently in the former group (93% vs. 38%, $p = 0.0007$).

Conclusion

When extravasations around the pubic or ischial bones are found on CT of pelvic fractures, EIA branch injuries should be considered.

P-342

Mid-term outcome of conservative management for segmental arterial mediolysis

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Purpose

Segmental arterial mediolysis (SAM) is a rare non-arteriosclerotic disease. There is little known about the natural course of untreated arterial lesions of SAM. We investigated clinical mid-term outcome and arterial change in SAM lesions using follow-up CT angiography (CTA).

Material and methods

This study group included five patients (three men and two women; mean age, 55 years) who were diagnosed with SAM using CTA and angiography at our hospital between December 2005 and February 2016. All patients had undergone at least one follow-up CTA after the diagnosis.

Results

A number of aneurysms ($n = 13$) and “string of bead” appearance ($n = 9$) were demonstrated, identifying the following 22 arterial involvement of SAM: celiac axis, 2 (9%); common hepatic artery, 1 (4.5%); splenic artery, 1 (4.5%); superior mesenteric artery and its branches, 11 (50%); right renal artery, 3 (13.6%); and inferior mesenteric artery, 4 (18.2%). Six lesions in three patients were treated with surgical or endovascular intervention because of ruptured or impending rupture of aneurysms. Finally, 16 arterial lesions were monitored for a mean period of 63 months (range, 11–103 months). During follow-up, all patients were free from arterial-related complications. The findings on follow-up CTA revealed unchanged arterial lesions ($n = 5$, 31.3%) and partial reverse remodeling lesions ($n = 11$, 68.7%).

Conclusion

Follow-up CTA showed that no progression lesions and no new lesions were observed in any of the cases. Although careful observation with CTA is required in patients with SAM to check for developing lesions, conservative management might be a choice for uncomplicated lesions.

P-343

A single femoral artery puncture and double-sheath method for obtaining CT during arterial portography (CTAP) and hepatic arteriography (CTHA)

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Purpose

The usefulness of a single-puncture and double-sheath method for CTAP/CTHA.

Material and methods

From Dec 2015 to Jan 2017, 67 patients (37 male and 40 female) with an age ranging from 51 to 92 years who had hepatocellular carcinoma (HCC) were arranged for pre-surgical evaluation of CTHA and CTAP. A 8-Fr angiosheath was placed into the right or left femoral artery first. Then a 4-Fr angiosheath was placed through a self-made hole by a 18-G puncture needle 1 cm below the valve of the previous 8-Fr angiosheath. Two 4-Fr RC-1 catheters were selectively placed through the 8-Fr and 4-Fr angiosheath into the common hepatic artery (CHA) and superior mesenteric artery (SMA), respectively, to perform future CTHA and CTAP.

Results

Total 66 patients successfully underwent this double-sheath method. Only one patient was shifted to bifemoral artery puncture due to severe tortuous aorta. The success rate was about 98.5%. No puncture site hematoma or aneurysm formation after the procedure was observed.

Conclusion

A single femoral artery puncture and double-sheath method is a safe and highly successful method for obtaining CT during arterial portography (CTAP) and hepatic arteriography (CTHA) without the need for double femoral puncture either at the ipsilateral or contralateral femoral artery.

P-344

CT liver perfusion for hepatocellular carcinoma nodule detection and follow-up after trans-arterial chemoembolization and comparison with hepato-specific contrast MRI: work in progress

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Purpose

To compare CT liver perfusion (CTLP) findings obtained using a dedicated processing tool with those obtained with MRI using gadoteric acid injection before and after trans-arterial chemoembolization (TACE) treatment.

Material and methods

Twenty patients (9 with cirrhosis) with 57 nodules, suspicious for hepatocellular carcinomas (HCCs) underwent CTLP on a 128 GE CT system. Perfusion maps of the mean slope of increase and blood flow were derived using CT-perfusion body processing tools. ROIs were appropriately drawn on non-treated HCCs or on partially treated tumors. MRI examination was performed on a 1.5-T system at ± 1 week after CTLP and included DWMRI images and dynamic contrast images acquisition (arterial/hepato-biliary phase) using gadoteric acid. HCC findings, when confirmed with invasive hepatic angiography (DSA), were treated by TACE. Follow-up was performed with CTLP and MRI.

Results

Forty-five HCCs were equally detected by both methods and were confirmed by DSA. Ten suspicious nodules ≤ 1 cm in size, detected by MRI, could not be found on CTLP or DSA. Two nodules seen in CTLP and MRI could not be found on DSA. Post-treatment follow-up was not statistically different ($p > 0.05$) for CTLP and MRI, but CT spatial resolution allowed better delineation/detection of viable tumor areas.

Conclusion

CTLP provides reliable perfusion maps which are useful in assessing untreated or percutaneously treated HCC lesions. There is some evidence that MRI has higher sensitivity in detecting suspicious sub-centimeter nodules, but this has to be confirmed with follow-up. CTLP seems to have higher specificity in diagnosing completely or partially treated lesions. DSA might fail in detecting small nodules from non-typical feeding arteries.

P-345

Efficacy of automated bleeding site detection and navigation software using multidetector-row computed tomography images for emergent transcatheter arterial embolization

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Purpose

To assess the reliability of automated bleeding site detection and navigation (ABDN) software using multidetector-row computed tomography (MDCT) images for emergent transcatheter arterial embolization (TAE).

Material and methods

Consecutive 53 patients underwent 57 TAE sessions during 7 months. Twenty-one patients were excluded because of no CT data ($n = 12$) and negative angiographic findings ($n = 9$). The remaining 34 TAE sessions and MDCT images of 32 patients (mean age, 62.9 years; range, 37–92 years) were included. ABDN software (IVR Simulator, SYNAPSE VINCENT, FUJIFILM Cooperation) was retrospectively used for identifying culprit arteries (automated method). The manual modification was added when needed (semi-automated method). Two observers independently reviewed MDCT images for evaluating culprit arteries (manual method). Detectability of the culprit artery was compared among automated, semi-automated, and manual methods. Time to analysis were also assessed.

Results

Sixty-four bleeding sites were identified on angiography. Automated method, semi-automated method, manual method by observer 1, and manual method by observer 2 identified 28 (43.8%), 53 (82.8%), 55 (85.9%), and 58 (90.6%) culprit arteries, respectively. Detectability of the semi-automated method was significantly better than that of the automated method ($P = 0.000$) and comparable with that of the manual method by both observers ($P = 0.193$ and 0.081). The average time to analysis was 185.4, 297.2, 186.2, and 243.7 secs for the automated method, semi-automated method, manual method by observer 1, and manual method by observer 2, respectively.

Conclusion

Although the performance of ABDN software alone is not sufficient, the addition of manual modification dramatically improves the performance and makes it acceptable for clinical use. Further refinement of software is needed.

P-346

The origin of the last normal branch from the feeding artery of pulmonary arteriovenous malformations

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Purpose

Reperfusion via the pulmonary-to-pulmonary arterial anastomoses is known as one type of recurrence of pulmonary arteriovenous malformations (PAVMs) after embolization. It is important to occlude the fistulous portion beyond the origin of the last normal branch from the feeding artery of PAVMs to prevent recurrence. We evaluated the origin of the last normal branch from the feeding artery of PAVMs by CT and its visibility on pulmonary arteriography (PAG).

Material and methods

We reviewed 37 patients with 72 PAVMs who underwent coil embolization in the previous 10 years. All patients underwent MDCT before embolization. CT images with lung window were reviewed with special interests in the origin of the last normal branch from the feeding artery of PAVMs. Origins of the last normal branches were divided into three types: sac, junction (just proximal to the sac), and proximal feeder (more than 5mm proximal to the sac). We also evaluated whether PAG can depict normal branches detected by MDCT.

Results

MDCT showed that the last normal branch originated from the sac in 26, the junction in 38, and the proximal feeder in 8 PAVMs. On selective PAG, the last normal branch could be visualized in only 28 PAVMs (39%); it could not be visualized because of high-flow shunt in the other 44 PAVMs.

Conclusion

Selective PAG frequently fails to demonstrate the last normal branch from the feeding artery of PAVM which often originates from the sac. Embolization of the sac would be required to prevent recurrence. Pre-therapeutic evaluation of CT images of the last normal branch from the feeding artery of PAVMs is important for successful treatment.

P-347

Arms down vs arms up cone-beam CT hepatic angiography performance assessment: vascular imaging quality and imaging artifacts

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Purpose

Positioning patients' arms above the head during intra-arterial hepatic cone-beam CT (A-CBCT) has been inherited from CT acquisitions, which can interfere with liver embolization procedure workflow. The goal of this study was to retrospectively compare image quality and artifacts based on A-CBCT performed with the arms up and down.

Material and methods

The IRB approved the retrospective evaluation of reformatted and 3D-rendered images from 91 consecutive A-CBCT scans (43 arms up, 48 arms down) acquired during hepatic arterial tumor embolization. Two interventional radiologists assigned a vessel visualization score (VVS) from 1 to 5 (non-diagnostic to optimal visualization of up to six-order vessel). The presence of streak artifacts across axial images was rated from 1 to 3 based on their impact on image quality

(none to significant). BMI, dose-area product (DAP), and the presence of respiratory and heartbeat motions during the acquisition were recorded. The impact of arm position on VVS and artifacts was assessed using univariate and multivariate analyses.

Results

VVSs were not significantly associated with arm positions for either rater before and after controlling for BMI and respiratory and heartbeat motions. One reader found that the streaks across were more likely to impact image quality in the arms down group ($p=0.005$). DAP was not different between the groups [23.9 (6.1–73.4) Gy·cm² for arms up, 26.1 (4.2–102.6) Gy·cm² for arms down, $p=0.54$].

Conclusion

A-CBCT angiography performed with the arms above the head is not superior to imaging performed with the arms by the patient's side for clinically relevant vascular visualization.

P-348

Detection of local recurrence after transcatheter arterial chemoembolization of hepatocellular carcinoma: comparison of parenchymal blood volume (PBV) mapping using cone-beam CT and MDCT

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Purpose

To evaluate the usefulness of parenchymal blood volume (PBV) mapping using cone-beam CT compared with that using MDCT for detecting local recurrence of HCC after TACE.

Material and methods

From March 2015 to October 2016, 32 patients with 58 iodized nodules who had undergone TACE and be considered local recurrence on follow-up CT were included in our study. We evaluated diagnostic efficacies for detecting local recurrence or viable tumor between two different modalities, recent follow-up MDCT and PBV mapping.

Results

The sensitivity, specificity, diagnostic accuracy, PPV, and NPV of PBV mapping were 100%, 97%, 98.8%, 96.2%, and 100%, respectively. The sensitivity, specificity, diagnostic accuracy, PPV, and NPV of MDCT were 68%, 93.9%, 82.8%, 89.5%, and 79.5%, respectively. The overall sensitivity and diagnostic accuracy for identifying local marginal recurrence were higher using PBV mapping than those using MDCT ($p < 0.05$). The 8 tumors with negative MDCT results were found to show marginal recurrence on PBV mapping. The performances of PBV mapping using cone-beam CT and MDCT in the diagnosis of local marginal recurrence were significantly different ($p = 0.039$).

Conclusion

PBV mapping was found to be better than MDCT in the detection of marginal recurrence after TACE. Compared with MDCT, PBV mapping has many advantages. It is free of beam-hardening artifacts, applies a color map, which reflects tumor angiogenesis, and easily provides images during chemoembolization. Overall, we believe that PBV mapping may be feasible as a modality for patients who have undergone chemoembolization and is more reliable than MDCT for the detection of HCC.

P-349

Research on R2*map for tracking adipose tissue-derived mesenchymal stem cells labeled by super paramagnetic iron oxide in rat liver

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WITHDRAWN

P-350

CT-guided ablation of adrenal metastases: treatment effectiveness and imaging follow-up

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Purpose

To retrospectively evaluate efficacy and safety of adrenal metastases CT-guided ablation, including radiofrequency ablation (RTA), microwave ablation (MWA), and cryoablation (CA), in terms of clinical outcomes and imaging follow-up.

Material and methods

Twenty adrenal metastases in 20 patients (mean age 65.1 years) were included in the study. Patients were selected on the basis of preprocedural imaging (contrast-enhanced CT and/or MRI). RTA was used to treat 8 patients, MWA was used in 4 patients, and CA was used in 8 patients. Contrast-enhanced CT and/or MRI was obtained 1–3 months after ablation and at 6-month intervals thereafter in all patients. Technical success, safety, local tumor control, and survival were evaluated. Successful treatment was defined as a lack of enhancement on follow-up CT and/or MRI, which focused on the additional contribution of DWI and subtracted sequences. Survival was defined by duration of follow-up imaging surveillance.

Results

Technical success was achieved in 100% of lesions. Intra-ablative hypertension was treated in 4 cases (20%). Local tumor progression was detected in 4/20 patients (20%) at 3 and 26 months after RFA. In 16 of 20 patients (80%), no residual or recurrent local disease was observed, with a mean imaging follow-up of 25 months (range 6–60 months). CA resulted in being the most effective and safe ablation procedure, with a mean survival time of 23 months and local control in 8 patients (100%). DWI and subtracted sequences were conclusive in 6 cases of unclear follow-up imaging findings.

Conclusion

Percutaneous ablative techniques (RFA, CA, and MWA) can be successfully used to treat adrenal metastases. Contrast-enhanced CT and MRI can monitor local response during follow-up, particularly through DWI and subtracted sequences.

P-351

Prevalence and systemic distribution of early atherosclerosis in a low-intermediate risk adult population

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Purpose

Whole-body magnetic resonance angiography (WBMRA) has previously been demonstrated to provide a systematic assessment and quantification of atherosclerosis within the body, with the extent of this being strongly predictive of future cardiovascular events. However, to date, this evaluation has not been assessed in a large population at low-intermediate risk of cardiovascular disease.

Material and methods

In total, 1,528 participants with <20% having a 10-year risk of cardiovascular disease underwent WBMRA. The scan was broken down into 31 arterial segments which were scored according to the maximum stenosis within them. These scores were then summated and normalized for the number of assessable arterial segments to provide a standardized atheroma score (SAS).

Results

Of the 46,903 potentially analyzable segments, 46,601 (99.4%) were interpretable. In total, 2,468 segments (5%) demonstrated stenoses. These were relatively evenly distributed throughout the body with no focal pattern of distribution. Of these, 747 (49.4%) participants had at least one stenotic vessel and 408 (27.0%) had multiple stenotic vessels. On multivariable linear regression, SAS strongly correlated with age, heart rate, systolic blood pressure, smoking status, and socioeconomic deprivation status ($p < 0.01$ for all).

Conclusion

In conclusion, WBMRA is feasible at a population level and identifies significant vascular disease, and the systematic nature of this evaluation ensures that atherosclerotic disease that would be missed by modalities assessing single vascular sites is detected.

P-352

Dual-energy CT of the brain immediately after mechanical thrombectomy for acute ischemic stroke: correlation with hemorrhagic complications

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Purpose

To correlate iodine extravasation presence, distribution, and concentration on dual-energy CT (DECT) of the brain performed immediately after mechanical revascularization for acute ischemic stroke with post-procedural hemorrhage development.

Material and methods

In our IRB-approved, retrospective study, we included 9 consecutive patients who developed intracranial hemorrhage after mechanical revascularization for ischemic stroke (group A) and 21 controls who did not develop hemorrhage (group B). All patients underwent post-procedural DECT of the brain. Iodine presence, distribution pattern

[deep white matter (DWM), cortical-sub, or both], and maximum concentration (mg/ml) were evaluated by means of commercially available software.

Results

Iodine extravasation was present in all 9 patients in group A and in 13/21 patients in group B ($p > 0.05$). In group A, 4/9 patients presented with DWM iodine distribution, 1/9 patient presented with cortical distribution, and 4/9 patients presented with both, whereas in group B, 4/13 patients presented with DWM iodine distribution, 0/13 patients presented with cortical distribution, and 9/13 patients presented with both. None of the distribution patterns were significantly associated with hemorrhage development. The mean maximum iodine concentration was 7.5 ± 3.7 mg/ml in group A (range 1.4–27.7 mg/ml) and 1.3 ± 0.3 mg/ml in group B (range 0–4.2 mg/ml) ($p = 0.0145$). According to ROC analysis, a cut-off value of 1.3 mg/ml had 100% sensitivity and 57% specificity for detecting patients who will develop hemorrhage.

Conclusion

Post-procedural intracerebral iodine extravasation with a maximum estimated concentration equal or greater than 1.3 mg/ml can identify patients at higher risk for post-procedural hemorrhage development with excellent sensitivity and good specificity.

P-353

Cone-beam CT-guided percutaneous procedures using electromagnetic tracking

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Purpose

Image-guided percutaneous procedures for invasive diagnostics and therapy can be challenging because of the limitations of the currently available imaging technology. Anatomy can be difficult to assess by ultrasound (US) because of lesion depth, large body habitus, or overlying structures. Cone-beam CT (CBCT) fused with 2D fluoroscopy is increasingly used for percutaneous interventions as an alternative to conventional CT guidance, but it cannot sufficiently reveal soft tissue deformation and feedback during needle insertion. This study evaluates the use of electromagnetically (EM) tracked US fused with CBCT for percutaneous interventions.

Material and methods

CBCT was performed using three EM tracked patches placed on the patient's skin around the anatomical region of interest for each procedure. Patches were semi-automatically recognized in the CBCT volume by the EM tracking system (PercuNav, Philips Healthcare) and were used for aligning the CBCT volume with live US images. A field generator positioned above the patient subsequently allowed the tracking of the patient, needle, and ultrasound probe.

Results

Three procedures were performed: two targeting an area in the liver and one in the pelvic region. Technical success was 100%. CBCT-US fusion could be performed in all patients and allowed for the planning and guidance of the intervention without further use of X-ray examinations.

Conclusion

Real-time CBCT-US fusion images and EM tracking can be employed in the interventional suite. This technology can circumvent the drawbacks of using a single technology, thereby facilitating complex percutaneous procedures.

P-354

Additional use of C-arm CT in adrenal vein sampling: impact on success rate

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Purpose

Adrenal vein sampling (AVS) is the gold standard to differentiate unilateral or bilateral hyperaldosteronism. Unilateral secretion of aldosterone implies a solitary adenoma. However, AVS is a difficult endovascular technique with a failure rate of around 33%. In previous years, a new technique has been described using C-arm CT. The aim of this study was to compare the success rate, dose radiation, and fluoroscopy time of AVS using C-arm CT between angiography and classic two-dimensional angiography.

Material and methods

Success rate, radiation dose, and fluoroscopy time of AVS in 51 patients between 2008 and 2016 were retrospectively reviewed. Samplings were performed without ACTH stimulation by the same radiologist during 2008–2014 with two-dimensional fluoroscopy guidance only and during 2015–2016 with two-dimensional fluoroscopy and adjunctive C-arm CT.

Results

Before adjunctive C-arm CT, 16/29 samplings were successful (55% of success). The mean fluoroscopy time was 18.1 minutes. The mean radiation dose was 75742 mGy·cm². During 2015–2016, using adjunctive C-arm CT, 21/22 samplings were successful (95% success); the success rate was significantly different compared with that of non-C-arm CT ($p = 0.018$, χ^2 test). The mean fluoroscopy time was 15.3 minutes, the mean radiation dose was 108508 mGy·cm² [showing no significant difference compared with classic two-dimensional fluoroscopy ($p = 0.21$ and $p = 0.17$, respectively)].

Conclusion

Using C-arm CT during AVS significantly improves the success rate without increasing the procedure time. There was no significant difference in the radiation dose but a trend toward a higher radiation dose using C-arm CT was observed.

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Advanced monoenergetic reconstruction technique in dual-energy computed tomography for the evaluation of vascular anatomy before adrenal vein sampling

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Purpose

To evaluate the usefulness of advanced monoenergetic reconstruction technique in dual-energy computed tomography (CT) (advanced monoenergetic image: AMI) in the evaluation of vascular anatomy before adrenal vein sampling (AVS).

Material and methods

Twelve patients underwent 3-phase (20, 30 and 70 s) contrast-enhanced CT before AVS. AMI was reconstructed at 40 keV and compared with the standard 120-kVp images (SI). Signal-to-noise ratio (SNR) and contrast-to-noise ratio (CNR) of the right adrenal vein were evaluated. Two radiologists subjectively assessed delineation of the right adrenal vein using the 5-point Likert scale (1: poor–5: excellent).

Results

SNRs of the right adrenal vein of AMI (20 s, 8.1 ± 5.6 ; 30 s, 6.0 ± 1.9 ; and 70 s, 7.8 ± 3.7) were approximately the same as those of the right

adrenal vein of SI (20 s, 7.4 ± 3.7 ; 30 s, 6.4 ± 3.3 ; and 70 s, 5.9 ± 2.8) (P: 20 s, 0.94; 30 s, 0.75; and 70 s, 0.14). CNRs of the right adrenal vein of AMI (20 s, 10.7 ± 6.5 ; 30 s, 7.8 ± 4.8 ; and 70 s, 5.7 ± 2.7) were higher than those of the right adrenal vein of SI (20 s, 4.1 ± 3.7 ; 30 s, 2.8 ± 2.6 ; and 70 s, 1.7 ± 1.7) (all P < 0.01). The Likert scales for delineation of the right adrenal vein of AMI (20 s, 4.8 ± 0.6 ; 30 s, 4.3 ± 1.2 ; and 70 s, 3.6 ± 1.4) were higher than those of SI (20 s, 4.1 ± 1.1 ; 30 s, 3.3 ± 1.4 ; and 70 s, 2.8 ± 1.2) (all P < 0.05).

Conclusion

AMI appears to be useful in the delineation of the right adrenal vein before AVS.

P-356

Follow-up imaging after renal cryoablation: a pictorial review

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Learning Objectives

To describe surveillance imaging findings after renal cryoablation, recognizing the signs of successful ablation, common complications, and disease recurrence.

Background

Cryoablation is an emerging technique for minimally invasive treatment of renal tumors, utilizing tissue freezing to cause cell death. As with other nephron-sparing renal tumor treatments, thorough imaging follow-up after cryoablation is critical to ensure adequate treatment response and monitor disease recurrence. Familiarity with typical post-ablation appearance and common post-procedural complications as well as recognition of signs of residual or recurrent neoplasm are crucial for accurate interpretation of follow-up imaging.

Clinical Findings/Procedure

In this exhibit, we will first review recommended post-ablation imaging modalities, exam protocols, and follow-up intervals. Next we will describe the expected findings on intraprocedural, immediate post-procedural, and remote follow-up imaging, providing pictorial examples from magnetic resonance, computed tomography, and ultrasound examinations. Finally, we will provide multimodal imaging examples of common post-ablation complications and recurrent disease, discussing potential confounders and image interpretation pearls.

Conclusion

Accurate interpretation of follow-up imaging is crucial to ensure adequate treatment response and monitor for disease recurrence after renal cryoablation. After reviewing this exhibit, the radiologist will be familiar with expected post-ablation imaging findings and recognize the radiological signs of disease recurrence and common post-procedural complications.

P-357

Findings based on MRI of liver tumors treated with selective internal radiotherapy (SIRT) using yttrium-90

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Learning Objectives

The objective of this pictorial essay is to demonstrate the main aspects of magnetic resonance imaging (MRI) of unresectable primary or secondary hepatic lesions in patients subjected to selective

internal radiotherapy (SIRT), thereby contributing to the expansion of knowledge in the radiology area.

Background

Transarterial SIRT with yttrium-90 also known as radioembolization is a therapy based on the administration of resin or glass microspheres loaded with the radioisotope yttrium-90 via selective arterial catheterization of tumor-feeding vessels. It is classified as a type of locoregional therapy. SIRT's main goal is to treat patients with primary or secondary hepatic lesions that are unresectable and not responsive to other therapies. Because it is a new technology still restricted to very few hospitals in Brazil but used on patients throughout the country, it is necessary to demonstrate the main imaging aspects of the liver lesions treated with SIRT based on MRI in addition to delineating the interpretation considerations of these images.

Clinical Findings/Procedure

MR images of patients treated by SIRT were used. Control examinations were performed 2 and 6 months after the procedure.

Conclusion

Radiological aspects highlighted in this pictorial essay:

- SIRT can be used for large and unresectable liver lesions.
- Partial and/or complete tumor response of lesions treated after SIRT.
- Emergence of areas of necrosis in unexpected places.
- Reactive segmental perfusional disorder.
- Paradoxical growth of tumor volume.
- Paradoxical hypertrophy of the hepatic lobe contralateral to SIRT.
- Atrophy of the hepatic lobe subjected to SIRT.

P-358

The usefulness of virtual fluoroscopic preprocedural planning during interventional radiology procedures

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Learning Objectives

The purpose of this exhibit is (1) to explain the process of virtual fluoroscopic preprocedural planning (VFPP) using a workstation, (2) to review the VFPP images, and (3) to retrospectively evaluate the usefulness of VFPP in the procedures.

Background

Since April 2015, we have used VFPP as a new navigation system to perform vascular and nonvascular interventional radiology procedures. VFPP was used as a reference to select the bile duct or vessels during the procedures.

Clinical Findings/Procedure

We applied VFPP to percutaneous transhepatic biliary drainage, embolization of internal iliac artery aneurysm, adrenal venous sampling, and balloon-occluded retrograde transvenous obliteration. VFPP uses an image that is created from the volume data obtained from MDCT imaging with workstation (SynapseVincent; Fujifilm Co., Tokyo, Japan); the trace lines of the bile duct or vessels on the Ray Summation image are similar to those of a fluoroscopy image. Because the lines can be displayed at any angle in the 3-dimensional virtual fluoroscopic image, we could also choose an appropriate working angle beforehand and perform the procedure in this state. Using intraoperative referencing, VFPP images enable a physician to advance the guidewire precisely and quickly into the common bile duct or target vessels under X-ray fluoroscopy guidance.

Conclusion

Intraoperative referencing using VFPP imaging in the procedure can intuitively be a useful tool for better localization of the guidewire in the bile duct or vessels.

P-359

Anatomical variants of the superior and inferior vena cava

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Learning Objectives

1. To illustrate characteristic CT findings of caval variants.
2. To provide a brief review of the embryonic development of the superior and inferior vena cava and errors in this development.

Background

Variants of the normal anatomy of the superior and inferior vena cava are congenital malformations depending upon the complex embryogenesis of the venous system that occur from less than 1% to 10% of the population. These variants are found in patients undergoing CT examination and are usually asymptomatic.

Clinical Findings/Procedure

We present CT results of variants of the superior and inferior vena cava, with anomalies of position and origin.

Conclusion

CT is a powerful tool for analyzing anatomical variants of the superior and inferior vena cava. Correct assessment of these caval variants is mandatory for the planning of interventional radiology or surgical procedures and for avoiding misdiagnosis.

P-360

A unique case of a double abdominal aorta

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We present a unique case of a double abdominal aorta in an adult male patient. The abdominal aorta bifurcated into 2 lumens after the renal arteries, one ventral and one dorsal. From every lumen, 2 arteries were separated in the caudal direction, and the vena cava remained intact.

P-361

The role of indium-111 WBC SPECT/CT in the definitive diagnosis of a mycotic aortic aneurysm (MAA)

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The mycotic aortic aneurysm (MAA) survival rate has improved with novel surgical advances, but delayed early diagnosis still greatly contributes to overall mortality. Indium-111 WBC SPECT/CT can expedite the definitive diagnosis of MAA based on non-specific anatomic imaging findings, enhancing the overall survival.

P-362

Persistent sciatic vessels with arteriovenous malformation in a hip disarticulation patient with Klippel-Trenaunay syndrome

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A 31-year-old male with a known diagnosis of Klippel-Trenaunay syndrome and left hip disarticulation presented with pain at the

stump. CT showed persistent sciatic vein and suggested arteriovenous malformation fed by a persistent sciatic artery confirmed on catheter angiography.

P-363

Individual-type pulmonary vein atresia mimicking pulmonary arteriovenous malformation

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We present a case of individual-type pulmonary vein atresia in a 48-year-old woman. The findings of computed tomography (CT) mimicked pulmonary arteriovenous malformation. It was accurately diagnosed by electrocardiogram-gated enhanced CT and pulmonary artery angiography.

P-364

Simultaneous early enhancement of IVC and aorta in an acute traumatic peroneal arteriovenous fistula (AVF)

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A 27-year-old patient sustained multiple bilateral calf stabblings. CT aortogram (early phase) showed equal opacification of the abdominal aorta and IVC. Lower-limb CT scan confirmed a traumatic AVF. Vascular surgery explored and repaired a transected left peroneal artery syphoning into an injured peroneal vein.

P-365

Chronic tuberculous lymphadenitis as a cause of bronchial pseudoaneurysm rupture in the oesophagus: CT findings and transcatheter artery embolisation using n-butyl cyanoacrylate

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We describe CT findings and the transcatheter embolisation of a bleeding bronchial artery pseudoaneurysm with oesophageal erosion in a hypovolemic-shock patient. The patient did not survive despite technical success. Autopsy revealed chronic tuberculous lymphadenitis around the bronchial artery pseudoaneurysm associated with oesophagomediastinal fistula.

P-366

Association of hepatoid adenocarcinoma of the lung with well-differentiated hepatocellular carcinoma of the liver

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Hepatoid adenocarcinoma is an extremely rare malignant neoplasm, which shows hepatocellular differentiation. We report a very unusual association of pulmonary hepatoid adenocarcinoma with hepatocellular carcinoma of the liver. Early detection of hepatoid adenocarcinoma is crucial because it is very aggressive.

P-367

Right rete mirabile internal carotid artery and unfused posterior cerebellar artery

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Carotid rete mirabile (CRM) is a rare physiological vascular network. We describe an uncommon case of CRM accompanying unfused posterior cerebellar artery and discuss its embryological and anatomical significance.

P-368

Unusual anatomical variants of the left adrenal vein via the renal capsular vein for adrenal vein sampling

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In two cases with adrenal vein sampling, the central vein of the left adrenal vein connected with the left renal vein or the gonadal vein via an unusual vein running in front of the left kidney, which was suspected to be the left renal capsular vein.

P-369

Iatrogenic inferior vena cava perforation after endovascular procedure

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We report the case of a patient who presented with hemodynamic instability following a cardiac endovascular procedure. CT showed perforation of the inferior vena cava (suprarenal segment) with active bleeding. The patient was successfully managed with conservative treatment.

Neuro and carotid intervention

P-370

Carotid artery stenting in patients with intolerance to intraoperative carotid clamping

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Purpose

To select a group of patients with the highest stroke risk during carotid artery endarterectomy for further qualification for stenting and to assess the results of carotid artery stenting (CAS) in patients with intolerance to intraoperative carotid clamping.

Material and methods

The study comprised 90 (7.9%) patients with clamping intolerance. In this group, 35 (38.9%) patients had a shunt (group 1). In 20 patients, symptoms of cerebral ischemia appeared for longer than 60 seconds (subgroup 1A). In 15 patients, symptoms were registered for less than 60 seconds (subgroup 1B). In 55 (61.1%) patients, surgery was not performed (group 2) because of the development of cerebral ischemia in less than 60 seconds (21 seconds on average). In group 2, 37 patients underwent CAS.

Results

Four cases of ischemic stroke appeared in group 1. In subgroup 1A, 1/20 (5%) case of ischemic stroke was registered. In subgroup 1B, 3/15 (20%) cases of ischemic stroke were registered. In group 2, 2/37 (5.4%) cases of ischemic strokes were registered: 1/33 (3%) was after a planned stenting and 1/3 (33%) occurred after stenting via direct access.

Conclusion

Patients with intolerance to carotid clamping constitute the group with the highest risk of intraoperative stroke. The use of a temporary shunt in the group of patients with high intolerance to test clamping is not a reliable method for preventing ischemic stroke. CAS, as an alternative to the use of shunts during a classical surgery, brings the greatest benefits to patients with a particularly high intolerance to test clamping. CAS via direct stenting may be used only in selected cases by a team with experience in classical and endovascular surgery.

P-371

Risk factors for restenosis after stenting or angioplasty of vertebral artery origin in short- and long-term follow-ups

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Purpose

Atherosclerosis of vertebral artery origin (VAO) is an important cause of cerebrovascular ischemic events. Endovascular treatment belongs to well-established therapeutic options in VAO. Our aim was to determine which factors affect short- and long-term restenosis rates after endovascular VAO therapy.

Material and methods

We conducted a single-centre retrospective analysis of 52 patients (36 men; mean age 64.48±9.54 years) who underwent 55 endovascular procedures (27 angioplasty alone and 28 stenting) between 2005 and 2015. We collected data on patient clinical characteristics, medication and results of post-interventional follow-up visits. Only patients with at least three follow-up visits, which involved color Doppler ultrasound, CT angiography or MR angiography were included in the study.

Results

In total, 15 of 55 vessels (27%) showed ≥70% restenosis at 1 year (short-term follow-up) and 18 at a mean follow-up of 52.9±31.8 months (long-term follow-up). Obesity was associated with ≥70% restenosis rates in the short-term ($P=0.009$, $OR=8.095$ 95%CI 1.698–38.595) and long-term ($P=0.008$, $OR=7.333$, 95%CI 1.760–32.210) follow-ups. Other risk factors, namely, hypertension, ischemic heart disease, smoking, diabetes mellitus, hypercholesterolemia, atrial fibrillation, CRP (>5mg/l) or pre-treatment anticoagulant administration were not associated with restenosis risk (all $P>0.05$). Patients undergoing angioplasty alone developed restenosis less frequently ($P=0.032$) [5/27 (18%)] during long-term follow-up compared with those undergoing stenting [13/28 (46%)].

Conclusion

Obesity represents a short- and long-term risk factor for ≥70% restenosis of VAO. Further studies are required to define therapeutic strategies lowering the restenosis rates in adipose individuals after VAO therapy, especially in the ones undergoing stenting.

P-372

Comparative study using a AngioJet® rheolytic mechanical thrombectomy device

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Purpose

To assess the feasibility of AngioJet-reolitic thrombectomy (RT) associated with standard local thrombolysis (ST) compared with ST therapy alone.

Material and methods

A study group of 15 consecutive patients (6 femoropopliteal bypass and 9 native vessel) with acute lower limb ischemia (onset < 24 hr) were treated with AngioJet-RT associated with standard therapy (ST); results were compared with an historical control group of another 15 patients treated with ST based on intra-arterial locoregional infusion of urokinase (60.000 UI/hr) plus systemic heparinization (1.000 UI/hr). The primary safety endpoints were restoration of vessel patency, major bleeding, distal embolization, and vascular access complications.

Results

Technical success (patency of the arterial tree) was 100%. Employment of AngioJet-RT associated with ST lowered the duration of intra-arterial infusion of urokinase (13.7±2.7hr vs 25.7±3.5hr) leading to shortening of the recovery period (2.8±0.7 days vs 4.3±1 days). Access site complications: the study group reported only a femoral access pseudoaneurysm (0.6%) solved by manual compression; in the control study group, 3 cases (2%) of pseudoaneurysm were appreciable. Bleeding: no bleeding was reported in the study group; in the control group, ST was interrupted in 2 cases (1.3%) due to major bleeding. No distal embolization was reported.

Conclusion

AngioJet-RT associated with ST compared with ST alone by shortening the infusion time of urokinase leads to a lower rate of complications and a faster discharge, thereby lowering costs. AngioJet-RT associated with ST is a valid tool for managing peripheral limb ischemia.

P-373

Carotid artery stenting in an octogenarian: is age a contraindication for the technique

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Purpose

This study was conducted to assess if age ≥80 years is related to increased morbidity and mortality or whether CAS is a feasible treatment with an acceptable complication rate.

Material and methods

This study was a single-center, retrospective database analysis evaluating CAS. Two groups of patients were included, one with patients >80 years and the other with patients <80 years. Demography, risk factors, operative outcome, and clinical events were recorded. Clinical and ultrasound follow-up was performed. Primary outcome included death, myocardial infarction, or stroke. Secondary outcome included restenosis, death, or new vascular events.

Results

In the 16-year period from 2000 to 2016, CAS was performed in 410 patients. Seventy patients were >80 years, most of them men. All patients were treated with the Acculink stent with or without

DPD. The operator team was the same in all cases. Risk factors demonstrated that there were no significant differences between the groups. The primary composite end point did not differ significantly between the two groups. Restenosis and recurrences were similar in both groups.

Conclusion

In our experience, carotid stent revascularization is a safe and effective procedure in patients >80 years with an acceptable complication rate.

P-374

Impact of clot histology on response to mechanical thrombectomy for acute ischemic stroke due to large vessel occlusion

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Purpose

Mechanical thrombectomy (MT) for acute ischemic stroke has proven to be effective in the recanalization of intracranial large vessel occlusion (LVO). Histological properties of clots were shown to correlate with stroke etiology, imaging signs, reperfusion after systemic thrombolysis, and MT. The aim of our study was to define the histological composition of retrieved clots and to correlate them with the response to MT using the aspiration technique.

Material and methods

Specimens from 55 cases of MT were histologically evaluated and classified into red blood cell-rich or red clots, fibrin-rich or white clots, and mixed clots. All procedures were conducted using a first-line aspiration approach followed, only when necessary, by stent retriever-assisted thrombectomy. Procedures were defined as simple aspiration thrombectomy (aspiration only, less than 3 passes) and complex thrombectomy (secondary stent retriever or more than 3 passes aspiration). Multivariate analysis was conducted to correlate age, sex, location of occlusion, systemic thrombolysis, and histological type of the clot with the efficacy of MT.

Results

Of the 55 clots, 35 were histologically classified as red clots, 10 as white clots, and 10 as mixed clots. In the red clots group, simple aspiration thrombectomy was successful in 82% cases; in the white clots group, it was successful in 66.6% cases; and in the mixed clot group, it was successful in 70% cases. Age, sex, location of occlusion, and systemic thrombolysis did not show significant correlation with the response to MT.

Conclusion

Red blood cell-rich clots were correlated with a slightly higher response to simple aspiration thrombectomy than fibrin-prevalent clots. Further studies should address the relationship between physical properties of clots and recanalization technique to optimize endovascular treatment.

P-375

Vitamin D levels and internal carotid artery calcium scores in patients with carotid artery stenosis: relation with symptomatology and atherosclerotic risk factors

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Purpose

Vascular calcification is a highly regulated process. Vitamin D deficiency has been associated with inflammation and is suggested to be related to vascular calcification. We assessed the relationship between calcification scores, vitamin D levels and other risk factors in patients with carotid artery stenosis prior to carotid artery intervention

Material and methods

Forty-nine patients (age, 69 ± 6 years; 33 men; 29 were symptomatic) with eGFR > 60 ml/min/1.73m², undergoing multi-detector CT (MDCT) angiography of the carotid arteries for assessment of stenosis were included. Patients were divided into mild, moderate, and severe calcification groups according to Agatston scores. 25 (OH) vitamin D levels were measured by LC-MS. Associations between calcification scores and cardiovascular risk factors and ischemic cerebrovascular diseases were assessed.

Results

Calcification scores did not differ with sex and age. Smoking, hypertension, and hypercholesterolemia were related to the presence of calcifications but not diabetes. In the mild calcification group, a negative correlation was observed between calcification and vitamin D levels. In the severe calcification group, a positive correlation was observed between calcification score; CaXP product; and calcium, phosphorus, and PTH levels. No association was found between calcifications and the presence of ischemic cerebrovascular disease.

Conclusion

Calcification scores were associated with cardiovascular risk factors. In advanced and early phases of calcification, increase in PTH and decrease in vitamin D levels, respectively, were related to the internal carotid artery calcification in patients with normal renal function. Calcification scores were not related to the presence of ischemic cerebrovascular diseases.

P-376

Initial clinical experience with the micromesh roadsaver carotid artery stent for the treatment of patients with symptomatic carotid artery disease without embolic protection device

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Purpose

The aim of this prospective study is to evaluate the safety and feasibility of "one-step" implantation of the micromesh roadsaver carotid artery stent in the treatment of symptomatic patients with unstable plaque without embolic protection devices.

Material and methods

Thirty patients (18 men; mean age 69 ± 11.2 years) affected by symptomatic (amaurosis fugax, TIA, and minor or major stroke) internal carotid artery stenosis (mean 80% diameter reduction) were treated with a dual-layer closed-cell stent without embolic protection

devices. Pre-procedural evaluation of the patients was performed with echo Doppler, DWI-MRI, angio-CT, and neurological examination. All patients had pre-procedural DWI cerebral ischemic lesions confirmed by neurological symptoms. Post-procedural evaluation was performed at 24 hours with DWI-MRI.

Results

All devices were satisfactorily deployed, and technical success was achieved in all patients without complications. Mean fluoroscopy time was 3.2 min. After carotid artery stenting, we observed new ischemic ipsilateral cerebral lesions at 24 hours on DWI-MRI in two cases (6.7%). At 1 and 3 months, ultrasound examination demonstrated patency of stents and external carotid arteries.

Conclusion

The roadsaver carotid artery stent placement without embolic protection device, in capable hands, thanks to its low profile and soft tip, represents a safe device that potentially reduces peri-procedural embolism because of less arch manipulation and atraumatic plaque crossing. The double-layer micromesh protects from plaque protrusion and late embolization. Although further studies with larger populations are needed, it seems to be safe and effective in the treatment of "one step" extracranial ICA with high-risk, lipid-rich, and ulcerated plaque.

P-377

Intracranial collateral assessment and functional outcome in patients with acute ischemic stroke in anterior circulation treated by endovascular therapy

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Purpose

Intracranial collaterals in patients with acute ischemic stroke in anterior circulation influence the functional outcome of patients. We compared different scoring methods of collaterals on CT angiography (CTA) before endovascular therapy with functional outcomes of patients with acute ischemic stroke treated with endovascular therapy.

Material and methods

Eighty-four patients with acute anterior circulation ischemic stroke consecutively treated with endovascular therapy in 1 year during 2015–2016 were involved in the study. Two independent neuroradiologists retrospectively evaluated intracranial collaterals on CTA using Miteff system, Maas system, and modified Tan scale. Functional outcomes of patients at 3 months were defined by modified Rankin scale scores of 0–6 points.

Results

In statistical analysis, using Pearson's Chi-square test, a significant correlation was found between poor collaterals in all collateral scoring systems and mortality ($p < 0.001$). There was no correlation between good collaterals on preoperative CTA and good functional outcome mRS 0–2 in any of the scoring collateral systems.

Conclusion

Poor outcome with mortality was associated with poor collateralisation on CTA in all 3 scoring systems in patients with acute ischemic stroke in the anterior circulation treated with endovascular therapy.

P-379

pCONus device for endovascular treatment of wide-neck intracranial bifurcation aneurysms

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Learning Objectives

To evaluate the possibility of endovascular treatment of complex and wide-neck intracranial bifurcation aneurysms using the pCONus device.

Background

The pCONus Bifurcation Aneurysm Implant is an endovascular device developed to assist coiling in the treatment of complex and wide-neck intracranial bifurcation aneurysms. We report our preliminary experience of using the pCONus device (Phenox, Bochum, Germany).

Clinical Findings/Procedure

Eighteen patients with 18 wide-neck aneurysms (4 recently ruptured) were treated from April 2014 to September 2016 using pCONus-assisted coiling. Twelve aneurysms were located in the anterior circulation (7 ACoA and 5 MCA) and 6 in the posterior circulation. The pCONus device was preferred over other techniques because of its optimal placement, mainly with respect to its precise deployment and complete recoverability. Primary endpoints were complete aneurysm occlusion and clinical safety, including absence of death or ischaemic events.

Technical success was achieved in all patients without ischaemic complications. Immediate angiographic results were complete aneurysm occlusion in 72% (13/18), residual neck remnant in 28% (5/18) and incomplete occlusion in 0% (0/18). The neurologic status remained unchanged at the follow-up. No aneurysmal bleeding or re-bleeding was recorded after treatment. Angiographic control at 3 months was obtained for 14 patients, with no significant modifications in aneurysmal filling. No intimal hyperplasia was observed.

Conclusion

Use of the pCONus device is confirmed to be safe and effective, with acceptable clinical and angiographic outcomes. Its precise deployment control facilitates and extends the possibility of endovascular treatment of complex and wide-neck intracranial bifurcation aneurysms.

P-380

Endovascular stroke treatment of acute tandem occlusion: a single-center experience

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Learning Objectives

To evaluate outcomes and their predictors in patients with acute ischemic stroke due to tandem internal carotid artery/middle cerebral artery occlusion undergoing endovascular treatment (ET).

Background

Baseline and procedural characteristics of patients were collected and analyzed. Outcomes included thrombolysis in cerebral infarction (TICI) score, 3-month modified Rankin scale score, symptomatic intracranial hemorrhage (sICH), and mortality.

Clinical Findings/Procedure

Seventy-two patients (mean age: 65.6±12.8 years; mean NIHSS: 19±2.9) were included in the analysis. Intravenous thrombolysis was performed in 51.3% and extracranial carotid artery stenting (CAS) in 53%. Successful recanalization (TICI≥2b) was achieved in 64%, and CAS patency at the 3-month follow-up was achieved in 97.1%. A good outcome at 3 months (mRS≤2) was observed in 32%. sICH occurred in 12.5%, and mortality was observed in 32%. In univariate analysis, predictors of a good outcome were baseline and follow-up Alberta Stroke Program Early CT scores (p<0.0001), good collaterals (p=0.0001), successful recanalization (p=0.005), and lower rate of sICH (p=0.003). In multivariate analysis, a good collateral flow was the only predictor of a good functional outcome (OR, 0.18; 95% CI, 0.04 to 0.75; p=0.01) and the use of more than one device for thrombectomy was the only variable associated with the occurrence of sICH (OR, 10.74; 95% CI, 1.37 to 84.13; p=0.02).

Conclusion

Despite stroke severity, ET resulted in reasonable outcomes. Good collateral flow was confirmed to strongly predict the outcome in this subgroup of patients.

P-381

Arteriovenous fistula of the vertebral artery in a healthy male teenager treated with the Amplatzer vascular plug

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A male teenager was suspected of arteriovenous fistula of the right vertebral artery (VA) as the ultrasound revealed an increased arterial blood flow. DSA revealed a cervical arteriovenous fistula of the right VA. The Amplatzer vascular plug and coils were used for embolization.

P-382

Accidental cerebral embolization during emergency endovascular treatment of a massive bleeding facial arteriovenous malformation using cyanoacrylate glue

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Unrestrainable bleeding of a large facial arteriovenous malformation was embolized from the external carotid artery using n-butyl-2-cyanoacrylate/lipiodol. The procedure was complicated with non-target embolization of the internal carotid. CT and MRI showed brain glue deposits, which spontaneously resolved after 9 months.

P-383

Superselective embolization of the glomus jugulare tumor

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We aimed to present a treatment for the glomus jugulare tumor expanding into the petrous temporal bone by superselective embolization of the feeding vessels using a transfemoral percutaneous catheter technique. Embolized patients had significantly less operative blood loss and operative time.

P-384**Endovascular treatment of high-flow cervical direct vertebro-vertebral arteriovenous fistula****A. Tizro**, C. Cinar, I. Oran*Interventional Radiology, Ege University Faculty of Medicine, Izmir, Turkey*

We report the treatment of a case of high-flow cervical direct vertebro-vertebral arteriovenous fistula (VVAVF) successfully occluded with detachable coils through the bilateral transarterial approach.

P-385**Embolization of dural AV fistula (DAVF) of the cavernous sinus with onyx complicated by superior ophtalmic vein thrombosis****U.M. Rozzanigo**¹, P. Zampieri², S. Sarubbo¹, F. Chioffi¹*¹Radiology, Ospedale Santa Chiara, Trento, Italy, ²Neuroradiology, Azienda Ospedaliera Universitaria Integrata Verona, Verona, Italy*

A traumatic DAVF between the external carotid artery and the cavernous sinus was treated with an onyx injection through the ascending pharyngeal artery. A droplet of onyx migrated into the superior ophtalmic vein, causing delayed thrombosis and iatrogenic eye blindness due to congestive retinopathy.

P-386**Blister-like aneurysm of the supraclinoid internal carotid artery treated with a flow-diverter stent****R. Zannoni**, E. Epifani, P. Piazza, R. Menozzi*Radiologia Interventistica, Azienda Ospedaliero-Universitaria di Parma, Parma, Italy*

In a patient suffering with subarachnoid hemorrhage, after a first negative angiogram, repeat angiography demonstrated a blister-like aneurysm arising from the supraclinoid segment of the internal carotid artery, which was successfully treated by the insertion of a flow-diverter stent.

P-387**Neck-bridging, endosaccular flow diversion, and coiling for the treatment of a recurrent aneurysm of the medial cerebral artery after clipping****S. Schob**¹, M. Aguilar-Perez¹, H. Henkes²*¹Clinic for Interventional and Diagnostic Neuroradiology, Katharinenhospital, Stuttgart, Germany, ²Radiolog. Zentrum & Klinik für Neuroradiologie, Katharinenhospital - Klinikum Stuttgart, Stuttgart, Germany*

WITHDRAWN

P-388**Transjugular coiling of the Cognard IV dural arteriovenous fistula using a new monopolar detachable coil system through a flow-directed microcatheter****P. Voigt**¹, R. Jantschke¹, U. Nestler², K.-T. Hoffmann¹, U. Quäschling¹*¹Department of Neuroradiology, Leipzig University Hospital, Leipzig, Germany, ²Department of Neurosurgery, Leipzig University Hospital, Leipzig, Germany*

To the best of our knowledge, this is the first report on the occlusion of a multiple feeder Cognard IV fistula, dural arteriovenous fistula, via the transvenous approach using a detachable coil system through a flow-directed microcatheter.

P-389**Issues pertaining to difficult bilateral retropharyngeal carotid stenting****S.B. Babu***Radiology, Khoo Teck Puat Hospital, Singapore, Singapore*

We report a female who presented with bilateral carotid stenosis, which was extremely tortuous and coursing through retropharynx. We will illustrate the difficulties and final outcome.

Oncologic intervention**P-390****Risk factors for the development of postembolization syndrome after hepatic chemoembolization for hepatocellular carcinoma****M. Lima**¹, S. Dutra², T. Bilhim³, **F. Veloso Gomes**³, É. Coimbra³*¹Radiologia, Centro Hospitalar de Lisboa Central - Hospital de Santo António dos Capuchos, Lisboa, Portugal, ²Radiologia, Hospital do Divino Espírito Santo, Ponta Delgada, Portugal, ³Radiologia, Centro Hospitalar de Lisboa Central - Hospital Curry Cabral, Lisboa, Portugal***Purpose**

To assess risk factors for the development of postembolization syndrome (PES) after hepatic transarterial chemoembolization (TACE) for hepatocellular carcinoma (HCC).

Material and methods

Single-center retrospective analysis of the clinical charts of 563 patients who underwent TACE from 1/1/2014 to 31/12/2015. Patients who experienced PES were identified based on prolongation of hospitalization due to pain, fever, nausea, or vomiting. TACE was performed in all patients with 1–2 vials of 100–300 microspheres loaded with doxorubicin. A control group with the patients who did not have PES was randomly created (3 controls for 1 case) to assess predictors of PES after TACE. Univariate and multivariate logistic regression analyses were performed to assess predictors of PES.

Results

The overall prevalence of PES was 6.2% and accounted for 85.4% of all the complications after TACE. TACE with doxorubicin dosage above 75 mg (more than 1 vial) was associated with a higher risk of PES ($p=0.030$). The size of the largest nodule treated and female sex were also associated with a higher risk of PES ($p=0.046$ and $p=0.037$, respectively). Age, CHILD and MELD scores, number of nodules, embolization of the cystic artery, use of additional embolics, previous TACE procedures, and segmental portal vein thrombosis were not related to the development of PES.

Conclusion

The dose of doxorubicin, the size of the largest nodule treated, and female sex are potential risk factors for the development of PES after TACE for HCC.

P-391

Transradial access (TRA) for TACE and hepatic arterial infusion chemotherapy (HAIC) of primary and metastatic liver cancer

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Purpose

To describe our initial experience with transradial access (TRA) for TACE in patients with HCC and liver metastases from colorectal cancer (LM-CRC). Patients are able to ambulate immediately and sit up in bed and are discharged home faster. TRA is preferred in obese and cancer patients who are deemed to be at a high risk of bleeding complications.

Material and methods

In this retrospective study, TRA TACE procedures were performed in 30 patients with HCC and HAIC and 3 patients with LM-CRC. Clinical evaluation and if indicated, Barbeau test were performed using a pulse oximeter to confirm the patency of the palmar arch. An expert IR placed a 6F Glidesheath Slender®-Transradial introducer sheath in the left/right radial artery with/without US guidance. A solution of 5000 U heparin was administered intra-arterially. A 120cm 5F vertebral Glidacath catheter was introduced over a 180cm 0.035inch hydrophilic guidewire (Terumo) down the aorta.

Results

Technical success was achieved in all cases (100%). No major complications were encountered. Mild pain was observed in 8% cases and was managed with analgesics. No radial artery thrombosis was found with an asymptomatic small hematoma in one patient (6%), which resolved spontaneously. Overall, 75% patients had prior transfemoral artery TACE, and all patients (100%) preferred the radial approach. All patients were in an ambulatory setting and were dismissed after 3 hours.

Conclusion

TRA allowed an outpatient management, reducing cost, hospitalization, and side effects. TRA is feasible, safe, well-accepted, and preferred in patients with previous femoral approaches.

P-392

Transarterial bland embolisation of HCC using the cyanoacrylate glue and 40–100-µm microspheres

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Purpose

To present a modified technique of TAE for HCC using both microspheres and the cyanoacrylate glue. To report on its feasibility and effects on disease progression and tumor devascularization.

Material and methods

Inclusion criteria were a) HCC according to the AASLD criteria, b) unsuitable for surgery, and c) multidisciplinary consensus on performing TAE. Exclusion criteria were 1) Child–Pugh C, 2) GI bleeding, 3) encephalopathy, and 4) portal thrombosis. All patients underwent preoperative MDCT or CE-MRI.

TAE was performed by entering the artery feeding the tumor, sparing the most healthy liver. Cone-beam CT was used for confirmation.

After full embolization with 40- or 100- µm microspheres, a mixture of approximately 0.3 mL cyanoacrylate/lipiodol in a 1:10 ratio was injected.

Follow-up was performed at 30 days, 3 months, and every 6 months. Response rates were assessed using the mRECIST criteria.

Results

Between 2013 and 2016, 64 patients and 78 HCCs were treated. Overall survival was 93%; 54 patients at the 1-year follow-up resulted in 24 complete responses (44%), 20 partial responses (37%), 4 stable diseases (7%), and 16 progressive diseases (30%). Forty-six tumors were completely devascularized at the 1-year control (71%); 17 had a residual supply (26%), and 2 did not show any devascularization (3%).

One case was complicated by the late-onset abscess of the treated lesion; another patient had postoperative pancreatitis. Both complications were treated conservatively.

Conclusion

TAE with microspheres and the cyanoacrylate glue for HCC is safe and feasible, offering desirable rates of 1-year disease control and tumor devascularization. These appear in line and in some cases, better compared with those reported in the current literature for standard TAE.

P-393

Preoperative embolisation of a replaced right hepatic artery before resection of pancreatic carcinoma

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Purpose

A replaced right hepatic artery (RRHA) is present in 7%–15% of patients. Radical resection of pancreatic head carcinoma in these cases often requires RRHA resection which may lead to ischaemic damage. The purpose of this study was to evaluate the outcome of preoperative embolisation of RRHA aimed to induce the development of hepatic arterial collaterals before resection of ductal pancreatic adenocarcinoma.

Material and methods

Between June 2014 and November 2016, embolisation of RRHA was performed prior to pancreatic resection in five patients. Micro-coils and micro-plugs were placed 1–1.5 cm distal to the origin of RRHA. The results and possible complications of embolisation, perioperative outcome and long-term effects were evaluated.

Results

Embolisation induced the formation of collaterals in all patients. One patient developed a hepatic abscess (measuring 5 cm), which was treated with drainage, and one patient developed gangrenous cholecystitis, which was treated with percutaneous cholecystostomy. Patients were operated after a median of 28 days (20–38 days). In one patient, resection could not be performed because of local extension of the disease. Resection was achieved in four patients (pancreaticoduodenectomy in three patients and total pancreatectomy in one patient). Two patients experienced major postoperative complications that were not related to ischaemia. Following resection, one patient died after 10 months and the other three are still alive after 2, 17 and 18 months, respectively.

Conclusion

Preoperative embolisation of RRHA can be relatively safely performed to induce the development of hepatic arterial collaterals before intended pancreatic resection.

P-394

Yttrium-90 radioembolization treatment for unresectable hepatocellular carcinoma: a single-centre prognostic factors analysis

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Purpose

To evaluate the efficacy and safety of ⁹⁰Y radioembolization in patients with unresectable HCC, correlating the results with independent prognostic factors for overall survival (OS) and complications.

Material and methods

Forty-three patients with advanced inoperable HCC including those with multiple bi-lobar lesions or portal vein thrombosis treated with radioembolization were reviewed. The treatment efficacy and safety were evaluated. Survival was calculated by the Kaplan–Meier method. Univariate analyses were performed for identifying potential prognostic factors. The radiologic response was evaluated using modified Response Criteria in Solid Tumors (mRECIST). Clinical toxicities were prospectively recorded.

Results

The median overall progression-free survival (PFS) and OS were 27.7 and 16.8 months, respectively. Longer median OS was revealed in patients without portal vein thrombosis ($p = 0.0241$) and in those whose pre-treatment haemoglobin values were higher ($p = 0.0471$). According to mRECIST criteria, we observed a disease control rate of 69.2% and 61.9% at the 3- and 6-month follow-up, respectively. Complications developed in 28 patients (65.1%), among which grade 2-3 events were noted in 17 patients; we noted that the activity administered dose was correlated with intraprocedural toxicity ($p = 0.039259$), whereas the use of the common hepatic artery as a release site was associated with the most frequent presentation of remote adverse events.

Conclusion

⁹⁰Y radioembolization is an alternative treatment with a promising outcome for poor-risk advanced inoperable HCC. Portal vein thrombosis and pre-treatment haemoglobin values can be predictors of efficacy. Activity administered dose and arterial release site can be predictors of safety.

P-395

Radioembolization with yttrium-90 resin microspheres for liver metastases of pancreatic adenocarcinoma: a retrospective multicenter analysis

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Purpose

Patients with chemotherapy-treated metastatic pancreatic cancer typically survive for 7–11 months. Liver metastases are common and are associated with poor outcomes. Radioembolization with yttrium-90 resin microspheres (Y-90 resin) may improve prognosis, but data are limited.

Material and methods

Retrospective patient, treatment, and outcome data were entered into a database of pancreatic adenocarcinoma metastases radioembolized with Y-90 resin. Outcomes included overall survival (OS; Kaplan–Meier), response rate (RECIST), and adverse events (AEs; CTCAE v4.0).

Results

Data from the first 24 patients (79% male, mean age 63 y) were analyzed. The median time from diagnosis to radioembolization with Y-90 resin was 10.2 mo. Nine patients had extrahepatic disease. The median dose delivered to the right ($n=14$), left ($n=2$), or whole ($n=8$) liver was 1.36 GBq. Radioembolization with Y-90 resin was concurrent with first-line chemotherapy in 12/21 patients, with ≥ 4 mo between chemotherapy onset and radioembolization with Y-90 resin. Median OS was 6.0 mo from radioembolization with Y-90 resin and 16.7 mo from diagnosis. Five patients experienced a partial response. Most AEs were grade 1 or 2. Three patients had grade 3 AEs (abdominal distension or pain, fatigue, ascites, odynophagia, oral sores, and biliary duct dilation) and 4 patients had grade 3 laboratory values (white blood cell count and bilirubin, alkaline phosphatase, and albumin levels). Two patients experienced grade 4 AEs, 1 had peripheral neuropathy, and 1 had elevated ALT and AST levels suggesting post-radioembolization hepatitis.

Conclusion

Overall, radioembolization with Y-90 resin was safe, with few serious AEs. Survival in this retrospective study was promising, given the generally poor prognosis for pancreatic adenocarcinoma; however, further investigation is needed.

P-396

Preoperative portal vein embolization (PVE) with major liver resection vs associating liver partition and portal vein ligation for staged hepatectomy (ALPPS) in advanced malignant hepatobiliary disease: a single-center experience

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Purpose

Compare the efficacy and safety of preoperative portal vein embolization (PVE) with liver resection and associating liver partition and portal vein ligation for staged hepatectomy (ALPPS).

To identify their main advantages and disadvantages.

To analyze the experience and results in our center.

Material and methods

The design of this study was descriptive, retrospective, and cross-sectional. Between January 2012 and December 2015, we analyzed 26 patients with advanced malignant liver disease: 73% (19/26) patients with metastatic carcinoma and 27% (7/26) patients primary hepatobiliary disease. A total of 62% (16/26) patients were treated with PVE with hepatic resection and 38% (10/26) patients were treated with ALPPS.

Results

The time to hypertrophy, calculated using a linear regression model, was 8 days for the ALPPS group and 32 days for the PVE group ($p < 0.001$). No differences were observed between the groups in the increase in the volume of the future liver remnant (FLR). Recurrence-free survival, measured from the date of hepatic resection until the date of radiographic detection of recurrence, was 77% for PVE and 12.5% for ALPPS groups ($p < 0.001$). The probability of recurrence, calculated using the logistic regression model, was 0.7 for the ALPPS group and 0.19 for the PVE group ($p < 0.05$) at a confidence interval

of 95%. The overall survival rate for 1 year, determined using the Kaplan–Meier method, was 80% for the PVE group and 40% for the ALPPS group.

Conclusion

The PVE method obtains a hypertrophy of FLR similar to that obtained by the ALPPS method; however, it requires more time. The PVE group has a lower probability of recurrence and higher overall survival than the ALPPS group.

P-397

Usefulness of CT arterial portogram (CTAP) in patients undergoing radioembolization with Y-90

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Purpose

CT arterial portography (CTAP) has been shown to be superior to conventional multiphase contrast-enhanced CT and MRI in detecting hepatic tumours. It can potentially change management, but its role in patients undergoing radioembolization with Y-90 has not been described.

Material and methods

Patients who underwent CTAP during Tc99m MAA workup prior to radioembolization for various hepatic tumours between June 2010 and June 2015 were identified.

CTAP appropriateness criteria were drawn. The criteria included suboptimal diagnostic scan, non-specific lesions on diagnostic scan, long interval between diagnostic scan and Tc99m MAA, unilobar disease, and large tumours with possible extrahepatic arterial supply and/or supply from more than one hepatic artery. Based on these, patients were stratified into three categories: most appropriate, appropriate, and least appropriate. The diagnostic studies in these patients were compared with CTAP, and its effect on further management was analysed.

Results

Eighty-seven patients underwent CTAP during Tc 99m MAA workup. CTAP was considered most appropriate in 16% (n = 14), appropriate in 25% (n=22), and least appropriate in 59% (n=51). CTAP significantly affected management in 71% of patients in the most appropriate group and 23% in the appropriate group and had no impact in least appropriate group.

Conclusion

CTAP is a valuable test in selected patients, but the criteria for its appropriateness has not been described before. It can significantly affect management when used selectively, thereby reducing the cost, time spent, and radiation exposure.

P-398

Retrospective analysis of a cohort of patients with unresectable HCC treated with SIRT and liver transplant

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Purpose

The aim of our study is to evaluate the radiological and clinical results of SIRT and hepatic transplant in 22 patients (Pts) with unresectable hepatocarcinoma (HCC). We analyzed the role of SIRT as a “bridging” or “downstaging” endovascular therapy for Pts with intermediate/advanced HCC.

Material and methods

We evaluated 274 Pts with unresectable HCC treated with yttrium-90 resin microspheres between 2008 and 2016. Of these, 22 Pts showed a such a good response to treatment (complete or partial) that they became eligible for hepatic transplant. We followed up Pts after SIRT with CT at 1–3 and 6 months after therapy. We analyzed the toxicity of SIRT, staging Pts from a radiological and clinical point of view.

Results

Overall, 8.02% of Pts with intermediate/advanced HCC had a successful transplant after SIRT, and they are still alive. In 4.4% cases, SIRT had a downstaging effect on pathology. PR, SD, and PD based on mRECIST criteria were evaluated in all Pts. Moreover, we evaluated the free survival rate of Pts transplanted and noticed that it was very similar to the free survival rate of Pts with low-grade HCC who received a hepatic transplant.

Conclusion

SIRT is a very safe and effective locoregional endovascular therapy. Although this procedure is not well-known and considered by interventional radiologist and pathologist, we maintain that it has a very important role as a downstaging and/or bridging therapy in case of intermediate/advanced HCC. Furthermore, Pts transplanted after SIRT have a free survival rate same as Pts with low-grade HCC who have received a hepatic transplant.

P-399

Percutaneous ablation of RAS mutant colorectal liver metastases is associated with high-rate local tumor progression

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Purpose

To evaluate the predictive values of RAS mutation status on local tumor progression (LTP) after percutaneous ablation of colorectal liver metastasis (CLM).

Material and methods

A retrospective analysis of patients who underwent CT-guided percutaneous ablation of CLMs from 2004 to 2015 and had a known RAS mutation status was performed. Patients were evaluated for LTP at CLMs treated with ablation. Multivariate Cox regression analysis was performed to determine factors associated with LTP-free survival.

Results

Overall, 92 patients with a known RAS mutation status underwent ablation of 137 CLMs. Thirty-six patients (39%) had a mutant RAS. LTP rates were 14% (8/56) for patients with wild-type RAS and 39% (14/36) for patients with mutant RAS (p=0.007). On analysis by individual CLM treated with ablation, LTP rates were 9.3% (8/86) for CLMs in patients with wild-type RAS and 33% (17/51) for CLMs in patients with mutant RAS (p=0.0004). LTP occurred earlier and at significantly higher rates for CLMs with diameter <2 cm in patients with mutant RAS, irrespective of ablation margins, than for CLMs with diameter <2 cm in patients with wild-type RAS (p=0.0002). Actuarial LTP-free survival was worse in patients with mutant RAS than in those with wild-type RAS (3-year LTP-free survival rate: 35% vs. 71%, p=0.001). In multivariate analysis, negative predictors of LTP-free survival were minimal ablation margin <5 mm [hazard ratio (HR) 2.48, 95% confidence interval (CI) 1.31–4.72; p=0.006] and mutant RAS (HR 3.01, 95% CI 1.60–5.77; p=0.001).

Conclusion

The presence of mutant RAS is associated with an earlier and higher rate of LTP among patients undergoing ablation of CLMs.

P-400

In vivo percutaneous renal microwave ablations: correlation of diameter with ablation work and ex vivo data

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Purpose

To compare the diameters of in vivo microwave ablation (MWA) performed in swine kidneys with ex vivo data and to correlate them with ablation work, a new metric reflecting the total energy delivered.

Material and methods

In 6 swine kidneys, 18 MWAs were performed successively in vivo using one to two MWA antennas (MicroThermX, Terumo). Ablations were created by delivering power (45, 60, or 90 W) for 5, 10, or 15 minutes. Ablation work was defined as sum of (power) * (time) * (number of antennas) for all phases during an ablation procedure (in kJ). The kidneys were removed by laparoscopic surgery immediately after ablation. After sacrifice, ablations zones were evaluated macroscopically, and the maximum diameters were recorded. Results were compared to ex vivo data by Wilcoxon sum-rank test and correlated to ablation work by Pearson correlation.

Results

Ablation work ranged from 13.5 to 108 kJ. For a single antenna (n=12), the in vivo diameter ranged from 12 to 35 mm, and for 2 antennas (n=6), it ranged from 15 to 49 mm. The in vivo diameters (8.6 ± 30.1) remained lower than the ex vivo diameters (11.7 ± 26.5) on an average, but no significant differences were observed ($p=0.31$ and 0.44 , respectively). Diameters increased linearly with ablation work either with 1 or 2 antennas, but only moderate correlations were observed [$r=0.43$ ($-0.19;0.81$), $p=0.16$ and 0.57 ($-0.44;0.95$), $p=0.24$, respectively].

Conclusion

Ablation diameters after in vivo renal MWA increase linearly with ablation work, but the moderate correlation justifies a careful imaging monitoring and setting adaptation if needed for optimal ablation.

P-401

Breast tumors treated with percutaneous image-guided cryoablation: prospective single-center experience of 32 consecutive non-surgical patients

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Purpose

To present our experience of breast cancer patients undergoing image-guided (US/CT) percutaneous cryoablation, without subsequent surgery.

Material and methods

Non-surgical patients were enrolled following indications of a multi-disciplinary board.

We collected the following data:

- Tumors: location, histology, and maximum diameter;
- Procedure: anesthesia, hospitalization duration, and complications; and

- Follow-up: clinical and radiological (MRI at 3, 12, 18, and 24 months for evaluation of local recurrence, skin retraction, inflammation, or burns).

Results

Overall, 32 tumors (30 ductal carcinomas, 2 lobular carcinomas) were treated in 32 female patients (median age 84 years); 25 of these tumors had positive hormone receptors, with a median maximal diameter of 15 mm (range 5–28 mm). Overall, 27 patients were treated under local anesthesia, and only 5 were treated under local anesthesia with conscious sedation. Hospitalization lasted for 1 day in 17 cases and 2 days in the remaining. Two (6%) cases of skin necrosis and 5 (16%) cases of hematoma were noted immediately. In one case (3%), skin retraction was still evident at the 12-month follow-up. The mean follow-up duration was 19.2 months; MRI at 3 months showed an incomplete treatment in 6% patients, and in 7%, recurrence was noted at 1 year. At 24 months, 12 patients underwent a follow-up, wherein 3 of them presented with a distant recurrence (new breast tumor and lymph node).

Conclusion

Cryoablation of breast tumors is safe with good local control in elderly patients. Most of the treatments can be performed under local anesthesia on an outpatient basis.

P-402

Early sorafenib-related biomarkers for the combination treatment of TACE and sorafenib in HCC patients

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WITHDRAWN

P-403

Quality of life in patients undergoing repetitive TACE for intermediate-stage HCC

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Purpose

To assess quality of life (QoL) changes in patients suffering from intermediate-stage HCC during repetitive TACE treatments, and to analyze factors influencing QoL.

Material and methods

We prospectively evaluated QoL in 82 patients undergoing repetitive TACE in a single-center study over 32 months using the validated EORTC QLQ-C30 and EORTC-HCC18 questionnaires before and 14 days after treatment. QoL changes over the time of repetitive treatment were evaluated using the Wilcoxon signed-rank test. Patient-related and procedural data as well as tumor response were analyzed using a common multivariate linear regression model to reveal factors potentially influencing QoL.

Results

No significant changes in QoL were observed regarding the categories global health ($p=0.75$), physical functioning ($p=0.06$), fever ($p=0.41$), pain ($p=0.41$), nausea, and vomiting ($p=0.42$) throughout a course of several TACE treatments. Tumor response showed no significant influence on changes in QoL ($p>0.175$). Patients with higher levels in global health and physical functioning before initial TACE

showed stronger decrease in these parameters ($p < 0.01$). High initial levels of pain, nausea, and vomiting were correlated to a reduction of pain and a significantly smaller increase in nausea and vomiting with repetitive treatment ($p < 0.01$).

Conclusion

Patients with high initial QoL showed higher than average QoL decrease, with the overall level still being acceptable. In contrast, patients with low initial QoL showed no relevant QoL decrease or even benefit with respect to pain.

Because tumor response did not alter QoL, aggressive TACE treatment is reasonable with respect to both response and QoL.

P-404

Microwave ablation of liver malignancies: a comparison between effects and early outcomes of percutaneous and intraoperative approaches under different liver conditions

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Purpose

Liver thermal ablation is an alternative treatment for hepatocellular carcinoma (HCC) and secondary liver malignancies. Microwave ablation (MWA) produces large ablation zones (AZs) in a short time; however, AZ prediction is based on preclinical ex vivo models, raising concerns about reproducibility and safety in humans. We aimed to investigate the effects produced by a new generation MWA system on human liver in vivo with different approaches (percutaneous or intraoperative) and under different liver conditions (cirrhosis or previous chemotherapy treatment) in comparison with manufacturer-provided predictions based on ex vivo animal models. Complete tumor ablation (CA) and early clinical outcomes were also assessed.

Material and methods

From October 2014, 60 consecutive patients (cirrhotic=31; non-cirrhotic=10; chemotherapy treated=19) with 81 liver nodules (HCC=31; mets=50) underwent MWA procedures (percutaneous=30; laparoscopic=18; laparoscopic=12), with a 2450MHz/100W generator with Thermosphere-Technology™ (Emprint™, Medtronic). A contrast-enhanced CT or MR was performed after one month to assess CA and measure AZ.

Results

A linear correlation between AZ volumes and ablation times was observed in vivo, without differences with respect to manufacturer-provided ex vivo predictions for all operative approaches and liver conditions. Other independent variables (sex, age, nodule location) showed no relationship when added to the model. Median (IQR) longitudinal and transverse roundness indexes of AZs were 0.77 (0.13) and 0.93 (0.11), respectively. CA at 1 month was 93% for percutaneous and 100% for intraoperative procedures ($p = 0.175$). Thirty-day morbidity and mortality were 3% and 0%, respectively.

Conclusion

MWA with Thermosphere-Technology™ produces predictable AZs on human liver in vivo according to manufacturer-provided ex vivo predictions. In our experience, this new-generation MWA system is effective and safe to treat liver malignancies in different operative and clinical settings.

P-405

Prior hepatectomy predicts local tumor progression and survival after percutaneous ablation of colorectal liver metastasis

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Purpose

To evaluate if the currently utilized hepatic resection criteria for patients with colorectal liver metastasis (CLM) promotes patient selection with optimal tumor biology translated in low rates of local tumor progression (LTP) at CLM developed post-resection treated with percutaneous ablation (PA).

Material and methods

Eighty-two consecutive patients with 97 post-resection CLMs treated with PA during 2004–2014 were included. Local tumor progression-free survival (LTPFS) from the time of PA between patients with ($n=49$) and without ($n=33$) history of hepatic resection were analyzed. Multivariate Cox regression analysis was utilized to identify factors associated with LTPFS by imaging.

Results

Median overall follow-up period for the present study was 28 months (range, 4.5–132). Three-year actuarial LTPFS was better in patients with a prior history of hepatic resection when compared to patients without history of hepatic resection (73% vs 34%, $P < 0.001$). Three-year recurrence-free survival (RFS) at any organ (23% vs 9.1%, $P = 0.02$) and overall survival (OS) (78% vs 48%, $P = 0.003$) were also better in patients with prior hepatic resection. Multivariate analysis identified negative predictors for LTPFS; no prior history of hepatic resection [hazard ratio (HR) 2.35, 95% confidence interval (CI) 1.02–5.45; $P = 0.045$], minimal ablation margin < 5 mm (HR 2.4, 95% CI 1.18–4.87; $P = 0.016$), and RAS mutant type (HR 2.65, 95% CI 1.18–5.94; $P = 0.019$).

Conclusion

History of hepatic resection for CLM is associated with improved LTPFS, RFS, and OS after PA of patients with CLMs. Such findings suggest inherent differences in tumor biology among the surgical and non-surgical populations and its related outcomes.

P-406

Cryoablation of T1b renal tumors: a single-center experience of 27 consecutive patients

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Purpose

To study the safety and efficacy of percutaneous image-guided cryoablation (CA) of T1b renal tumors.

Material and methods

This is a single-center, retrospective, observational study of T1b renal tumors treated with percutaneous image-guided (CT or MRI) CA between 2008 and 2016 in a population of non-surgical candidates.

Technical success, complications, primary local tumor control (LTC), and overall survival were carefully investigated.

Results

Twenty-seven patients (12 female, 15 male; mean age 72.3 ± 14.3 years; range 32–91) with 27 biopsy-proven T1b renal tumors were treated in 27 consecutive sessions. The mean maximum diameter of target tumors was 47.9 ± 6.3 mm (range 41–63). Hydro- or carbo-dissection of nearby non-target organs was applied in 22 (77.8%) cases. Technical success was 87.5%. Primary LTC was 94.4%, 93.3%, 91.6%, 77.7%, and 50% at the 6-, 12-, 18-, 24-, and 36-month follow-ups, respectively. Three patients showed signs of local recurrence at the 6-, 24-, and 36-month follow-ups. Nine patients reported one or more complications (33.3%; seven haemorrhagic): 8 grade I-II and one grade III-IV. One patient died 24 months after CA due to the metastatic evolution of his kidney cancer.

Conclusion

CA of T1b renal tumors is an effective treatment, with optimal LTC rates at the early and mid-term follow-ups; however, due to the lack of long-term data, it should be strictly reserved to non-surgical candidates. Complications (mostly hemorrhagic) are frequent, but in most of the cases, they are self-limiting, thus needing only surveillance.

P-407

Transarterial chemoembolization of liver metastasis from uveal melanoma using melphalan and calibrated microspheres: treatment response and complications

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Purpose

To investigate the efficacy and safety of hepatic transarterial chemoembolization (TACE) using melphalan and microspheres in patients with liver metastasis from uveal melanoma (UM).

Material and methods

This monocentric retrospective study was conducted from 2006 to 2016, including 35 consecutive patients with liver metastasis from ocular melanoma treated by TACE using melphalan and calibrated microspheres (250µm). Radiological response was assessed according to RECIST 1.1, m RECIST, and EASL based on contrast-enhanced computed tomography (CT) or magnetic resonance imaging (MRI). The primary endpoint was the overall survival (OS). Liver metastasis response (LMR) and complications evaluated with the common terminology criteria for adverse events (CTCAE) were secondary endpoints.

Results

The 35 patients underwent 139 TACEs (mean, 4.0 sessions; range 1–9) with an OS of 22.5 months (range 2–63). LMR combining partial and complete response was 46%, 90%, and 90% with RECIST 1.1, mRECIST, EASL, respectively. There were 24 major complications (CTCAE > 3) in 14 patients, including 2 deaths due to septic shock.

Conclusion

For patients with liver metastases from UM, TACE using melphalan showed good results on OS compared to those observed in previous reports and good results on LMR, with an acceptable rate of complications. This treatment seems to shift the prognosis for most of patients to other secondary locations.

P-408

Clinical outcomes following percutaneous thermal ablation of hepatocellular adenomas

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Purpose

To assess the safety and efficacy of percutaneous thermal ablation for the treatment of hepatocellular adenomas.

Material and methods

Ethics board approved, single-arm, retrospective, cohort study of patients with pathologically proven hepatocellular adenomas treated with percutaneous thermal ablation at a tertiary referral center from 1999 to 2016. Demographic, procedural, and outcome data were collected and summarized with appropriate measures of central tendency and dispersion. Complications were graded as per the SIR reporting guidelines. Primary and secondary efficacies were based on postprocedural imaging.

Results

Thirty-six patients (4 male, 32 female) with a median age of 35 years underwent 44 procedures for the treatment of 58 tumors. Of these, 22% had a history of adenoma-related hemorrhage. The median tumor size was 2.1 cm (95% CI: 1.0–5.2). Majority of the treatments were provided on an outpatient basis under moderate sedation using radiofrequency ablation with ultrasound guidance. The median procedure time was 85 minutes. There were two immediate postprocedural hemorrhages (4.5% per procedure). During a median follow-up of 1.7 years (95% CI: 0.2–8.0), there were no instances of malignant transformation, adenoma-related hemorrhages, or deaths. The primary and secondary efficacy rates were 88% and 100%, respectively.

Conclusion

Thermal ablation for the treatment of hepatocellular adenoma had primary and secondary efficacy rates of 88% and 100%, respectively. The complication rate was 4.5%. The clinical efficacy during a median follow-up of 1.7 year was 100%.

P-409

Outcomes of percutaneous CT-guided cryoablation of renal neoplasms: volumetric analysis of the ice ball to lesion ratio as a predictor of recurrence

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Purpose

To evaluate the safety and efficacy of CT-guided cryoablation of renal neoplasms and identify factors predictive of clinical success.

Material and methods

A retrospective analysis of patients undergoing percutaneous CT-guided cryoablation of renal masses between 2008 and 2016 at a single center. Endpoints included technical success, freedom from recurrence, survival, and adverse events. In addition, 3D quantitative analysis of the ratio of ice ball to lesion volume was performed.

Results

Overall, 108 renal neoplasms in 100 consecutive patients (63 male and 37 female, mean age 67 years) were enrolled in the study. The mean lesion diameter was 3.04 cm (range 1–6.5 cm), with a mean lesion volume of 14.32 cm³. The mean number of probes used was

2.98. The mean ice-ball volume was 33.26 cm³. Fifty-four lesions demonstrated medullary involvement (50%). Hydrosdissection was required in 13 lesions (12%) due to proximity of bowel loops. Technical success was achieved in 107 of the 108 lesions (99%). Major bleeding occurred in 3 patients requiring transfusions. There was a single 30-day mortality not directly related to the procedure. Mean follow-up was 13 months. Local recurrence was noted in 4 of 100 patients (4%), while secondary lesions in the contralateral kidney were observed in 3 patients (3%). The mean ratio of ice-ball volume to lesion volume at the index procedure was 1.10 in patients with recurrent lesions and 2.37 in patients without recurrent lesions.

Conclusion

Percutaneous CT-guided cryoablation is a safe and effective procedure for the treatment of renal neoplasms. An ice ball to lesion volumetric ratio of <1.5 may be predictive of recurrence.

P-410

Efficiency and clinical outcomes of stents loaded with 125 iodine seeds for unresectable oesophageal cancer: a multi-centre, retrospective analysis

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Purpose

To explore the risk factors associated with the clinical outcomes in patients with unresectable oesophageal cancer who underwent 125 iodine (¹²⁵I) seed-loaded irradiation stent placement.

Material and methods

Patients with oesophageal cancer treated with ¹²⁵I irradiation stent because of progressive dysphagia between June 1, 2012 and March 31, 2016 in 5 hospitals at China were included in this retrospective study. Univariate and multivariate analyses were performed to identify the associations between the pretreatment characteristics and the clinical outcomes in terms of the overall survival, relief from dysphagia and the complications after stent insertion.

Results

A total of 201 patients were included. Histology of tumour (squamous-cell carcinoma vs adenocarcinoma; $p=0.046$), Eastern Cooperative Oncology Group (ECOG) performance status scores (0-1 vs. 2-3; $p=0.013$) and serum total protein (TP) concentration (≥ 66 g/L vs <66 g/L) were identified as the independent risk factors associated with the overall survival. For the relief of dysphagia, age (≥ 71 years vs <71 years), tumour location (superior vs inferior), tumour node metastases (TNM) classification (IV vs II) and T stage (T4 vs T3) were the independent risk factors. No significant association was found between the composite complications and the pre-treatment characteristics.

Conclusion

Among patients with unresectable oesophageal cancer who underwent a ¹²⁵I seed-loaded irradiation stent placement, those with squamous-cell carcinoma, ECOG scores of 0-1 and higher TP (≥ 66 g/L) could achieve longer overall survival; young patients (<71 years), inferior segment tumour, TNM stage II and T3 stage may benefit most in terms of relief from dysphagia using this therapy.

P-411

Initial assessment of clinical feasibility, safety and efficacy of NanoKnife irreversible electroporation (IRE) in the focal treatment of localised renal cell carcinoma (RCC) with delayed interval tumour resection (IRENE trial)

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Purpose

To evaluate the feasibility, adverse event profile, functional outcome and efficacy of focal irreversible electroporation (IRE) for pT1a renal cell carcinoma (RCC) in consecutive patients of the first prospective, monocentric phase 2a pilot ablate-and-resect study (IRENE trial).

Material and methods

Seven patients (mean age 68 years; ECOG 0-1; Charlson Score 0-2) with biopsy-proven RCC pT1a cN0cM0 and a mean tumour size of 22 mm (range 15–39) underwent percutaneous CT-guided, ECG-triggered IRE under general anaesthesia and deep muscle paralysis with 3–6 monopolar electrodes followed by complete surgical resection 28 days after IRE. Multiparametric MRI was performed 1 day before as well as 2, 7, 27 and 112 days after IRE.

Results

Technical feasibility was achieved in all patients, but electrode placement and ablation were complex with a mean overall procedure time of 129 min. There were no major procedure-related complications. In all cases, MR imaging demonstrated a complete coverage of the tumour area by the ablation zone. Resection exhibited in 4/7 cases with ypT0V0N0Pn0R0 and 3/7 cases with ypT1aV0N0Pn0R1 due to microscopic residual tumour areas with viable or uncertain viable tumour cells. The best indicator of response in MR seemed to be reduction of enhancement. Renal function after IRE was retained in all cases with no urinary leakage or retention, no renal infarction and no significant change in creatinine. Mean follow-up of 25 months had no evidence of local recurrence or metastasis.

Conclusion

Renal percutaneous NanoKnife IRE appears to be a safe treatment for SRM but needs a high procedural effort and further studies for certain repeatable ablations.

P-412

New treatment for prostate cancer: prostatic artery chemoembolization

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Purpose

To evaluate the outcome of prostatic artery chemoembolization (PACE) in patients with prostate cancer (Pca).

Material and methods

Between March 2015 and February 2017, 30 patients with Pca underwent PACE. Gleason score ranged between 6 and 10, and staging was T2NoMo.

For PACE, Chelidonium majus mother tincture 1cc and docetaxel 1cc mixed with lipiodol 0.5 were injected in prostatic arteries. In the last 10 patients, Chelidonium majus 0.5cc was mixed with

docetaxel 1cc and lipiodol 0.5cc and injected through the same route. Embolization of these arteries was performed with 150–300- μ m embospheres.

Results

Mean patient age was 68.4 years. Patients (5, 16.7%) whose PSA did not decrease under 2 ng/mL after PACE were considered to have experienced initial biochemical failure. Of the 25 patients with technical success, there were 20 (80%) initial biochemical successes and 2 (10%) biochemical failures in a short term within 12 months. At this time, there were 7 (28%) patients with biochemical failure and 18 (72%) patients with biochemical success. Twelve patients were evaluated at mid-term between 12 and 18 months, with 2 (10%) mid-term failures. Among the 25 patients with technical success, there were 16 (64%) with biochemical success. There was a major complication, bladder wall ischemia, treated by surgery.

Conclusion

PACE for Pca is a new, safe, and promising outpatient procedure, with good short- and mid-term results.

P-413

Advanced-stage hepatocellular carcinoma: who will benefit from the treatment using TACE monotherapy compared with that using TACE plus sorafenib?

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WITHDRAWN

P-414

Catheter Directed Computed Tomography Hepatic Angiography for Yttrium-90 Selective Internal Radiotherapy of Hepatocellular Carcinoma: Correlation with SPECT-CT and its impact on coiling rates, safety and efficacy

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Purpose

To evaluate the use of catheter directed intra-arterial computed tomography hepatic angiography (CD-CTHA) in reducing the rate of prophylactic embolization of extrahepatic vessels in patients undergoing Yttrium-90 selective internal radiotherapy (Y-90 SIRT) of hepatocellular carcinoma (HCC).

Material and methods

Between May 2010 to June 2015, 186 patients undergoing Y-90 SIRT with resin microspheres for HCC were analyzed. All procedures were performed in a hybrid-CT and digital subtraction angiography unit. CD-CTHA was performed for these patients during exploratory hepatic angiography. Selective prophylactic embolization of extrahepatic vessels was performed if extrahepatic enhancement was seen on CD-CTHA or if an extrahepatic vessel was deemed to be too close to the final catheter position for Y-90 microsphere delivery.

Results

Thirty-five patients (18.8%) required selective embolization of extrahepatic vessels, which was lower than rates reported in literature

that performed Y-90 SIRT without CD-CTHA (36.8–80%, $p < 0.001$). Technical success of Y-90 SIRT, as defined by tumour uptake assessed by bremsstrahlung SPECT/CT, was 99.5%. Extrahepatic uptake of Y-90 microspheres on bremsstrahlung SPECT/CT was 1.1% ($n=2$, gastric and gallbladder). These two patients were monitored closely and were discharged without any complications. Two separate patients (1.1%) developed radiation gastritis, and one separate patient (0.5%) developed radiation pneumonitis. These rates were below the threshold suggested by the Society of Interventional Radiologists' Quality Improvement Guidelines (3.0%, and 1.0% respectively). Median survival of 13.1 months (95% CI 8.5–17.0 months) was comparable to survival rates reported in literature.

Conclusion

The use of CD-CTHA in Y-90 SIRT of HCC reduces the rate of prophylactic embolization of extrahepatic vessels while maintaining a high technical success rate of treatment and a favorable side effect profile.

P-415

Idarubicin-loaded DC Bead® for chemoembolization of HCC: interim analysis of IDASPHERE II (FFCD 1307) multicenter single-arm phase II trial

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Purpose

The primary endpoint was to assess the objective response (OR) rate at 6 months after trans-arterial chemoembolization (TACE) for HCC using the idarubicin-loaded DC Bead®.

Material and methods

TACE sessions (1–4) were performed using 10mg of idarubicin loaded in the 100–300- μ DC Bead®. Toxicity assessed according to NCI-CTCAE v4.0. or evaluated by MRI centralized review using mRECIST criteria was the primary endpoint. The study involved a 2-step Fleming design (H_0 : OR at 25% at 6 months vs H_1 : 40%, power=90%, one-sided: $\alpha=5\%$). Forty-six patients (pts) were included for the interim analysis (91 pts initially planned), and 44 pts were evaluable.

Results

Forty-six pts (median age: 71 years range: 44–89 years; male: 87%; Child A: 80%) were enrolled in 7 centers. Performance status was 0 in 83%, 1 in 15%, and 3 in 2%. BCLC status was A in 10.9%, B in 76.1%, and C in 13%. Bilobar disease was reported in 51%, with >3 HCC nodules in 53.5% pts. Complete response, partial response, and stable disease were observed in 6 (13.6%), 16 (36.4%), and 4 (9.1%) pts, respectively. OR rate at 6 months was 50% (90% CI: 36.8%–63.2%). The trial was stopped at interim analysis because of efficacy: OR was achieved in 22 pts (19 pts or more were expected). In term of toxicities, 72% of the patients had at least one grade 3–4 toxicity, mainly transaminase increase.

Conclusion

TACE of HCC using the idarubicin-loaded DC Bead® is well-tolerated and provides a 50% objective response rate at 6 months. A randomized phase 3 trial is warranted.

P-416

Chemoembolization adopting polyethylene glycol drug-eluting embolics loaded with doxorubicin for the treatment of hepatocellular carcinoma

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Purpose

To study the efficacy and tolerability of transarterial chemoembolization (TACE) using polyethylene glycol (PEG) drug-elutable microspheres loaded with doxorubicin for the treatment of hepatocellular carcinoma (HCC).

Material and methods

Eighty-four patients with unresectable HCC by tumor board were assigned to TACE and treated with polyethylene glycol drug-elutable (PEG) embolics loaded with doxorubicin. Patients were prospectively enrolled and included 32 (76%) males and 10 (24%) females. Median sample age was 65 years (range 42–83). Patients were treated with 50 mg of doxorubicin loaded in 2 ml of PEG embolics (diameter 100±25 µm) that were infused via the chemoembolization method. Data collected included previous cancer therapy, tumor size, number of lesions and TACE, tumor response (1, 3, and 6 months), type and intensity of adverse events, and quality of life (QoL).

Results

One month following TACE, tumor response rate was 79% [complete response (CR)=50%, partial response (PR)=29%, stable disease (SD)=17%, and progressive disease (PD)=5%]. At 3 months, CR=48%, PR=24%, SD=24%, and PD=3%. At 6 months, CR, PR, SD, and PD were 43%, 19%, 29%, and 10%, respectively. TACE was well-tolerated by all patients with evidences of no procedure complications or systemic drug-related side effects. Fever (33%), transaminase rise (17%), and pain (35%) were the most frequent side effects, with a mostly mild intensity (G1-2). QoL was 80 at 1 month after TACE and 81 and 82 at 3- and 6-month time points, respectively.

Conclusion

Data suggest that PEG embolics are efficacious and safe for the treatment of HCC, as indicated by the good tolerability, QoL, and high tumor response.

P-417

Percutaneous ablation of hepatic dome tumours through the transpulmonary pathway

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Purpose

To retrospectively analyse the safety and efficacy of transpulmonary percutaneous ablation, both radiofrequency (RF) and microwave (MW), in managing hepatic dome tumours.

Material and methods

We treated 27 hepatic dome tumours from 21 patients (with a mean age of 66 years). The tumours were subjected to transpulmonary tomography-guided thermal ablation (RF or MW) in a single session. Sixteen of these tumours were hepatocarcinomas (HCC) and 11 were metastases (Mx) of colorectal cancer diagnosed by biopsies or imaging techniques. Follow-up was conducted 1 month after the ablation and subsequently at various times through computed tomography (CT) or magnetic resonance imaging (MRI) of the liver.

Results

The mean follow-up time was 7 months (1–14 months), and full response was achieved in 71% of the treated patients (60% of the HCCs and 40% of the Mx). The presence of pneumothorax was observed in 8 patients (38%; 50% of these patients had HCCs and the other 50% had Mx) during the ablation session, which spontaneously resolved without the need of a drainage catheter. There were no other complications in the subsequent check-ups.

Conclusion

Transpulmonary percutaneous thermal ablation (RF or MW) of hepatic dome tumours appears to be a safe and effective technique.

P-418

Contrast-enhanced ultrasonography-guided radiofrequency ablation of hepatic neoplasms

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Purpose

The objective of this retrospective study is to evaluate the efficacy of contrast-enhanced ultrasound (CEUS) in guiding the treatment of hepatocellular carcinomas (HCCs) and hepatic metastases with percutaneous radiofrequency ablation (RFA).

Material and methods

From January 2010 to December 2015, a single-center retrospective review of all RFAs performed at our institution was conducted. In total, 295 RFA procedures were performed, of which 59 were CEUS guided with a total of 49 patients [39 males, average age 62.5 years (range: 32–87)] presenting with an average of 1.3 lesions. Preoperative baseline imaging was performed with computed tomography (CT) or magnetic resonance imaging (MRI). Intraoperatively, CEUS images were compared to US images performed at the same RFA session to determine the ability of CEUS to increase the visualization of lesions. The efficacy of the treatment was evaluated with follow-up imaging for the presence of residual or recurrent disease.

Results

Following the administration of a contrast agent, CEUS allowed for increased visualization in 54 (91.5%) cases, as indicated by the increased flow signals or newly appeared signals. This enabled targeted treatment of the lesion, previously poorly appreciated on preoperative imaging. With an average of 207 days of follow-up, 12 (20.3%) of the targeted lesions were incompletely treated or missed despite improved visualization, as evidenced by recurrence on follow-up imaging. These lesions required reintervention, which was subsequently successful in 100% cases.

Conclusion

CEUS increases visualization and provides better characterization of hypervascular hepatic lesions not well-appreciated on conventional US. Hence, this retrospective study suggests that CEUS is a promising adjunct to conventional image-guided hepatic RFAs.

P-419

Two-dimensional perfusion angiography of hepatocellular carcinoma before and after chemoembolization

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Purpose

To evaluate the quantifiable changes of two-dimensional perfusion angiography for transarterial chemoembolization (TACE) in patients with hepatocellular carcinoma (HCC).

Material and methods

This prospective study included 70 TACE patients diagnosed with HCC from November 20, 2015 to March 31, 2016. Intraoperative two-dimensional perfusion angiography (Allura Xper FD20, Philips Healthcare) was performed in a single session before and after TACE. Multiphase preprocedural and postprocedural CT scans were reviewed. Index lesions were defined as all discrete lesions ≥ 1.5 cm. The pre- and post-area under the curve (AUC) analysis utilized regions of interest of representative portions of the tumor obtained on a workstation and then compared the results using paired t-tests. The correlation between change in AUC and objective response was evaluated for significance using one-way ANOVA on ranks.

Results

Eighty lesions meeting the inclusion criteria were identified in 70 patients. A statistically significant change in average tumoral AUC (Δ AUC) was identified after chemoembolization (Δ AUC=10795.7 $\pm$ 9631.1, $p<0.001$). The largest Δ AUC was present in the tumors that showed complete response (CR) to treatment on follow-up imaging (16816.1 $\pm$ 10128.4). The Δ AUC was significant in the CR, PR, and SD groups ($p<0.01$). Amongst all lesions evaluated, a significant relationship was identified between the Δ AUC and tumor response according to RECIST 1.1 criteria using one-way ANOVA testing on ranks ($p<0.001$).

Conclusion

Two-dimensional perfusion angiography demonstrates quantifiable changes in physiological parameters. Assessment of these changes may be used for point-of-care analysis of treatment efficacy, suggesting a need for an additional on-table treatment.

P-420

Chemoembolization with drug-eluting beads loaded with doxorubicin for the treatment of cholangiocarcinoma

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Purpose

To report clinical outcomes of transarterial chemoembolization (TACE) using drug-eluting beads (DEBs) loaded with doxorubicin for the treatment of unresectable intrahepatic cholangiocarcinoma (CCA).

Material and methods

We treated 127 patients with doxorubicin via TACE. Inclusion criteria were diagnosis of unresectable CCA, indication for TACE, performance status (PS) 0–2, >3 months of life expectancy, older than 18 years, and written consent. TACE was performed using DEBs in 109 (86%) patients and polyethylene glycol (PEG) drug-eluting beads loaded with doxorubicin in 18 (14%) patients.

Results

Tumor response among the sampled 127 patients was partial response (PR) in 19 (15%) patients, stable disease (SD) in 101 (80%) patients, and progressive disease (PD) in 7 (5%) patients 3 months after therapy, and no complete response was observed. There were differences between the type of embolics: PR was 7% in the DEB and 77% in the PEG group. SD was 88% in the DEB and 8% in the PEG group. PD was 5% in the DEB and 15% in the PEG group. Most frequent side effects were abdominal pain, fever, nausea, and transaminase increase.

Conclusion

TACE was effective and safe for CCA treatment, with a high disease control rate. The best response for PEG embolics-TACE was PR, whereas it was SD for DEB-TACE.

P-421

A modified ablative margin assessment system for radiofrequency ablation combined with conventional transarterial chemoembolization of hepatocellular carcinoma: the lipiodol deposition made a difference

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Purpose

To create a modified ablative margin assessment system evaluating the treatment efficacy of radiofrequency ablation combined with conventional transarterial chemoembolization (cTACE-RFA) for hepatocellular carcinoma (HCC).

Material and methods

The retrospective study included 177 patients with solitary HCC sized 2.0–5.0cm, who underwent cTACE-RFA. Ablative margins were classified into four grades: grade A, with a thickness ≥ 5 mm in all directions; grades B and C, with an intact ablative margin and the part < 5mm surrounding the tumor region with dense and poor lipiodol deposition, respectively; and grade D, with a non-intact ablative margin without residual tumor. We calculated the cumulative local tumor progression (LTP) and overall survival (OS) rates for each grade of ablative margin and analyzed the factors contributing to clinical outcomes.

Results

The median follow-up was 44 months (range, 7–96 months). Ablative margin of grade A/B had better LTP and OS than that of grade C/D ($P<0.05$), and the LTP and OS between grade A and B had no statistically significant difference ($P>0.05$). Based on multivariate analyses, ablative margin of grade C/D ($P<0.001$ and $P=0.001$, respectively) and tumor size ($P=0.017$) were the independent risk factors for LTP and ablative margin of grade C/D ($P<0.001$ and $P<0.001$, respectively) and Child–pugh class B ($P=0.024$) were the independent risk factors for OS.

Conclusion

Ablative margin of grade C/D led to worse LTP and OS after cTACE-RFA for HCC. For HCC with a difficult to reach ablative margin ≥ 5 mm, an ablative margin of grade B may be acceptable.

P-422

Transarterial embolotherapy for local recurrence of hepatocellular carcinoma after carbon ion radiotherapy

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Purpose

The role of particle radiotherapy, including proton-beam therapy and carbon ion radiotherapy (C-ion RT), in the management of hepatocellular carcinoma (HCC) has been expanding rapidly. The purpose of this study is to evaluate the safety of transarterial chemoembolization or embolization (TACE/TAE) for local recurrence after C-ion RT.

Material and methods

From September 12, 2010 to September 2016, 129 patients underwent C-ion RT for HCC, and local recurrence was observed in 13 patients (10.0%). We examined the survival rate, local treatment

effects defined by modified RECIST criteria, and adverse events defined by CTCAE v4.0 in 9 consecutive patients who underwent TACE/TAE at our institution.

Results

The median age was 82 years (range: 62–90 years). Seven patients were Child–Pugh class A and two were class B. The median time from C-ion RT to local recurrence was 23.5 months (7.9–45.9 months). Three patients had local recurrence alone, and six patients had both local recurrence and recurrences at other sites in the liver. The mean tumor diameter of locally recurrent lesions was 2.8 cm (1.0–3.8 cm). Conventional TACE was performed in eight patients, and bland TAE using microspheres in one patient. The local effects of target lesions were CR for seven patients and PR for two patients. Adverse events of Grade 2 were observed in six patients (nausea: 1, pleural effusion: 1, albumin decline: 2, aspartate aminotransferase elevation: 1, and amylase elevation: 1). No adverse events of Grade 3 or higher were observed. Following TACE, re-irradiation with C-ion RT was performed in 4 patients. The median survival from the date of TACE/TAE was 18.9 months (95% confidence interval: 10.3–27.5 months).

Conclusion

TACE/TAE for locally recurrent HCC after C-ion RT is generally safe and can be an effective treatment option.

P-423

Postembolization syndrome in 70–150- μ m drug-eluting bead transarterial chemoembolization for hepatocellular carcinoma

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Purpose

To compare postembolization syndrome (PES) with 70–150- μ m and 100–300- μ m doxorubicin drug-eluting beads (DEBs) for optimizing pre- and postprocedural management for transarterial chemoembolization (TACE) of hepatocellular carcinoma (HCC).

Material and methods

From June 2012 to November 2016, 92 consecutive patients with HCC treated with DEBs were reviewed. The patients were divided according to the size of DEBs used in treatment. In group 1, 38 patients (40 procedures) were treated with 100–300- μ m DEBs. In group 2, 40 patients (52 procedures) were treated with 70–150- μ m DEBs. TACE with DEBs was performed with doxorubicin. The celiac artery or superior mesenteric artery was catheterized with a 5-F catheter. A 2.8-F coaxial microcatheter was used to select the right or left hepatic artery or a more selective arterial branch. PES included abdominal pain, fever, nausea, vomiting, and fatigue. All adverse events recorded were graded using the National Cancer Institute Common Terminology Criteria for Adverse Events, version 4.03.

Results

Age, sex, and liver function tests at the time of the procedure for each patient were not significantly different between groups. PES regardless of severity was observed in 73.9% of all procedures. Grade 1 or 2 PES occurred in 21 (52.5%) procedures of group 1 and 25 (48.7%) procedures of group 2. The grade of PES was statistically similar between the two groups ($p=0.788$). There were no statistically significant differences in terms of abdominal pain, fever, nausea, and vomiting ($p>0.05$). There was 1 death related to the procedure in each group.

Conclusion

TACE with 70–150- μ m DEBs has PES rates similar to that with 100–300- μ m beads and does not show a trend toward less toxicity.

P-424

Perceptions of quality in interventional oncology: a community-based definition

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Purpose

To understand how patients and referring providers perceive the quality of interventional oncology (IO) services at a large academic medical center.

Material and methods

Seventeen patients (65 $\pm$ 14-yr old; 5 women) were interviewed before and 1–4 weeks after receiving liver-directed therapy about their experiences, expectations, and concerns. Twelve referring physicians and nurse practitioners from hepatology, oncology, and surgical oncology were also interviewed about their experiences with IO and coordination of care. Interviews were conducted using conversational interviewing to minimize filtered answers and analyzed according to the constructivist grounded theory to identify themes. These are well-validated methods in the field of social sciences. Interview themes were also quantified using content analysis. Relationships between demographics and interview themes were compared via chi-squared tests and t-tests, respectively.

Results

Overall, both patients and providers felt that IO services were high quality (average rating: 8.9/10). Patients described IO quality in terms of care coordination; wait times; treatment success/side effects; and provider reputation, transparency, and empathy. Providers described quality in terms of technical skill, communication/care coordination, availability/flexibility, and being up to date/academic. Common critiques involved feeling care plans and appointments were not well-communicated to other providers after IO procedures and concerns about patients requiring more in-depth clinical evaluation/management than IO could provide. Interview themes were consistent across age, sex, and procedure-type ($p>0.05$). Theme frequency and emphasis varied across provider specialties ($p<0.05$).

Conclusion

IO patients and referring providers have diverse perceptions of quality that should be understood to design quality metrics and initiatives that reflect these perceptions.

P-425

Y90-radioembolisation via variant hepatic arteries: is there a relevant risk for non-target embolisation?

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Purpose

To evaluate the safety of yttrium-90 (Y90) radioembolisation (RE) in patients with a variant hepatic arterial anatomy.

Material and methods

Between 2010 and 2016, 10 patients underwent RE with Y90-resin microspheres via a right hepatic artery arising from the superior mesenteric artery and 9 patients via a left hepatic artery arising from the left gastric artery. Extrahepatic vessels deemed at risk for non-target embolisation were routinely coil embolised (e.g. right phrenic artery arising from an aberrant left hepatic artery), and the tip of the microcatheter was placed at least 3 cm distally to the

last extra-hepatic side branch to minimise the risk of non-target embolisation to the GI tract. The administered activity was calculated according to the manufacturer's recommendation without any empirical dose reductions.

Patient and treatment data were retrospectively analysed regarding peri- and post-interventional complications, particularly for signs of non-target embolisation to the GI tract.

Results

None of the 19 patients showed any signs or symptoms indicating a potential non-target embolisation to the GI tract within the first 48 hours after Y90 RE, and all patients were discharged on the second post-interventional day as scheduled. In one patient, extrahepatic activity in the ventral abdominal wall was noted on the post-interventional bremsstrahlung images, which most likely resulted from an unnoticed calciform artery but remained asymptomatic.

Conclusion

Y90 RE via an aberrant left or right hepatic artery appears to be safe as long as the catheter tip is placed at least 3 cm distal to the last extrahepatic vessel.

P-426

Treatment of lung tumours with high-energy microwave ablation: a single-centre experience

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Purpose

The purpose of our study is to report the safety, technical success, effectiveness, local progression-free survival (LPFS) and overall survival of percutaneous microwave ablation (MWA) in treating lung tumours unsuitable for surgery.

Material and methods

Nineteen patients with 31 tumours (mean diameter 2.4 cm) underwent percutaneous MWA in 28 sessions. Microwave ablation was performed using a 2450-MHz generator (Emprint/Covidien, Boulder, CO, USA). Procedures were performed under cone-beam CT (CBCT) and under fluoro-CT (one session) guidance. Safety, technical success, effectiveness, LPFS and overall survival (OS) were evaluated. Safety was defined as the frequency of major and minor complications. The efficacy was evaluated on the basis of imaging characteristics using the RECIST criteria. CT follow-up was performed at 1, 3 and 6 months and yearly. LPFS was defined as the interval between MWA treatment and evidence of local recurrence, if there was any. OS was defined as the percentage of patients who were still alive.

Results

Technical success was 100%. Residual disease was registered in two cases, one of which was retreated. Complete ablation was obtained in the remaining cases (90.3%). During available follow-up (mean 9.6 months), 9/31 tumours demonstrated local recurrence. Five tumours were re-treated and none of them presented residual disease during follow-up (LPFS 22.6%). Overall survival was 93.8%.

Conclusion

Percutaneous high-energy MWA is a safe, effective and confident technique to treat lung tumours not suitable for surgery.

P-427

Degradable starch microspheres (DSM) as embolising agent for transarterial chemoembolisation (TACE) of locally advanced hepatocellular carcinoma (HCC): safety and efficacy

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Purpose

DSM represents an alternative to Lipiodol or drug-eluting beads (DEB) as an embolising agent for TACE in HCC. Shorter ischaemia and thus better tolerability makes DSM-TACE a promising option for multifocal/extensive disease, where highly selective TACE is not possible and more extensive treatment is required. Data on toxicity and effectiveness, however, is scarce. We retrospectively reviewed 29 HCC patients undergoing repetitive DSM-TACE for safety and efficacy.

Material and methods

In total, 29 HCC patients (BCLC stages: 3×A, 17×B, 8×C, 1×D) were treated with ≥3 DSM-TACEs using a standard dose of 50mg doxorubicin/epirubicin and 120–450mg DSM (EmboceptS, Pharmacept). Six HCCs were unimodular and 23 multinodular (18 bilobar). Mean lesion size was 7cm (0.8–20cm). Two patients had main portal vein invasion. DSM-TACE was selective in 6, lobar in 10, and bilobar in 13 patients. Response was assessed by CE-CT/CE-MRI every 3–4 months.

Results

In 139 DSM-TACEs (3–12/patient, mean 4.8), no deaths and only one possibly procedure-related major complication occurred. Minor adverse events were pain responsive to analgesics (23%), transient nausea (14%), vomiting (4%), and post-embolization syndrome (4%). Transient and mostly mild laboratory changes were bone marrow toxicity (8%) and increase of INR (10%), creatinine (7%), or bilirubin (39%). Treatment response was complete remission in 2, partial response in 17, stable disease in 5, and progression in 2 cases. Overall median survival was 10.8 months: 19.1 months for BCLC stages A+B and 6.7 months for BCLC stages C+D.

Conclusion

Tolerability of DSM-TACE was excellent even in patients with advanced HCC. Response rates and survival were promising in our series of patients with locally advanced disease.

P-428

What is the factor influencing the renal functional outcome after percutaneous cryoablation for renal masses

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Purpose

To clarify the factors influencing the renal functional outcome after percutaneous cryoablation (PCA) for renal masses.

Material and methods

From April 2013 to July 2016, 108 sessions of CT-guided PCAs for 94 patients were performed. Among these, PCAs for recurrent tumors and for patients with multiple renal masses who underwent multiple sessions of PCAs were excluded. As a result, 54 patients (mean age, 69.3±12.7 years) with 54 renal masses were investigated. The mean estimated glomerular filtration rate (eGFR) before and 6 months after the procedure were 56.9±17.4 and 51.8±19.5 mL/min/1.73m², respectively. Average decline rate of eGFR was 10.1%±12.0%. These patients were divided into two groups by a decline rate of eGFR, one was below (Group A) and the other was above the average decline rate (Group B). Age, sex, solitary kidneys or bilateral kidneys, preprocedural eGFR, tumor diameter, RENAL nephrometry score, with or

without transcatheter arterial embolization prior to PCA, and number of punctured cryoneedles were compared between the two groups.

Results

All factors except for the preprocedural eGFR were not associated with postprocedural decline of renal function. Preprocedural eGFR of Groups A and B were 51.8 ± 15.5 and 61.9 ± 17.7 mL/min/1.73m² ($P < 0.05$), respectively. Renal insufficiency was a significant factor influencing the renal function after PCA.

Conclusion

Renal function should be followed up carefully, especially in patients with a chronic kidney disease.

P-429

Feasibility and safety of repeated transarterial chemoembolization using miriplatin–lipiodol suspension for unresectable hepatocellular carcinoma

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Purpose

To retrospectively evaluate the feasibility and safety of repeated transarterial chemoembolization (TACE) three or more times using a new platinum-based anticancer agent, miriplatin (MPT)–lipiodol (LPD) suspension (repeated MPT/LPD TACE) for hepatocellular carcinoma (HCC).

Material and methods

Between January 2013 and December 2016, 16 patients (10 males, 6 females; age 73 ± 7 years) who underwent repeated MPT/LPD TACE were examined. The maximum dose of MPT and LPD per session was limited to 140 mg and 10 ml, respectively. Total dose of MPT, LPD, and porous gelatin sponge particles and adverse events of the first and last MPT/LPD TACE were evaluated.

Results

The mean $\pm$ standard deviation (SD) of the total number of MPT/LPD TACE per patient was 3.7 ± 1.1 (range, 3–7). MPT/LPD TACE were performed at intervals of 231 ± 189 (range, 42–836) days. The mean $\pm$ SD dose of total MPT, LPD, and porous gelatin sponge particles per patient were 303 ± 103 (range, 182–492.8) mg, 21 ± 7.3 (range, 13–35) ml, and 84 ± 57 (range, 28–246.4) mg, respectively. The mean $\pm$ SD dose of MPT, LPD, and porous gelatin sponge particles per session were 83 ± 36 (range, 21–140) mg, 5.9 ± 2.6 (range, 1.5–10) ml, and 22 ± 21 (range, 4–144) mg, respectively. There were no significant differences in any adverse events between the first and last MPT/LPD TACE (Wilcoxon's signed-rank test).

Conclusion

Repeated MPT/LPD TACE for HCC is feasible and safe in selected patients.

P-430

Transarterial radioembolization following chemoembolization for unresectable hepatocellular carcinoma: response based on apparent diffusion coefficient change is an independent predictor for survival

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Purpose

To evaluate whether apparent diffusion coefficient (ADC) change during diffusion-weighted magnetic resonance imaging (MRI) after transarterial radioembolization (TARE) can predict survival in patients with prior transarterial chemoembolization with drug-eluting beads (DEB-TACE) for hepatocellular carcinoma (HCC).

Material and methods

We identified all patients who underwent DEB-TACE prior to TARE for HCC between 2007 and 2016. Response on MRI was determined by modified RECIST (mRECIST) and ADC change relative to pre-TARE imaging. Kaplan–Meier and log-rank tests were used to correlate the response/disease and treatment variables with survival. Multivariable Cox regression models were used to correct for confounders.

Results

A total of 29 patients were included. Univariable analysis showed that response determined by mRECIST was a non-significant predictor for survival ($p = 0.057$) and response determined by ADC change was a significant predictor for survival ($p = 0.011$). Number of prior DEB-TACE procedures ($p = 0.037$), female gender ($p < 0.001$), and BCLC C ($p = 0.03$) were related with worse survival. The number of prior DEB-TACE procedures was significantly higher in non-responders determined based on ADC change ($p = 0.028$). Multivariable analyses showed that response based on ADC change remained significantly related to survival after correcting for number of prior DEB-TACE procedures ($p = 0.041$).

Conclusion

Change in ADC following TARE is an independent predictor for survival in patients who previously underwent DEB-TACE for HCC.

P-431

Safety and efficacy of transarterial radioembolization in patients with intermediate or advanced-stage hepatocellular carcinoma refractory to chemoembolization

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Purpose

To evaluate the safety and efficacy of transarterial radioembolization (TARE) in patients with hepatocellular carcinoma (HCC) who are refractory to transarterial chemoembolization (TACE) with drug-eluting beads (DEB-TACE).

Material and methods

We identified all patients who underwent TARE for HCC following one or more sessions of DEB-TACE from 2007 to 2016. Adverse events (grade > 3) were graded according to the common terminology criteria for adverse events. Overall survival was estimated using the Kaplan–Meier test and was determined since the first TACE and since the TARE procedure.

Results

Thirty patients were included. Barcelona Clinical Liver Cancer stage B and C were assigned to 15 (50%) patients each. Patients underwent a mean of 1.7 TACE procedures (range 1–4) prior to TARE. Grade 3 adverse events following TARE included: fatigue (20%), bilirubin increase (10%), cholecystitis (3.3%), and a gastric ulcer (3.3%). Three patients (10%) were downstaged within the Milan criteria and underwent liver transplantation. The median overall survival since the first TACE was 32.3 months (95% CI 17.2–42.1). The median overall survival since TARE was 14.8 months (95% CI 8.33–26.5).

Conclusion

TARE is safe and efficient in patients with intermediate or advanced-stage HCC who are refractory to TACE. This treatment strategy has the potential to downstage to liver transplantation.

P-432

Pharmacokinetic profile of doxorubicin in patients with unresectable hepatocellular carcinoma treated with drug-eluting microsphere chemoembolization

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Purpose

To evaluate the pharmacokinetic (PK) profile, maximum tolerated dose, safety, and efficacy of LifePearl[®] microspheres loaded with doxorubicin in the treatment of unresectable hepatocellular carcinoma (HCC) by transarterial chemoembolization (TACE).

Material and methods

LifePearl-DOXO is a prospective, multicenter PK study enrolling up to 25 patients with HCC suitable for TACE treatment. The loaded dose of doxorubicin was escalated from 75 mg to 100 mg and finally to 150 mg under the supervision of a safety review board with each dose administered to three patients. The primary endpoint was dose escalation and PK profile. Blood samples were collected on pre-specified time points for PK analysis of doxorubicin by the central lab. The primary safety endpoint was defined as any grade ≥ 3 adverse event (CTCAE v4.03) occurring during 30 days following the intervention. After the final dose was reached, additional 15 patients were enrolled to assess PK and treatment efficacy. Response was assessed by a core laboratory according to RECIST 1.1, EASL, and mRECIST criteria after 3 months.

Results

Enrolled patients had a mean age of 70.4 $\pm$ 10.1 years and were all diagnosed with BCLC B HCC with 75% patients with Child–Pugh status A and 25% patients with Child–Pugh status B. On an average, patients had 2.1 $\pm$ 1.1 target lesions corresponding to a sum of diameters of 111.13 $\pm$ 78.5 mm. No serious events were recorded in patients who already reached the 30-day safety endpoint.

Conclusion

Full PK profiling, including peak plasma concentration and plasma half-life; toxicity; and adverse events occurring up to 30 days post-procedure will be available at the time of presentation.

P-433

Pharmacokinetic profile of irinotecan in patients with liver metastases from colorectal cancer treated with unilobar or bilobar drug-eluting microsphere chemoembolization

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Purpose

To evaluate the pharmacokinetic (PK) profile, treatment safety, and efficacy of LifePearl[®] microspheres loaded with irinotecan in the treatment of liver predominant metastatic colorectal cancer (mCRC) by transarterial chemoembolization (TACE).

Material and methods

LifePearl[®] microspheres loaded with irinotecan is a prospective, single-arm, multicenter PK study enrolling up to 20 patients with CRC with liver predominant unresectable metastatic disease, without portal vein involvement, with ECOG performance status 0 or 1, life expectancy ≥ 3 months, and adequate hematologic function. The primary endpoint of the study is the PK profile of LifePearl[®] microspheres loaded with irinotecan. The secondary endpoints were as follows: adverse events (grade ≥ 3 according to CTCAE v4) up to 30 days post-initial treatment, overall survival, progression-free survival, response rate (mRECIST criteria) 3 months after the first treatment assessed by a core laboratory, and technical success (ability to deliver $\geq 75\%$ of the planned dose during the first chemoembolization).

Results

Treatment involved infusion of LifePearl[®] microspheres loaded with 100 (unilobar) or 200 mg (bilobar) of irinotecan with treatment repetition after 2 or 4 weeks, respectively. Blood samples were collected for PK analysis of irinotecan and metabolite SN-38 during the first TACE and analyzed by a central laboratory. Of the 10 patients enrolled thus far, one died and four experienced grade 3 treatment-related adverse events in up to 30 days.

Conclusion

Full PK profiling, including peak plasma concentration, area under curve, and plasma half-life; procedural success; toxicity; and adverse events occurring up to 30 days post-procedure will be available at the time of presentation.

P-434

Treatment of unresectable HCC with doxorubicin-eluting microspheres: a single-center experience

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Purpose

We aimed to investigate tumor response in patients with liver tumors undergoing transarterial chemoembolization with doxorubicin-eluting microspheres.

Material and methods

This was a cohort study of 39 consecutive eligible patients. Patients were enrolled in the study if they were older than 18 years, were treated with chemoembolization by LifePearl[®] microspheres loaded with doxorubicin, and had given informed consent.

Data collected were related to procedural success, adverse events according to CTCAE v4 classification, and response to treatment according to RECIST 1.1.

Results

We collected data from 39 consecutive patients with BCLC B who were treated with LifePearl® loaded with doxorubicin from April 2015 to October 2016 in one Spanish center. The sample included 32 (82%) males, with a mean age of 71 ± 9 years (range 50–82 years). The ECOG performance status was 0 for 69% patients and 1 for the remaining patients, and the Child–Pugh score was A (85% patients) or B. Patients mainly presented with 1 to 2 lesions (70%) and had no more than 5 lesions. The mean tumor size at baseline was 23.0 ± 14.3 mm, with a mean of 2.2 ± 1.4 target lesions per patient, corresponding to a total sum of diameters lesion of 48.6 ± 25.2 mm.

Conclusion

Treatment safety, tumor response, and clinical follow-up at 6 months will be available at the time of presentation.

P-435

Correlation between background liver radiation dose and hepatotoxicity in Y-90 radioembolization of primary and metastatic liver tumors

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Purpose

To identify whether background liver dose is associated with liver function changes after ⁹⁰Yttrium radioembolization of primary and secondary liver malignancies.

Material and methods

Patients who had undergone Y-90 radioembolization for primary or metastatic liver tumors and who had pre-treatment SPECT-CT (n=45) were included in the study. After excluding subjects with evidence of progressive disease or peritoneal seeding (n=12), bile duct stricture (n=1), chylous ascites (n=1), and liver abscess (n=1) on follow-up, 30 subjects were analyzed. Changes in liver enzyme levels, bilirubin, INR and any new onset of ascites and hepatic encephalopathy 3 months after the intervention were assessed.

Results

In subjects undergoing Sir-Sphere embolization, there was no statistically significant correlation between pre- and post-treatment liver function lab values and new-onset ascites and hepatic encephalopathy. Total liver absorbed dose and liver absorbed dose per session were not associated with hepatotoxicity within the range of treatment doses. In subjects undergoing TheraSphere embolization, there was correlation between increased AST levels and the liver absorbed dose per session (difference: 19.5, $r=0.540$, $P=0.014$).

Conclusion

Radioembolization-induced liver disease is a relatively uncommon but relevant complication after Y-90 treatments of liver tumors. There is no consistent correlation between markers of hepatic cell damage and normal liver absorbed dose in the range of 15.3–115.3 Gy liver absorbed dose.

P-436

Real-time 3D virtual target fluoroscopic display for challenging hepatocellular carcinoma ablations using cone-beam CT

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Purpose

To assess the effectiveness of the 3D virtual target fluoroscopic display (3D-VTFD) as guidance during challenging percutaneous ablation procedures for hepatocellular carcinoma (HCC).

Material and methods

This retrospective study was approved by the ethical review board and informed written consent was waived. During 1 year (2014), 67 HCC tumors (mean diameter: 31 ± 21 mm; range: 9–90 mm; 24 tumors ≥ 30 mm; 16 infiltrative tumors) in 53 consecutive patients (mean age: 66.6 ± 11.8 years; range: 41–89 years; 9 women) were ablated with irreversible electroporation (n=39), multi-bipolar radiofrequency (n=25), or microwave (n=3) in combination with ultrasound and 3D-VTFD guidance because the procedures were regarded as unfeasible under ultrasound alone. 3D-VTFD consisted of fluoroscopic 3D visualization of the index tumor previously segmented from cone-beam CT acquisition. Results were assessed at 1 month and then every 3 months by CT or MRI. Factors associated with overall local tumor progression (initial treatment failure and subsequent local tumor progression) were assessed using a mixed logistic regression model.

Results

Complete ablation was achieved for 58 (86.6%) tumors after one (n=53) or two (n=5) procedures. After a median follow-up of 12.8 months (1–23.2), among the 58 tumors showing imaging characteristics consistent with complete ablation, local tumor progression occurred in 9 tumors. Thus, the overall local tumor progression rate was 26.8% (18/67). As per multivariate analysis, the dome location and infiltrative form were associated with local tumor progression. No major complication occurred.

Conclusion

3D-VTFD is a safe and effective method for guiding challenging ablations of HCC that are commonly regarded as unfeasible using ultrasound alone.

P-437

Microwave ablation of malignant renal tumours: intermediate-term results and usefulness of RENAL and mRENAL scores for predicting outcomes and complications

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Purpose

The aim of this study was to evaluate intermediate-term results after microwave ablation (MWA) of renal tumours and determine the association of RENAL and modified RENAL (mRENAL) scores with oncological outcomes and complications.

Material and methods

In May 2008–September 2014, 58 patients with early-stage renal cell carcinoma (RCC T1a or T1b) were judged to be unsuitable for surgery and treated with percutaneous MWA. Follow-up with contrast-enhanced computed tomography (CECT) was performed at 1, 3, 6, 12 and 24 months after the procedure. Technical success (TS), primary technical effectiveness (PTE), secondary technical

effectiveness (STE), local tumour progression rate (LTPR), cancer-specific survival rate (CSSR), disease-free survival (DFS), overall survival (OS) and safety were recorded. All lesions were evaluated using RENAL and mRENAL scores, and complications were assessed using RENAL scores.

Results

The TS rate was 100%, PTE was 93%, STE was 100%, LTPR was 15.7% at 1 year, CSSR was 96.5%, DFS was 87.9% at 5 years and OS was 80.6%. Mean follow-up was 25.7 months (range: 3–72 months). The mean $\pm$ standard deviation (SD) RENAL and mRENAL scores of all treated tumours were 6.7 ± 2.05 (range: 4–11) and 7 ± 2.3 (range: 4–12), respectively. Major complications occurred in two patients and minor complications occurred in three patients. Overall complications significantly correlated with RENAL scores; in particular, E and L represent negative predictors for safety and effectiveness.

Conclusion

MWA is a valuable alternative for treating RCCs. The correlation with outcomes and complications of RENAL and mRENAL scores could help in customising MWA indicators in patients with RCC.

P-438

Y-90 radiation segmentectomy for early-stage HCC: time to consider it as a curative treatment

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Purpose

We report the outcomes of Y-90 radiation segmentectomy (high-dose Y-90 to ≤ 2 hepatic segments) in patients with early-stage HCC and preserved liver function. We hypothesized that this novel therapy has outcomes consistent with those of standard curative treatments in these selected patients.

Material and methods

With IRB approval, we searched our prospectively acquired database (2003–2016) for patients with Child–Pugh A solitary HCC ≤ 5 cm not amenable to percutaneous ablation and who underwent radiation segmentectomy with glass microspheres (target dose > 190 Gy). We excluded patients who underwent subsequent surgery. We studied radiologic response (EASL/WHO), time-to-progression (TTP), and median overall survival (OS) using the Kaplan–Meier model. Patients who achieved complete response were further assessed for local tumor recurrence rate (LTR).

Results

Seventy patients underwent radiation segmentectomy. One-month follow-up response (partial + complete response) rates were 59% and 26% and 6-month follow-up response rates were 86% and 49% based on EASL and WHO criteria, respectively. The median TTP was 2.4 years (95% CI: 2.1–5.7), while the median target lesion TTP was not reached, with 73% patients having no target lesion progression at 5 years. In patients having CR based on WHO criteria ($n=11$), the LTR rate was 0%. Median OS was 6.7 years (95% CI: 3.1–6.7); the 1-, 3-, and 5-year survival probability was 98%, 66%, and 57%, respectively. For patients with baseline tumor size ≤ 3 cm ($n=45$), the median OS was not reached, whereas the 1-, 3-, and 5-year survival probability was 100%, 82%, and 75%, respectively.

Conclusion

Radiation segmentectomy provides outcomes (tumor progression/recurrence, OS) similar to surgical resection/RFA in patients with early HCC and preserved liver function.

P-439

Long-term outcomes of patients with intrahepatic cholangiocarcinoma who underwent percutaneous ablation

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Purpose

Despite increasing incidence rates of intrahepatic cholangiocarcinoma (IH-CCA) worldwide, less than 5% patients are amenable for image-guided loco-regional therapies, and reports on the use of ablation in the Western world are limited. We aim to report our experience on the use of percutaneous ablation for IH-CCA.

Material and methods

A single-institution retrospective analysis was performed of 12 consecutive patients (6 men; mean age, 66 years) with 18 IH-CCA (mean tumor size, 1.5 cm; range, 0.8–2.3 cm) treated with percutaneous ablation between 2007 and 2015. Ablations were performed with radiofrequency (13 tumors), microwave (4 tumors), and irreversible electroporation (1 tumor) under computed tomography guidance. Technical effectiveness, safety, local tumor progression-free survival (LTPFS) by imaging, and overall survival (OS) rates were analyzed.

Results

The median study follow-up was for 52.3 months (range, 2.7–81.3 months). Primary and secondary efficacy rates per patient were 92% and 100%, respectively. Among the 18 tumors treated with percutaneous ablation, two (11.1%) developed LTP during the study period. The mean LTPFS was 30.9 months with cumulative 1-, 3-, and 5-year LTPFS rates of 79.5%, 34%, and 22.7%, respectively. The mean OS was 37.5 months with cumulative 1-, 3-, and 5-year OS rates of 100%, 62.5%, and 37.5%, respectively. One patient developed asymptomatic biloma that was managed conservatively. No other complications were recorded.

Conclusion

Percutaneous ablation may represent a safe and effective treatment modality with a high rate of local tumor control in patients with small IH-CCA.

P-440

Transarterial chemoembolization for the treatment of hepatocellular carcinoma with abdominal cavity metastases

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Purpose

To evaluate the feasibility and efficacy of transarterial chemoembolization (TACE) for the treatment of hepatocellular carcinoma (HCC) with abdominal cavity metastases.

Material and methods

From Jan 2016 to Jan 2017, 7 patients (mean age 49.3 ± 12.9 years, 85.7% male) with HCC and abdominal cavity metastases were treated by TACE. In total, 14 interventional procedures were performed on these 7 patients. The intrahepatic tumor number ranged from 1 to 6 and the size ranged from 5 to 10.5 cm. The number of abdominal cavity metastases ranged from 1 to 8, with the size ranging from 2.1 to 21.4 cm. Treated arteries include branches of the hepatic artery for intrahepatic tumors (7 cases) and gastroduodenal artery (5 cases) and superior mesenteric artery (4 cases) for abdominal cavity metastases. Lipiodol alone without chemotherapeutic agents was delivered to SMA. Responses were defined using the mRECIST criteria based on an enhanced abdominal CT or MRI.

Objective response and clinical adverse events were retrospectively studied.

Results

The technical success rate was 100% with no procedure-related complications. Radiologically confirmed complete response (CR), partial response (PR), and disease progression (PD) for intrahepatic disease were observed in 4, 2, and 1 patient, respectively. For abdominal cavity metastases, CR, PR, and PD were observed in 2, 5, and 0 patients, respectively. No severe adverse effects were noted.

Conclusion

TACE is feasible and can be effectively performed on abdominal cavity metastases in patients with HCC, resulting in an optimized imaging response. Further investigations on long-term survival should be performed.

P-441

CT-guided radioactive ¹²⁵I seed implantation in the treatment of spinal metastatic tumors

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Purpose

To evaluate the safety and clinical efficacy of CT-guided percutaneous radioactive ¹²⁵I seed implantation in the treatment of spinal metastatic tumors.

Material and methods

In total, 20 cases (23 lesions) of spinal metastatic tumors with spinal compression and severe back pain were treated by CT-guided percutaneous ¹²⁵I seed implantation. Intractable pain and nerve function before and after therapy were evaluated. Postoperative cumulative local tumor control rates and cumulative survival rates were calculated.

Results

The median follow-up period was 14 months (range 7–32 months). There was no patient lost to follow-up. No severe complication occurred. Intractable pain was significantly relieved 1 month after therapy. The neural retention rate of 12 patients with nerve function impairment was 85.00% (17/20) and the neural function recovery rate was 30.00% (6/20) 3 months after ¹²⁵I seed implantation. The local tumor control rates at 3, 6, and 12 months were 100%, 100%, and 90%, respectively. The survival rates at 6 and 12 months were 100% and 78.81%, respectively.

Conclusion

CT-guided percutaneous radioactive ¹²⁵I seed implantation for spinal metastatic tumors is safe and feasible. It can relieve pain and effectively improve neural function.

P-442

Percutaneous intraductal radiofrequency ablation for the treatment of biliary stent occlusion: a preliminary result

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Purpose

To assess the feasibility and effectiveness of a novel method of percutaneous intraductal radiofrequency (RF) ablation for the treatment of biliary stent occlusion.

Material and methods

We specifically report a retrospective study presenting the results of percutaneous intraductal RF in patients with biliary stent occlusion. A total of 43 cases involving biliary stent occlusion were treated by placing an EndoHPB catheter, and percutaneous intraductal RF ablation was performed to clean the stents. Stent patency was evaluated

by cholangiography and followed up by contrast-enhanced computed tomography or ultrasound after the removal of the drainage catheter.

Results

Following the procedures, of the 43 patients, 40 survived and 3 died with a median survival of 80.5 (range: 30–243) d. One patient was lost to follow-up. One patient had stent patency at the time of the last follow-up. Two patients with stent blockage at 35 and 44 d after the procedure underwent percutaneous transhepatic drain insertion only. The levels of bilirubin before and after the procedure were 128 ± 65 and 63 ± 29 $\mu\text{mol/L}$, respectively. There were no related complications (haemorrhage, bile duct perforation, bile leak or pancreatitis), and all patient stent patency was confirmed by cholangiography after the procedure, with a median patency time of 107 (range: 12–180) d.

Conclusion

This preliminary clinical study demonstrated that percutaneous intraductal RF is safe and effective for the treatment of biliary stent occlusion, increasing the duration of stent patency, although randomized controlled trials are needed to confirm the effectiveness of this approach.

P-443

Efficacy of combined preoperative transarterial chemoembolization and hepatic resection for large hepatocellular carcinoma

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Purpose

To compare outcomes of combined preoperative transarterial chemoembolization (TACE) and hepatic resection with those of hepatic resection alone in patients with large (≥ 5 cm) hepatocellular carcinoma (HCC).

Material and methods

Forty-six patients with large HCC were retrospectively analyzed, including 14 treated by combined preoperative TACE and hepatic resection (pre-TACE group) and 32 treated by hepatic resection alone (resection group). Tumor recurrence rates were compared.

Results

Ninety-three percent patients had single lesions; 3 patients in the pre-TACE group had two masses in the same lobe or segment, of which the size of the smaller ones were less than 3 cm. In 46 patients, the mean tumor diameter was 8.3 cm (5.0–23.5 cm). All patients were classified as Child–Turcotte–Pugh class A. Hepatitis B virus infection was the most common cause of HCC (78.26%; 36/46). There was no significant difference between the two groups in terms of age, tumor size, alpha-fetoprotein (AFP) level, and prothrombin induced by vitamin K absence-II (PIVKA-II) level ($P > 0.05$). On the pathology report, the mean interval between preoperative TACE and hepatic surgery was 63 days (20–266 days) and the mean tumor necrosis rate was 85% (30%–100%). Tumor recurrence rates were significantly lower in the pre-TACE group (14.29%; 2/14) than those in the resection group (53.13%; 17/32) ($P = 0.014$). The mean interval until tumor recurrence was longer in the pre-TACE group than that in the resection group (781.0 vs. 263.1 days), but it was not statistically different ($P > 0.05$).

Conclusion

Combined preoperative TACE and hepatic resection provided lower recurrence rates in patients with large HCC.

P-444

MRI and 3D reconstruction used in liver microwave ablation: initial research

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Purpose

To verify the feasibility of multi-series MRI and three-dimensional (3D) reconstruction in planning liver microwave ablation (MWA) and evaluating the treatment response.

Material and methods

From Aug 2015 to Oct 2016, 16 patients (21 lesions) who underwent liver MWA were enrolled in this study. MRI (T1WI/T2WI/multi-b-value DWI) was performed preoperatively and at follow-up. The procedure duration was recorded. All data were autotransferred to our workstation (Syngo.via) for analysis.

Results

All liver MWA were successfully performed with MRI guidance. The mean tumor size was 1.78 ± 0.67 cm. The effectiveness of the technique was assessed after 1–3 months. Complications were classified according to the Common Terminology Criteria for Adverse Events. From 6 to 10 months postoperatively, no serious or fatal complication or local tumor recurrence was observed. The surgical route was a 100% match with the 3D reconstruction planned route. Compared with CTA, MRI shows 99% (29/30) of the nearby small vessels. Multi-series 3D reconstruction efficiently showed postoperative signal change and ablation margin.

Conclusion

MRI and 3D reconstruction are feasible and effective in planning and evaluating liver MWA for hepatic tumors. First, we successfully performed MWA under MRI guidance with safe and efficient monitoring. Vertical and parallel surface display has given more and precise information for evaluation and follow-up. Furthermore, DWI shows its potential ability in evaluating the heat area and change in the ablation area and normal tissue. In conclusion, the benefit of 3D analysis over existing techniques lies in its ability to provide complete tumor information that is pathologically more accurate and representative. The available clinical data strongly support the advantages of 3D quantitative tumor analysis over non-3D techniques for the assessment of tumor response.

P-445

Comparison of the quality of life after different transarterial therapies for primary and secondary hepatic malignancy

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Purpose

Assessment of the outcome of palliative tumor therapies should not only include response/survival data but also include health-related quality of life (QoL). The purpose of this study was to compare QoL after initial treatment for primary and secondary hepatic malignancy with different transarterial therapies [chemoembolization (TACE), radioembolization (RE), and isolated chemoperfusion (CP)].

Material and methods

We prospectively evaluated QoL in 119 initial transarterial therapies (TACE n=67; RE n=30, and CP n=22) in a single-center study over 17 months using the validated EORTC QLQ-C30 and EORTC-HCC18 questionnaires before and 14d after treatment. Changes in QoL after treatment were evaluated. Patient-related/procedural data and tumor response were analyzed in a multivariate linear regression

model to investigate potential influence factors on QoL. Subgroup analysis was performed for different tumors.

Results

The mean return rate was 71.4% allowing analysis in 85 therapies (TACE n=46, RE n=23, and CP n=16). The initial global health status was the highest in CP with 69.8% (TACE 62.5% and RE 53.6%). The global health decrease was significantly higher in CP (–32.8%) than in TACE (–10.5%; p=0.01) and RE (–5.4%; p=0.005). Findings for other parameters were similar. Less impairment was found for RE than for TACE with respect to global health, physical/social functioning, fatigue, and pain. Objective RECIST response rates were 2.3%, 4.8%, and 6.7% for TACE, RE, and CP, respectively (stable disease: TACE 63.6%, RE 61.9%, and CP 46.7%).

Conclusion

Overall, CP significantly decreased QoL compared with TACE or RE. This needs to be considered during outcome assessment. RE resulted in slightly less QoL impairment and better RECIST response compared with TACE.

P-446

Initial experience of cone-beam computed tomography-guided percutaneous radiofrequency ablation of lung tumors

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Purpose

The aim of this study was to evaluate the technical feasibility and safety of cone-beam computed tomography (CBCT)-guided percutaneous radiofrequency ablation (RFA) of lung tumors.

Material and methods

From January 2016 to December 2016, 14 patients with 25 lung tumors (7 primary lung and 18 metastatic tumors) were enrolled and treated with CBCT-guided percutaneous RFA. Unenhanced CBCT were performed and used to insert the RF electrode with the aid of planning software. Procedure time, technical success, primary technical effectiveness, and frequency of complication rates were evaluated.

Results

The mean diameter of the lung tumor was 12 mm (5–21 mm). Nineteen RFA sessions were performed. The mean procedure time was 67.5 min (range 40–120 min). CBCT-guided percutaneous RFA was successfully performed in 18 sessions (94.7%). When evaluated by enhanced CT after percutaneous RFA, the primary technical effectiveness rate was 100%. Complication after RFA was pneumothorax in 4 cases after 19 sessions of RFA (21%). Percutaneous catheter insertion was needed in 2 sessions (10.5%). There was no mortality-related to lung RFA.

Conclusion

CBCT-guided percutaneous RFA is a feasible and safe technique for the treatment of lung tumors.

P-447

Treatment of bone tumors with arterial embolization

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Purpose

To study the efficacy of the treatment of primary and metastatic bone tumors with selective arterial embolization.

Material and methods

Thirty patients with primary and metastatic bone tumors were treated at RCRC RAMS from 2006 to 2016 [men, 18 (60%); women, 12 (40%)]. The average age was 37.32 ± 12.82 years (range, 12–68 years). Primary and metastatic (mainly metastatic kidney cancer) bone tumors were observed in 18 and 12 patients, respectively. The lesion site was the spine and others in 17 and 13 cases, respectively. If the spine was affected, embolization was performed in corresponding segments (with the exception of the Adamkiewicz artery). The goal of embolization was palliative care sometimes in combined schemes (15 cases) and preoperative embolization (15 cases). In 25 patients, a single embolization was performed, whereas in 5 patients, it was performed twice because of extensive network of the collateral vessels. Beads and a spiral were used in 22 and 8 cases, respectively.

Results

Embolization was technically successful in 100% cases. In 6 (33.3%) cases, residual blood remained within 5%–30%. Clinical response after palliative embolization was pain relief and improved limb function in 93.3% cases. Blood loss significantly decreased in 80% preoperative embolization cases. Postembolization syndrome was present in most patients; paresthesia was observed in 26.7% cases.

Conclusion

Selective embolization of the arteries is an effective option in the treatment of bone tumors for palliation or as part of combination therapy. Careful feeding artery embolization is necessary for achieving an adequate effect.

P-448

Initial experience of no-touch switching monopolar laparoscopic radiofrequency ablation using a separable cluster electrode in patients with hepatocellular carcinoma located on the liver surface

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Purpose

Percutaneous radiofrequency ablation (RFA) in the treatment of hepatocellular carcinoma (HCC) located on the liver surface is challenging because of overlapping ribs or the lung. We evaluated technical outcomes and safety of no-touch switching monopolar laparoscopic RFA using a separable cluster electrode in patients with HCC located on the liver surface.

Material and methods

From November 2015 to December 2016, 7 patients with 8 HCCs located on the liver surface were enrolled and treated with no-touch switching monopolar laparoscopic RFA using a separable cluster electrode. Tumor characteristics, technical success, primary technical effectiveness, and frequency of major complication rates were evaluated.

Results

The mean diameter of the 8 HCCs was 26.9mm (20–45mm). Six HCCs were located at the liver dome. One HCC was located at the surface of medial aspect of segment 6 and 1 HCC was located at the caudate

lobe. No-touch switching monopolar laparoscopic RFA was successfully performed in all patients. When evaluated by enhanced CT after RFA, the primary technical effectiveness rate was 100%. No patients had a major complication after RFA.

Conclusion

No-touch switching monopolar laparoscopic RFA using a separable cluster electrode is a feasible and safe technique for the treatment of HCCs located on the liver surface.

P-449

Radiofrequency ablation of kidney tumors with high-frequency jet ventilation and real-time US-CT image fusion/virtual needle track guidance: a single-center experience

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Purpose

In this study, we aimed to present short-term results as well as to assess the efficacy and safety of real-time US-CT image fusion/virtual needle track-guided (US-CT fusion/VNT) percutaneous radiofrequency ablation (RFA) of kidney tumors.

Material and methods

We have retrospectively reviewed all patients who were treated with US-CT fusion/VNT-guided percutaneous RFA at the Danderyd hospital for kidney tumors between September 2014 and November 2015. Our study includes 19 patients (13 males and 6 females). General anesthesia with muscle paralysis and high-frequency jet ventilation were used in all cases.

Results

In total, ablation of 19 lesions was performed; 11/19 (57.9%) of the tumors were exophytic and 8/19 (42.1%) of the tumors were non-exophytic. The diameter of the lesions ranged between 0.8 and 4.0 cm. According to percutaneous biopsy, 14/19 (73.7%) of the lesions were malignant, 2/19 (10.5%) were angiomyolipomas, and 3/19 (15.8%) of the biopsies were inconclusive. Per-operative mortality and mortality at 6 months was 0%. In 1 patient (5%), complications occurred in the form of subcapsular bleeding after treatment (no therapy required). Peritoneal seeding at the RFA tract developed in 1 patient within the 3-month follow-up. Of the 19 tumors, 2 tumors (10.5%) required retreatment because of incomplete ablation. All residual tumors were successfully ablated with an additional session of RFA. Recurrence free survival at 6 months was 94.7%.

Conclusion

Real-time US-CT fusion/VNT-guided percutaneous RFA is an effective and safe method for the treatment of kidney tumors that can be repeated several times.

P-450

Real-time US-CT/MRI image fusion/virtual needle track-guided percutaneous microwave ablation for liver tumors: a single-center experience

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Purpose

In this study, we aimed to present short-term results as well as to assess the efficacy and safety of real-time US-CT/MRI image fusion/virtual needle track-guided (US-CT/MRI fusion/VNT) percutaneous microwave ablation (MWA) of liver tumors.

Material and methods

We have retrospectively reviewed all patients who were treated with US-CT/MRI fusion/VNT percutaneous MWA at the Danderyd hospital

for liver tumors between March 2014 and April 2015. Our study includes 75 patients (57 males and 18 females) aged 30–90 years treated for liver tumors.

Results

In total, ablation of 190 lesions was performed. The number of lesions per patient varied between 1 and 15. The diameter of the lesions ranged between 0.5 and 7.0 cm. Diagnosis included primary liver tumor (n= 38) and metastatic disease (n=37). Per-operative mortality was 0%, mortality at 6 months was 8% (n=6), and mortality at 12 months was 17.3% (n=13) because of the generalized spread of cancer. In 1 patient (1.3%), the major complication was bleeding after treatment of a 30-mm HCC in segment 6. This complication was successfully treated with embolization. Of the 190 tumors, 10 (5.3%) required retreatment because of incomplete ablation. All residual tumors were successfully ablated by an additional session of MWA. Recurrence-free survival at 3, 6, and 12 months was 86.4%, 76.8%, and 71%, respectively.

Conclusion

Real-time US-CT/MRI image fusion/VNT percutaneous MWA is an effective and safe method for the treatment of liver tumors that can be repeated several times.

P-451

Efficacy and safety of renal arterial embolization for angiomyolipomas using absolute ethanol: identifying a predictive factor of tumor response

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Purpose

To evaluate the efficacy and safety of renal arterial embolization (RAE) of angiomyolipomas based on the sacrificed renal parenchymal volume (% sacrificed volume) and to identify predictive factors of tumor shrinkage.

Material and methods

Between April 2005 and October 2016, 31 patients with renal AMLs $\geq$ 40 mm underwent RAE with absolute ethanol. Of them, 18 patients (4 men and 14 women) who were followed up with imaging for at least 6 months were included. Three embolization techniques were used: selective RAE, balloon-occluded RAE, and RAE with closed renal circuit (RAE-CRC). RAE-CRC was indicated for huge tumors to aspirate large amounts of applied ethanol via the renal vein. Tumor reduction rate, renal function, % sacrificed volume, and amount of fat content were evaluated.

Results

Median pretreatment AML maximal size was 75 mm (range 41–145 mm). The median imaging follow-up was 52 months (range 6–138 months). Technical success was obtained in all cases. Significant reduction in tumor size (median 34 mm) was observed after ethanol embolization ($p < 0.001$, paired-t test). Median % sacrificed volume was 8.3% (range 0%–34.8%), and no deterioration of kidney function was observed. Correlation between fat content and tumor reduction [coefficient = -0.58 (95% CI: -0.824 – -0.155), $p = 0.0116$] was identified; thus fat content was identified as a predictive factor of tumor shrinkage.

Conclusion

RAE is effective in the mid-to-long term, with theoretical benefits in safety and durability of result. Significant tumor reduction is modulated by the tissue composition of AMLs.

P-452

Response assessment by volumetric iodine-uptake measurement: preliminary experience in patients with intermediate-advanced hepatocellular carcinoma treated with yttrium-90 radioembolization

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Purpose

To retrospectively evaluate volumetric iodine uptake (VIU) changes by dual-energy CT (DECT) for assessing early response to yttrium-90 radioembolization (Y90) in patients with intermediate-advanced hepatocellular carcinoma (HCC) compared with RECIST 1.1 and mRECIST.

Material and methods

The study included 24 patients (20 men; mean age 63.4 ± 13.5 years) treated with Y90 and evaluated with DECT before and 1–2 months after treatment. One radiologist measured VIU on late arterial phase spectral images before and after treatment. Responders were defined as those with $\geq 15\%$ VIU reduction. A second radiologist evaluated the target tumor response at the 1–2- and 6-month follow-up according to RECIST 1.1 and mRECIST. Overall survival (OS) was evaluated by Kaplan–Meier analysis and compared by Cox regression analysis.

Results

VIU identified a higher number of responders (18 patients, 75%) than with RECIST 1.1 (12.5% at 1–2 months and 23.8% at 6 months) and mRECIST (29.2% at 1–2 months and 61.9% at 6 months). There was no statistically significant correlation between OS and RECIST 1.1 ($P=0.70$ at 1–2 months and $P=0.28$ at 6 months) or mRECIST ($P=0.47$ at 1–2 months and $P=0.67$ at 6 months), whereas the median OS was significantly higher in VIU responders (29.4 months) than in non-responders (7.4 months) (HR 0.14; 95% CI 0.03–0.51; $P = 0.0047$).

Conclusion

As opposed to mRECIST and RECIST 1.1, VIU is associated with OS after Y90 in patients with intermediate-advanced HCC, representing a sensitive parameter in the early assessment of tumor response.

P-453

Portal hypertension is related to poor outcomes after chemoembolization

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Purpose

To evaluate the effects of portal hypertension on outcomes after chemoembolization in patients with hepatocellular carcinomas (HCCs).

Material and methods

From January 2005 to December 2007, 147 patients underwent conventional chemoembolization as their first-line treatment for single HCCs ≥ 1 cm and < 5 cm. Clinically significant portal hypertension (CSPH) was addressed and graded as 0, 1, and 2. The effects of CSPH along with other factors on local tumor progression (LTP), LTP of HCCs with initial compact Lipiodol uptake, and disease progression were analyzed with Cox proportional hazard regression.

Results

Higher performance status [$p = .032$, hazard ratio (HR) = 2.474], higher CSPH grades (grade 1, $p = .006$, HR = 3.243 and grade 2, $p < .001$, HR = 6.192), larger tumor size ($p = .025$, HR = 1.301), and less selective catheterization ($p = .010$, HR = 1.940) were significantly related to early LTP. Regarding HCCs with initial compact Lipiodol uptake ($n = 75$), female gender ($p = .027$, HR = 2.339) and higher CSPH grades (grade 1, $p = .010$, HR = 5.249 and grade 2, $p < .001$, HR = 10.469) were significantly related to early LTP. Higher CSPH grades (grade 1, $p = .013$, HR = 1.919 and grade 2, $p < .001$, HR = 3.153) and less selective catheterization ($p = .028$, HR = 1.575) were also significantly related to early disease progression.

Conclusion

Higher CSPH grades were significantly related to poor prognosis after chemoembolization, and the effects were greater in HCCs with initial compact Lipiodol uptake.

P-454

Efficacy of cone beam CT-based liver perfusion map for assessing tumor vascularity and evaluating treatment response after TACE for HCC

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Purpose

We evaluated the efficacy of cone-beam computed tomography (CBCT)-based liver perfusion map for assessing tumor vascularity and evaluating immediate tumor response after TACE.

Material and methods

From August to June 2016, 37 patients with 61 tumor lesions who underwent CBCT with post-processing software after TACE for HCC treatment were enrolled. Two reviewers evaluated the confidence level of viable tumors using angiography, CBCT, a CBCT-based liver perfusion map, and lipiodol CT after TACE using a four-point scale. The mean tumor blood volume (BV) was measured on perfusion image by drawing ROI along the tumor margin before and after TACE. The treatment response to TACE was recorded according to the modified RECIST on the first follow-up imaging study after TACE. The prediction power was evaluated using multiple logistic regression which was adjusted with age, sex, and tumor size.

Results

Mean tumor BV before and after TACE was -0.12 ± 33.01 and -12.78 ± 23.45 ml/L, respectively. CBCT, CBCT-based liver perfusion map, lipiodol CT, and mean tumor BV were significant ($p = 0.0035$, $p < 0.0001$, $p = 0.0004$, and $p < 0.0001$, respectively) in predicting viable tumor but angiography was not ($p = 0.9842$). C-statistics of mean tumor BV was the highest at 0.884; visual scoring of CBCT-based liver perfusion map was the second highest (0.855). C-statistics of CBCT and lipiodol CT were 0.787 and 0.827, respectively.

Conclusion

A CBCT-based liver perfusion map provided reliable images for predicting viable tumor by qualitative analysis with visual scoring and by quantitative analysis with mean tumor BV as a perfusion factor after TACE.

P-455

Is age a possible independent prognostic factor for overall survival after transarterial chemoembolization in patients with hepatocellular carcinoma

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Purpose

Age is not one of the criteria in the Barcelona Clinic Liver Cancer (BCLC) classification, and there are few articles considering the clinical outcome in elderly patients with hepatocellular carcinoma (HCC) treated with transarterial chemoembolization (TACE). We evaluated whether age could be an independent prognostic factor for overall survival (OS) for patients with HCC treated with TACE.

Material and methods

Our retrospective study included 225 patients with HCC who underwent TACE. One hundred and forty-five patients < 70 years (mean age 60 ± 7 years) and 80 patients ≥ 70 years (mean age 75 ± 4 years) were included based on the following criteria: Child-Pugh class A/B, performance status (PS) ≤ 1 and HCC unfit for other effective therapies.

Results

Elderly patients showed a median OS of 33 months (95% CI: 24.8–41.1), whereas younger patients showed a median OS of 44 months (95% CI: 14.9–73.1) with a statistically significant difference ($p = 0.005$). Thirty-eight younger patients underwent liver transplantation (LT). To minimize the impact of confounding factors on survival analysis, the propensity model matched 61 patients of each group for gender, Child-Pugh class, portal vein thrombosis, PS, BCLC tumour gross pathology and independent prognostic factors. Younger patients, who underwent LT, were excluded from the propensity model. After matching, the median OS did not differ between elderly (33 months; 95% CI: 24.8–41.1) and younger patients (36 months; 95% CI: 25.7–46.3).

Conclusion

TACE should be considered effective and safe for elderly patients. LT is the only therapeutic strategy that guarantees longer survival; age is not an independent prognostic factor for OS in patients with HCC.

P-456

Evaluation of transarterial chemoembolization with drug-eluting beads for hepatocellular carcinoma and the relationship between vascular lake and local response

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Purpose

To investigate the efficacy and safety of transarterial chemoembolization with drug-eluting beads (DEB-TACE) for hepatocellular carcinoma (HCC) and the relationship between vascular lake and local response.

Material and methods

From August 2014 to October 2015, a total of 32 patients with 47 HCCs (more than 10 mm in diameter) underwent DEB-TACE using epirubicin-loaded DC beads or cisplatin-loaded HepaSpheres. The median age was 76 (range: 61–86) years, male/female: 27/5, Child-Pugh A/B/C: 16/16/0, median diameter of the tumor: 30 (range: 11–170) mm, and DC bead/HepaSphere: 26/6. Tumor response was evaluated by modified RECIST criteria. In addition, we evaluated the predictive factors of vascular lake and the relationship between vascular lake and local response. The association with outcomes was analyzed for tumor size, tumor number, macroscopic type, capsule, type of beads, and selection of feeding arteries.

Results

Forty-four nodules were enrolled as target lesions. The numbers of CR, PR, SD, and PD were 4, 19, 19, and 2, respectively. The response rate of target lesions was 52.3%. The frequency of vascular lakes was 27.7% (13/47). All lesions with vascular lake were more than 40 mm in diameter and occurred with significantly more frequency in patients with single HCC ($p=0.0014$). Univariate statistical analysis indicated that selection of feeding arteries and vascular lake was associated with local response. However, in multivariate statistical analysis, there were no significant relationships.

Conclusion

Vascular lake may be associated with tumor size and number. Here no significant relationship was observed between vascular lake and local response.

P-457

HIFU for prostate cancer: 1250 patients with a 10-year follow-up

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Purpose

The aim of this investigation was to evaluate the efficacy of HIFU treatment for patients with prostate cancer and failure after external beam radiotherapy (EBRT) and local recurrence after radical prostatectomy (RPE). All patients were stratified by tumor risk progression according to D'Amico classification.

Material and methods

In total, 1250 patients were treated at Samara oncology center between 2007 and 2017: 359 patients with low risk, 375 with intermediate risk, 467 with high risk progression and 49 after EBRT and RPE failure. Nine hundred eighty-five patients underwent transurethral resection of the prostate (TURP) + HIFU treatment and 265 underwent only HIFU treatment (volume prostate < 40cc). The mean follow-up was 69 (range 3–119) months. The mean age of all patients was 68.4 (52–89) years.

Results

The median PSA level at 72 months after HIFU treatment was 0.5 (0.0–3.7) ng/ml for patients with low risk, 1.04 (0.2–6.5) ng/ml for those with intermediate risk, 3.5 (0–21.2) ng/ml for those with high risk progression and 1.7 (0.0–9.9) ng/ml for those after EBRT and RPE failure. After 10 years, the rate of progression for patients with low, intermediate and high risk and those after EBRT and RPE failure was 6%, 8%, 37.2% and 19.7%, respectively. Kaplan–Meier analyses of the total group indicated that the disease-free survival after the 10-year follow-up was 84.2% for all patients.

Conclusion

Therefore, HIFU treatment is a safe, minimally invasive treatment for localized and locally advanced prostate cancer with a disease-free survival of 84.2% with mild and transient side effects; HIFU treatment can also be successfully performed in patients with local recurrence after RPE and EBRT failure.

P-458

Short-, mid- and long-term outcomes of irreversible electroporation treatment in renal cell carcinoma: a prospective single centre study

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Purpose

Irreversible electroporation (IRE) is a non-thermal nephron-sparing technique which offers an alternative treatment for renal tumours

in patients unsuitable for other therapies. Here we aimed to provide short- to long-term clinical data on these patients over 7 years.

Material and methods

Ethics approval was obtained for a prospective non-randomised trial to investigate treatment safety of IRE for solid tumours. Nineteen patients with renal tumours deemed surgically unresectable and unsuitable for thermal ablation were treated between 1st December 2008 and 30th October 2015. Prospective data was obtained from our IRE database and patient records. Two to six needle electrodes were inserted under anaesthesia with neuromuscular blockade and pulse delivery was synchronised to the cardiac rhythm. Patients were followed up clinically and with CT for adverse events and recurrence-free survival.

Results

Nineteen patients underwent 29 ablation episodes for 27 tumours. Of these, 84% ($n=16$) had renal cell carcinoma, 42% ($n=8$) had solitary kidney and 94% ($n=18$) had lesions adjacent to thermally-sensitive structures. Success was correlated to tumour size, with 94% lesions < 3 cm (15/16) successfully ablated after ≤ 2 rounds of IRE versus 63% lesions ≥ 3 cm (7/11). Stratification by follow-up duration showed complete ablation post ≤ 2 rounds of IRE in 100% of patients followed up for short- and mid-term and 58% those followed up for long-term. Partial ureteric stenosis was observed post-IRE in 1 patient. No other major complications were observed.

Conclusion

Renal IRE is a safe alternative treatment for renal tumours. Better results are observed in short-to-mid-term and tumours < 3cm, with ablation rates comparable to those with thermal techniques.

P-459

Comparative safety and effectiveness of different transarterial embolization therapies either alone or in combination with local ablative or adjuvant systemic treatments for unresectable hepatocellular carcinoma: a systematic review and network meta-analysis of randomized controlled trials

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Purpose

This is a network meta-analysis (NMA) of different embolization options for unresectable hepatocellular carcinoma (HCC).

Material and methods

Medical databases were searched for randomized controlled trials (RCTs) evaluating bland transarterial embolization (TAE), conventional chemoembolization (TACE), drug-eluting bead TACE (DEB-TACE), or transarterial radioembolization (TARE) either alone or combined with adjuvant chemotherapy, local liver ablation, or external radiotherapy for unresectable HCC. Random effects Bayesian models with a binomial and normal likelihood were used (WinBUGS). Competing treatments were ranked with the SUCRA statistic. Sensitivity, consistency, model fit, and meta-regression analyses were performed.

Results

The network of evidence included 53 RCTs (12 direct comparisons) with 5,598 patients with HCC. Combinations of TACE with external radiotherapy or local liver ablation achieved the best tumor response and survival over most other treatments. The median survival was 13.9 months in the control, 20.7 months in cases treated with TACE, 20.9 months in cases treated with bland TAE, 30.1 months in cases treated with TACE plus external radiotherapy, and 33.1 months in cases treated with TACE plus liver ablation. TARE was the safest treatment with a non-significant risk of adverse events, while

all other therapies were associated with a significantly higher risk of toxicity compared with the control (OR range, 12.1–70.6). TACE, DEB-TACE, TARE, and adjuvant systemic agents neither improved the objective response of treated tumors (OR range, 0.86–1.79) nor conferred any survival benefit (HR range, 0.82–1.15) over bland TAE alone.

Conclusion

Chemo- and radioembolization improved patient survival, but were not more effective than bland particle embolization. Chemoembolization combined with external radiotherapy or local liver ablation may significantly improve patient survival compared with embolization monotherapies.

P-460

Hepatocellular carcinoma with portal vein tumor thrombus: transarterial chemoembolization combined with CT-guided iodine-125 seed implantation

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Purpose

To investigate methods and effects of transarterial chemoembolization (TACE) combined with CT-guided iodine-125 seed implantation on hepatocellular carcinoma (HCC) with portal vein tumor thrombus (PVTT).

Material and methods

Forty-eight patients with HCC and PVTT underwent TACE combined with CT-guided iodine-125 seed implantation. Based on the invasive location of PVTT, types A, B, and C were defined as PVTT in the main portal vein, that in the first order portal vein branch, and that in the second or lower-order portal vein branches, respectively. Based on the locations of iodine-125 seeds implanted inside PVTT or around PVTT, two groups were defined: internal group (iodine-125 seeds implanted directly inside PVTT) and peripheral group (iodine-125 seeds implanted into the peripheral parenchymal or tumor tissue at less than 1.7cm). DCR, TTP, and OS of overall patients were analyzed based on the types of PVTT and in the two groups.

Results

In types A, B, and C, OS was 8, 11.5, and 15 months, respectively ($p=0.003$); DCR of PVTT was 69.23%, 75%, and 81.82%, respectively ($p=0.548$); DCR of intrahepatic tumors was 69.23%, 75%, and 81.82%, respectively ($p=0.483$); the median TTP of PVTT was 4.5, 8, and 11 months, respectively ($p=0.030$); and the median TTP of the intrahepatic tumor was 5, 9, and 9.5 months, respectively ($p=0.012$). In the internal and peripheral groups, OS was 10 and 11.5 months, respectively ($p=0.239$) and DCR of PVTT and intrahepatic tumors was 69.23% and 68.18% ($p=0.591$) and 73.07% and 77.27% ($p=0.502$), respectively. The median TTP of PVTT and intrahepatic tumors in the internal and peripheral groups was 7 and 10 months ($p=0.276$) and 8 and 9.5 months, respectively ($p=0.089$).

Conclusion

TACE combined with CT-guided iodine-125 seed implantation (irrespective of the method) may effectively control the progression of PVTT and intrahepatic tumor and prolong survival in patients with HCC.

P-461

The role of interventional radiology in the treatment of intra-hepatic cholangiocarcinoma

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Purpose

To describe the current level of evidence regarding interventional treatments in the management of ICC and interventional procedures aiming to improve the future liver remnant surgery.

Material and methods

A systematic literature search was performed in PubMed, selecting only studies published in English from January 2005 to June 2016 reporting on interventional radiology treatments in patients with unresectable ICC. The primary endpoint was to investigate safety and complications of these techniques. The secondary endpoint was to present the current status of interventional radiology in the treatment of unresectable ICC. The following variables were extracted, where available, from the included articles: number of patients, number of lesions and their diameter, number of sessions of treatment, complications, mean follow-up, and technical and clinical success. Median survival was calculated.

Results

Multiple treatment options are available for inoperable ICC and no randomized studies exist to compare treatments. The studies that we evaluated showed a great heterogeneity in treated populations and the selection of therapy from one center to another. There was no significant difference in median survival between treatments, but TACE was associated with a greater risk of major complications than radioembolization and thermal ablation. Similar to the approach used for HCC, thermal ablation was preferred when lesions are no more than 3 and the size is suitable (ideally under 3 and up to 5 cm).

Conclusion

The current study provides important data demonstrating the feasibility, safety, and potential efficacy of interventional procedures for ICC both in inoperable patients and in borderline ones to make them suitable for surgery.

P-462

Percutaneous microwave ablation of renal cell carcinoma using a high-power microwave system: focus upon feasibility, safety, and efficacy

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Purpose

Small- to medium-sized renal masses are increasingly imaged as incidental findings requiring a treatment strategy that preserves the renal function and minimizes procedural morbidity. Percutaneous ablation is an expanding, minimally invasive approach. The purpose of this study was to review feasibility, safety, and mid-term efficacy of percutaneous microwave ablation (MWA) for renal cell carcinoma (RCC) treatment using a high-power microwave system.

Material and methods

Institutional database research identified 48 consecutive patients with a single RCC lesion (biopsy proven) who underwent percutaneous MWA using a high-power microwave system. All patients had undergone biopsy in a different session using an 18-G semi-automatic soft tissue biopsy needle. Contrast-enhanced computed tomography or magnetic resonance imaging was used for

post-ablation follow-up. Patient and tumor characteristics, microwave technique, complications, and pattern of recurrence were evaluated.

Results

The patient age was 74 years (male:female: 31:19). The average lesion size was 3.1 cm (range 2.0–4.3 cm). The 3-year overall survival was 95.8% (46/48). Two patients died during the 3-year follow-up because of reasons unrelated to MWA and RCC. Minor complications, including hematomas requiring nothing but observation, occurred in 3% (6/50) cases. Local recurrence of 6.25% (3/48) was observed with 2/3 cases being re-treated achieving a total clinical success of 97.9% (47/48 lesions).

Conclusion

Percutaneous MWA of RCC using a high-power microwave system is a feasible, safe, and efficacious technique for the treatment of small- to medium-sized renal masses.

P-463

Left hepatic and segment IV yttrium-90 radioembolization using glass microspheres without routine embolization of the right gastric artery

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Purpose

To evaluate the safety of yttrium-90 radioembolization (RE) using glass microspheres in the treatment of left lobar or segment IV tumor without prophylactic embolization of the right gastric artery (RGA).

Material and methods

All patients undergoing left lobar or proximal segment 4 RE with glass microspheres between October 2012 and January 2016 for primary or liver-dominant metastatic disease were reviewed. Glass microspheres were administered at least 1 cm distal to the identified RGA in all cases. Patients treated from a replaced left hepatic artery (n = 14) or separate origin of the segment 4 hepatic artery (n = 3) were excluded. The necessity for embolization of the RGA, distal hepaticocenteric arteries, or other vessels was recorded, and the incidence of radiation-induced gastric ulceration was monitored by the performing physician for up to 3 months.

Results

RE to the left lobe (n = 34) or proximal segment 4 (n = 18) was performed in 52 patients. Prophylactic embolization of the RGA was performed in only 6 patients (11.5%). During mapping angiography, embolization was performed in 17 patients (mean vessels 1.47, median 1, range 0–3). Distal hepaticocenteric vessels of the left hepatic artery were embolized in 4 patients (7.8%). Two parasitized vessels (3.8%) and 4 (7.7%) branches of the left hepatic artery were embolized for the purpose of redistribution. No treatment-related gastric or duodenal ulceration was observed. Ten (19.2%) patients underwent EGD evaluation following RE for other indications; no incidental radiation-induced ulcers were identified.

Conclusion

RE of the left hepatic or segment 4 arteries using glass microspheres can be performed safely without routine embolization of the RGA.

P-464

Portal vein infiltration in patients with hepatocellular carcinoma: the relevance of correct classification

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Purpose

Portal vein invasion (PVI) has significant impact on the prognosis of patients with hepatocellular carcinoma (HCC). Treatment is determined according to BCLC stages. In BCLC-B, TACE is recommended, whereas for patients with PVI (BCLC-C/D), systemic therapy or radioembolization may be preferable. Patients with minor PVI are frequently misclassified due to radiological challenges in determining malignant PVI or non-adherence to guidelines. Aim of this study is the re-evaluation of PVI and the analysis of the impact of misclassification.

Material and methods

Overall, 861 HCC patients of a total of 1413 were extracted from the clinical registry of our tertiary center as an ongoing effort to re-evaluate the extent of PVI in all patients treated between 01/2000 and 12/2015. PVI was diagnosed by re-evaluating all available CT or MRI scans. PVI was documented using the Liver Cancer Study Group of Japan classification ranging from Vp0 to Vp4: Vp0=no PVI, Vp1=segmental, Vp2=right anterior or posterior PV, Vp3=right or left PV, and Vp4=main trunk. Influence on overall survival (OS) was calculated for each BCLC stage.

Results

Overall, 279 patients were classified with PVI. BCLC classification in these patients prior to reevaluation was A/B/C/D in 10/14/179/76 of cases. When comparing the patients with and without PVI, those initially classified as BCLC-A yielded an OS of 21.5 months vs. 103.9 months (p=0.001) and those initially classified as BCLC-B yielded an OS of 10.9 months vs. 39.8 months (p=0.001).

Conclusion

Even minor PVI leads to dismal prognosis. Meticulous evaluation of cross-sectional imaging is crucial for the clinical management of patients with HCC. Once PVI has been diagnosed, such patients have to be classified as advanced stage.

P-465

Safety and efficacy of 100- μ DEB-TACE in patients with non-resectable HCC

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Purpose

To evaluate the short-term safety and efficacy of 100- μ DEB-TACE for the treatment of non-resectable HCC. Small particles may allow a more concentrated drug delivery as well as greater tumor penetration than larger particles. However, there is still some concern regarding the possibility that small spheres could be more toxic.

Material and methods

Ten academic hospitals were involved in this multicenter, single-arm, prospective study (NCT2670122). Approval from the ethical committee was obtained. All patients provided informed consent. The primary aim was to assess treatment safety and tolerability. The second end point was treatment efficacy. DEB-TACE with selective and ultra-selective administration of up to 3 ml of tightly calibrated 100- μ drug-eluting microspheres with up to 150 mg of doxorubicin was administered to patients with Child-Pugh class $\leq$ B7; ECOG 0. mRECIST was used for response evaluation.

Results

From March 2015 to November 2016, 131 patients underwent 100- μ DEB-TACE. Of these, 70.2%, 18.3% and 11.5% patients had Child-Pugh class A5, A6 and B7, respectively. The mean patient age was 68.3 yr (47–84 yr). BCLC class A and B were observed in 57.2% and 25.9% patients, respectively. Overall, 223 nodules with a mean size of 27.7 mm (8–100 mm) and a mean of 1.7 nodules per patient were treated. A total of 244 TACEs have been performed (a mean of 1.8 procedures per patient). The 3-month objective response rate was 72.8%. The 30-day mortality, minor complication rate and major complications rate were 0%, 6.9% and 4%, respectively.

Conclusion

Safety profile and short-term efficacy of 100- μ DEB-TACE is similar to that of standard DEB-TACE.

P-466

Does immediate CT post-chemoembolization of colorectal metastases in the liver predict PET response?

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Purpose

- (1) To establish the clinical significance of tumor contrast retention post-chemoembolization.
- (2) To test the hypothesis that the effect of DEBIRI TACE is due to the diffusion of the prodrug irinotecan into the tumor.

Material and methods

All patients underwent a non-enhanced CT immediately post-DEBIRI TACE. Patients who underwent PET-CT pre- and post-DEBIRI TACE within 3 months of DEBIRI were included. Eleven patients were identified, 7 of whom completed DEBIRI treatment. Reasons for incomplete treatment included refusal (in 2 patients) and change of treatment by the clinician (in 2 patients). The pattern of post-DEBIRI enhancement was matched to the PET-CT response. If 75%–100% of the enhancement area matched, the response was classified as type 1; if 25%–75% matched, as type 2 or a partial match; and if 0%–25% matched, as type 3.

Results

Five patients demonstrated a type 1 response, 2 demonstrated a type 2 response, and 4 demonstrated a type 3 response. One type 1, one type 2, and all type 3 responders exhibited significant metabolic disease progression on PET-CT.

Conclusion

Post-DEBIRI contrast enhancement did not predict disease response. However, our results indicated that in patients who responded to DEBIRI, the post-DEBIRI enhancement area matched the PET-CT response. This was surprising as the conventional hypothesis is that the treatment response is due to the diffusion of the active drug into the tumor from the adjacent healthy liver. We hypothesized that the mechanism of action of DEBIRI was due to the active conversion of the prodrug in the tumor or the blockage of the tumor microvasculature.

P-467

Microwave ablation of focal liver lesions: 5-year experience at an oncologic centre

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Purpose

To describe the 5-year experience of using microwave therapy on liver lesions and CT follow-up for evaluating treatment response and identifying local recurrence prognostic factors after microwave ablation.

Material and methods

Our retrospective study evaluated all liver lesions submitted for microwave ablation to our oncologic centre during 5 years. Enhanced CT was conducted for all patients after the procedure and at 3-month intervals thereafter. Recurrence rates, complications, and technique effectiveness were analyzed. Lesion features and ablation details will be further analyzed for predicting treatment success and

outcomes and highlighting the size and location (central, perivascular, and subcapsular) of the lesions and the ablation zone/coagulation area ratio.

Results

The study population included 139 patients with a total of 245 liver lesions submitted for microwave ablation. Most of the lesions (83.5%) were liver metastases (colorectal metastases, 48.9%; breast metastases, 12.9%; neuroendocrine tumors metastases, 7.9%; and other several metastases, 13.9%) and 14.4% were HCC. The median follow-up was 18 months, and minor complications occurred in 8 patients. Local recurrence occurred in 21% patients, with a majority occurring 3–6 months post-procedure. Further analysis will be detailed, fulfilling the aims of this study.

Conclusion

Microwave ablation of focal liver lesions is effective and safe with better outcomes than liver surgery in terms of post-procedural morbidity, ability to re-treat very effectively and an increased patient overall survival. CT follow-up of ablated areas can reflect early recurrence and the need for additional procedures. We estimate that at our centre, the optimal ablation margin is the strongest local recurrence predictor.

P-468

Experience of irreversible electroporation for improving survival in locally advanced pancreatic adenocarcinoma in Asia

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Purpose

Irreversible electroporation (IRE) is a non-thermal focal therapy that utilizes high-voltage electric pulses for permanently rupturing the cellular membrane and inducing apoptosis. In this study, we evaluated the safety and efficacy of a protocol based on intra-operative ultrasound-guided IRE in patients with locally advanced pancreatic cancer (LAPC). Data were collected from 7 countries in Asia

Material and methods

From 2012 to 2015, we performed laparotomic and laparoscopic IRE under US guidance in 70 patients with stage III LAPC. These patients were enrolled into a prospective institutional review board approved trial.

Results

No IRE-related deaths occurred. A median follow-up of 30.8 months showed that 18.6% of patients sustained complications with a median grade of 2 (range 1–3, no grade 4 or 5 complications were observed). Six patients (8.6%) experienced local recurrence, and 34.3% experienced distant progression (with 50% of these metastases to the liver). Overall survival was 27.4 months.

Conclusion

Our study suggests that IRE is safe and effective in controlling locally advanced pancreatic cancer. We surmise that the addition of IRE to the chemotherapy regimen may provide a survival advantage.

P-469

Technical note: a single-center experience of positron emission tomography-computed tomography (PETCT)-guided lung biopsy for better yield

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Purpose

To evaluate the feasibility of PETCT-guided lung biopsies for tissue sampling and better yield, thereby minimizing the need for repeat procedures and also reducing patient morbidity.

Material and methods

Twenty individuals diagnosed with a pulmonary mass lesion on CT scan were considered for PETCT studies. Patients with central lung masses masqueraded by the atelectatic lung underwent PETCT-guided percutaneous biopsy procedures. The biopsy samples were obtained from the most PET avid areas. An 18G coaxial (BARD automatic max core and semiautomatic truclide coaxial disposable biopsy instrument) system was used for the procedure. Biopsy throw of 2.2 cm and minimum of 5 and maximum of 10 cores were obtained. All cores were analyzed by an oncopathologist.

Results

Adequate samples were obtained in all patients. Average biopsy core length was 2.2 cm. All sampled cores defined cancer cells and were adequate for various other tests. None of the patients had to undergo repeat biopsy due to inadequacy of sample.

Conclusion

Guided core biopsy plays an important role in obtaining tissue samples for analysis. CT guidance is routinely used for lung biopsies. Quite often the sample biopsied may not be true representative of tumor cells. The use of PETCT guidance in those instances helps in tissue sampling, thereby minimizing the repeat procedures and significantly reducing patient morbidity. In our series of 20 patients, all the cores showed cancer cells and were sufficient for various other tissue analyses; hence, we recommend PETCT-guided biopsies.

P-470

Lipiodol as an imaging biomarker of tumor response after transarterial chemoembolization therapy in patients with primary and metastatic liver cancer: preliminary results

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Purpose

To establish the role of Lipiodol as an imaging biomarker of tumor response.

Material and methods

Thirty-nine patients with HCC (n=22) or metastatic disease (n=17) were included in this prospective, single-arm, phase II clinical trial. Patients were treated with conventional transarterial chemoembolization (cTACE). Imaging was performed at baseline (BL, MRI/CT), 24 h post-TACE (CT), and at 1, 3, and 6 months post-TACE (MRI/CT). Data analysis included intra- and extratumoral Lipiodol deposition at BL and on follow-up and tumor response assessment using WHO, RECIST, mRECIST, EASL, and qEASL guidelines. BL tumor enhancement was compared between responders and non-responders for each response assessment guideline separately. Statistical analysis included linear regression and student's t-tests.

Results

Responders presented high tumor enhancement at 1 (WHO, RECIST, EASL; all p<0.05), 3 (WHO, mRECIST, EASL, qEASL; all p<0.05), and

6-month follow-ups (RECIST, $p=0.037$). Furthermore, a small overall tumor area and high Lipiodol deposition were predictive of response 1 and 3 months post-TACE on applying the qEASL guidelines. BL tumor enhancement showed a weak correlation with Lipiodol deposition (24 h CT; $R^2=0.106$). Extratumoral Lipiodol washout was substantially higher than intratumoral washout.

Conclusion

BL tumor enhancement showed a weak positive trend in predicting Lipiodol deposition after cTACE. High tumor enhancement at BL and Lipiodol deposition on initial follow-up (24 h) were predictive of response to therapy till 6 and 3 months post-TACE, respectively. Patients with small enhancing tumors exhibited a high possibility of responding to treatment. In conclusion, Lipiodol can be used as an imaging biomarker for tumor response in patients treated with cTACE.

P-471

Transarterial chemoembolization of hepatocellular carcinoma with 100±25-µm and 200±25-µm Lifepearl microspheres: short-term follow-up and safety profile

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Purpose

To evaluate short-term response and safety profile of doxorubicin-preloaded 100±25-µm and 200±25-µm Lifepearl microspheres in the treatment of hypervascular hepatocellular carcinoma (HCC).

Material and methods

Forty-nine typical hypervascular HCC (mean size, 25.5 mm; range, 59–11 mm) in 37 patients [26 males; mean age, 63.2±13.3 years; BCLC-A (n=17) and BCLC-B (n=20)] were prospectively enrolled. TACE procedure was highly standardized as follows: dual-phase CBCT-assisted procedure; superselective microcatheterization (2.7 Fr); embolic agent: 100 mg of doxorubicin divided in vials of 100±25-µm and 200±25-µm particles; embolization protocol: 100±25-µm particles were injected first, and if arterial flow arrest was not achieved, 200±25-µm particles were injected till stasis. Procedures were scored by the degree of achieved superselective microcatheterization. Results were evaluated according to mRECIST criteria using MDCT/MRI at 1-month follow-up. Toxicity evaluation was based on the comparison of pre- and post-procedural laboratory tests (with a cut-off of 50% of increase); the onset of major or minor complications was recorded.

Results

In 19 patients, the score was 0 (no non-target sub-segmental artery embolization), whereas in 30 patients who underwent TACE, the score was 1 (one non-target sub-segmental artery embolization). At 1-month follow-up, complete response was observed in 65.3% of patients, partial response in 18.3%, and stable disease in 14.2%, with an objective response rate of 83.6% and disease control rate of 97.8%. In 12/49 patients, a significant increase was noticed in hepatic laboratory tests, but only 4 patients developed symptoms requiring specific medical treatment. One patient developed a hepatic abscess in the treated area.

Conclusion

TACE with Lifepearl microspheres provides excellent short-term control of HCC burden with a favorable toxicity profile.

P-472

Microwave ablation in the management of colorectal cancer lung metastases

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Purpose

Approximately 3% of patients with colorectal cancer (CRC) lung metastases are amenable to metastasectomy. Lung radiofrequency (RF) ablation can be performed safely and with comparable oncologic outcomes in this patient population. Microwave (MW) ablation is an evolving thermal ablation technology with at least theoretical benefits over RF. Here we present the clinical outcomes of MW ablation of CRC cancer lung metastases.

Material and methods

We selected patients with CRC lung metastases who were treated with MW ablation from our institutional HIPAA-registered and IRB-approved clinical ablation database. All patients were evaluated by CT at 4–8 weeks and/or by PET/CT every 3 months thereafter. Oncologic endpoints included local tumor progression rate and local progression-free and overall survival rates. Complications were recorded.

Results

Fifty patients with 79 lung lesions were included. Mean follow-up period was 43.2 months. Mean lesion size was 1.1 (range, 0.3–3.2) cm. Eight (10%) lesions demonstrated local progression during follow-up, 2 of which were successfully retreated without evidence of local progression during follow-up. Local progression (assisted)-free survival rates at 1, 2, and 3 years was 94%, 86%, and 86%, and median time to local progression was not reached. Overall survival rate after lung ablation was 100% at 1 year, 97% at 2 years, and 86% at 3 years. Mean minimal ablation margin was 5.2 (range, 0–19) mm. Mean ablation margin in the lesions with local recurrence was 4.6 mm vs 5.3 mm in the patients without recurrence ($p=0.70$). Pneumothorax rate was 35%, and chest tube rate was 26%. Additional complications included a bronchopleural fistula in 1 patient and an empyema in another patient. Both were successfully managed with thoracotomy and without further sequelae.

Conclusion

MW is a safe local therapy that provides extended local control of CRC lung metastases.

P-473

CT-guided percutaneous cryoablation of renal cell carcinoma: impact of histology and ablative margins on treatment success

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Purpose

To evaluate factors affecting local tumour control and complications after the cryoablation of renal cell carcinomas (RCCs).

Material and methods

A retrospective analysis of 157 patients who underwent CT-guided percutaneous cryoablation (PCA) of biopsy-proven RCCs was performed. Patients with a mean age of 69 (range, 44–89) years were followed up for 6 months or longer with MRI. All patients underwent MRI at day 1 to assess ablative margins. Factors affecting local

tumour control and complications were evaluated: tumour size, RENAL score, histology and Fuhrman grade, enhancement pattern and ablative margins.

Results

Median follow-up period was 33 (range, 6–86) months. Mean tumour diameter was 25.4 (range, 10–60) mm. Recurrences were observed in 17 patients with clear cell RCC (ccRCC) and in 1 with non-clear cell RCC. All controlled tumours demonstrated ablative margins of 5 mm or more on MRI at day 1. Recurrence rate was significantly correlated with low ablative margins ($p < 0.0001$) and ccRCC subtype ($p = 0.046$). On multivariate analysis, only ablative margins remained significant ($p < 0.0001$). Complications were rare (15% Clavien 1; 0.006% Clavien 2 and 4; 0.2% Clavien 3). Complication rate correlated with tumour size ($p = 0.028$), number of cryoneedles ($p = 0.01$) and polar location ($p = 0.04$) but not with RENAL score ($p = 0.059$). On multivariate analysis, only mid-pole location was associated with complications ($p = 0.013$).

Conclusion

MRI at day 1 was highly predictive of recurrence. Insufficient ablative margins and clear cell histological subtype were associated with incomplete local tumour control following CT-guided PCA for RCCs. The complication rate of PCA for RCCs was low.

P-474

Theranostic application of lipiodol for transarterial chemoembolization in a VX2 tumor animal model

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Purpose

To establish and validate the role of lipiodol as a tumor-seeking theranostic agent and specific imaging biomarker of tumor tissue after transarterial chemoembolization (TACE) in an animal tumor model for liver cancer.

Material and methods

Thirty-six rabbits were implanted with VX2 tumors and treated with a lipiodol-based TACE protocol. Animals were sacrificed at 24 h or 7 or 20 days post-TACE and underwent serial native and contrast-enhanced CT scans before TACE and immediately before sacrifice. Tumor vascularity and lipiodol deposition within tumors and hepatic tissues were quantified using 3D quantitative assessment tools and with measurements of arterial flow (AF), portal flow (PF), and the perfusion index [$PI = AF/(AF + PF)$].

Results

Twenty-four hours post-TACE, a significant decrease in tumor PI (pre-TACE=62.25%, post-TACE=49.05%, $p = 0.04$) was measured, which was maintained at 7 days ($p = 0.003$) but not at 20 days ($p = 0.4$). A strong correlation ($R^2 = 0.894$) was found between the volume of enhanced tumor tissue at baseline and that of lipiodol-positive tumor post-TACE. Continuous lipiodol deposition across all time points was measured within the tumors; however, gradual and ultimately near-complete lipiodol washout was observed for hepatic deposits.

Conclusion

Tumor hyperenhancement, as visualized on contrast-enhanced CT pre-TACE, demonstrated an excellent correlation with lipiodol deposition post-TACE, indicating that lipiodol is a tumor-seeking agent with a tumor-specific deposition pattern. Changes in PI over time indicated initial tumor devascularization, followed by revascularization and recurrence. In addition, lipiodol was permanently and specifically retained by the tumor tissue as opposed to a rapid

washout from the hepatic tissue. In summary, the aforementioned findings established the role of lipiodol as a tumor-specific theranostic agent.

P-475

The evaluation of the ablative area with non-contrast CT after cryoablation therapy for small renal tumors

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Purpose

Cryoablation therapy is an alternative curative treatment for small renal tumor. It is difficult to evaluate the precise ablative area after cryoablation in patients with poor renal function because a contrast material cannot be used. The purpose of this study was to assess the ablative area with non-contrast CT compared with that with contrast-enhanced CT.

Material and methods

In this retrospective study, 23 patients underwent total 25 cryoablation therapies for small renal tumor between June 2014 and August 2016. The ablative volume was measured with non-contrast and contrast-enhanced CT at 2 days after ablation using a 3-dimensional work station. The volume difference between the ablative area with non-contrast CT and that with contrast-enhanced CT was evaluated by Wilcoxon rank-sum test ($P < 0.05$) and Spearman's rank correlation coefficient (ρ , $P < 0.05$).

Results

The measured ablative volume with non-contrast CT (55.6 ± 30.8 ml) was significantly larger than that with contrast-enhanced CT (40.1 ± 22.4 ml) at the parenchymal phase ($P = 0.00008$), and there was a positive relationship between the measured ablative volume with non-contrast CT and that with contrast-enhanced CT ($\rho = 0.88$, $P = 0.00001$).

Conclusion

Non-contrast CT was a feasible option for the evaluation of the ablative area after cryoablation in patients with poor renal function, although the ablative area could be overestimated with non-contrast CT compared with that with contrast-enhanced CT.

P-476

IRE of liver malignancies after major liver surgery: is it safe and effective?

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Purpose

Surgical resection is the preferred treatment for patients with liver malignancies. Tumor recurrence in the liver remnant after lobectomy is often not amenable to surgical excision. In such patients, local ablative techniques, especially IRE are important treatment options to preserve remaining vessels. However, these patients harbor innumerable surgical clips that possibly interfere with IRE. Here we report on our experience with IRE after major liver surgery in terms of efficacy, safety, and liver function after treatment.

Material and methods

Twelve patients were treated with CT-guided IRE for recurrent liver malignancies after major liver surgery (trisectorectomy in 9/12 patients, non-anatomic major liver-resection in 3/12 patients). They underwent systematic follow-up with MRI. Distances from the active tip of the IRE probe to the nearest surgical clip were measured on CT

images acquired during IRE. Liver function was assessed using the MELD score before and 1 and 6 weeks after IRE. Wilcoxon signed-rank test was used to investigate changes in the MELD score.

Results

All patients had titan surgical clips within an average distance of 25 ± 20 (range, 0–65) mm from the active tip of the probe. In 5/12 patients, surgical clips were located closer than 20 mm. We observed no complication during the intervention or at follow-up. Based on follow-up imaging, complete ablation was achieved in all patients. The presence of clips did not modulate the ablation zone. No patient exhibited vessel thrombosis. The average MELD score before IRE was 6.6 ± 4.5 , 1 week after IRE was 6.1 ± 2.3 , and 6 weeks after IRE was 6.1 ± 3.1 ($p > 0.05$).

Conclusion

The presence of surgical clips close to the IRE probes did not interfere with successful ablation. Thus, IRE is a safe local ablative technique after major liver surgery and does not deteriorate liver function.

P-477

Intra-arterial chemoperfusion (IACP) for treating irresectable chest wall or lymph node recurrence of breast cancer not amenable to radiation therapy

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Purpose

Approximately 10% of breast cancers locally recur after mastectomy. Depending on the type of previous radiotherapy, chest wall recurrences are not amenable to resection or radiation therapy. In such patients, intra-arterial chemoperfusion (IACP) is a treatment option. Here we report our long-term experiences with IACP based on the type of breast cancer (luminal vs. basal).

Material and methods

Eleven women (age, 32–84 years) with chest wall ($n=3$) or loco-regional lymph node recurrence ($n=7$) or both ($n=1$) were included; the recurrences were of basal-type (triple-negative) breast cancer in 4 patients and of luminal A/B-type breast cancer in 7. IACP was superselectively performed via the internal thoracic artery or an axillary artery branch using a perfusor-guided infusion of 30-mg mitoxantrone via microcatheter. IACP was repeated every 3 weeks depending on tumor response and leukocyte count. MRI/CT was performed prior to each IACP session and every 3 months during follow-up. Local control was defined as CR, PR, or SD.

Results

Five patients underwent 4 IACP sessions, 2 underwent 3 sessions, and 4 underwent 1 session. CR was achieved in 4/11 patients, PR in 4/11, SD in 3/11, and PD in 0/11, yielding a local control rate of 100% (11/11). Six of the 8 responders (75%) had luminal A/B-type breast cancer. Two of the 3 non-responders (66.7%) had basal-type breast cancer. Four of the 8 responders demonstrated long-term (>36 months) CR and had luminal A/B-type cancer. Two of the 3 non-responders died <2 months after therapy initiation. One patient experienced a major side effect (cardiac decompensation); minor side effects occurred in 3/11 patients.

Conclusion

For patients with unresectable, locally recurrent luminal A/B-type breast cancers not amenable to radiation therapy, IACP offers long-term local control or even complete remission with minimal side effects.

P-478

Hepatic arterial embolization using cone-beam CT with tumor-feeding vessel detection software: impact on HCC response

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Purpose

Dedicated software using cone-beam CT has shown a high sensitivity in detecting tumor-feeding vessels during hepatic arterial embolization (HAE) of hepatocellular carcinoma (HCC) compared with 2D imaging. The primary hypothesis of this study was that HCC tumors treated with HAE guided by tumor feeding vessel detection software (TFVDS) would show a more complete response (CR). Secondary analysis on the impact of X-ray dose exposure was also performed.

Material and methods

A total of 19 males and 8 females (median age: 69 years, 46–85) with 44 HCC tumors (median size: 38 mm, 6–100) treated with HAE between January 2013 and December 2014 were included. Exclusion criteria were extrahepatic supply, >4 tumors, tumor size > 10 cm, and adjunctive local therapy. Baseline patient and procedure characteristics were reviewed. Differences in CR per modified Response Evaluation Criteria In Solid Tumors were assessed by univariate and multivariate analyses for tumor size, number, location, and use of TFVDS.

Results

The median imaging follow-up was 20.1 months (2–33). Use of TFVDS (13 patients, 19 tumors) was the only factor predictive of CR (odds ratio=3.85 [95%CI: 1.09, 13.67], $p=0.04$) on univariate analysis but not on multivariate analysis (odds ratio=3.26 [0.87, 12.23], $p=0.08$). A higher rate of CR was observed for HAE using TFVDS guidance vs 2D imaging alone (68.4%, 13/19, vs 36%, 9/25, $p=0.03$). The dose area product was significantly lower when TFVDS guidance was used (149.7 Gy.cm^2 , 38–365, vs 227.8 Gy.cm^2 , 85.3–468.6, $p=0.05$).

Conclusion

HCCs embolized with tumor-feeding vessel detection software showed a better response.

P-479

Safety and efficacy of conventional transarterial embolization (cTACE) followed by percutaneous thermal ablation (PTA) of unresectable hepatocellular carcinoma (HCC): a single-center experience

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Purpose

To determine the safety and efficacy of combined conventional transarterial embolization (cTACE) and percutaneous thermal ablation (PTA) in inoperable hepatocellular carcinoma (HCC).

Material and methods

Retrospective analysis of our database was conducted to identify patients with unresectable HCC who underwent cTACE followed by PTA from 2007 to 2016. cTACE was performed with a mixture of Lipiodol® (Guerbet, Villepinte, Fr), mitomycin, and polyvinyl alcohol particles (300–500 μm). PTA was performed with radio-frequency or microwave energy with Cool Tip® probes or Evident® antennas (Covidien, Dublin, Ireland). Efficacy was assessed by overall survival (OS), time-to-progression (TTP), and treatment response via mRECIST criteria. Safety was assessed according to Common

terminology criteria for adverse events (CTCAE) v4.0. Prognostic factors were tested using multiple linear regression analysis.

Results

Sixty-seven (n=67) patients were identified (14 females and 53 males) with unresectable HCC who underwent cTACE followed by PTA from 2007 to 2016. The mean age was 63.8 (44–84) years. The average MELD score was 9.6. Child–Pugh A, B, and C patients were 51 (76%), 15(21%), and 1(3%), respectively. The mean lesion size was 4.6 (1.3–16.2) cm. OS was 31.9 months with TTP of 13.7 months.

When stratified by lesion size, OS and TTP were as follows: lesions < 2 cm, 54.6 and 17.8 months; lesions between 2 and 3 cm, 27.3 and 12.4 months; lesions between 3 and 4 cm, 26.9 and 10.7 months; and lesions > 4cm, 33.6 and 16.2 months, respectively. OS and TTP stratified according to patient's stage (BLCL) were as follows for early (A), intermediate (B), advanced (C), and terminal (D) stages: 31.05 and 15.3 months, 38.4 and 17.1 months, 31.7 and 11.48 months, and 3.8 and 16 months, respectively.

At the 1-month follow-up imaging, 39 (58.2%) patients had complete response, 21 (31.3%) had partial response, and 6 (8.9%) had disease progression. Objective response was achieved in 60 patients (89.5%). Images were not available in one patient. Six complications were reported: three grade 1 (bradycardia), two grade 2 (seizure and pneumothorax), and one grade 4 (acute bleeding).

Conclusion

cTACE followed by PTA is an effective and safe treatment approach for unresectable HCC, with apparent advantage in patients at intermediate and advanced stages and those with larger lesions.

P-480

Evolution of the prostate gland volume and voiding symptoms after percutaneous irreversible electroporation (IRE) of prostate cancer

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Purpose

The objective was to document the evolution of the volume of the prostate gland after irreversible electroporation (IRE) of prostate cancer (Pca) and to evaluate voiding symptoms before and 6 months after treatment.

Material and methods

We retrospectively analyzed 19 IRE procedures (mean age 61 years). The prostate gland volumes before and 6 weeks, 3 months, 6 months, and 12 months after IRE were evaluated in the MRI scans. The voiding symptoms (weak urinary stream or sensation of incomplete emptying) were rated by the patients on a 5-point scale (1 = no problem; 2 = very small problem; 3 = small problem; 4 = moderate problem; and 5 = big problem) before and 6 months after IRE.

Results

There was a significant volume reduction of the prostate gland in the first 3 months after ablation. The mean percentage change after 6 weeks was 31% with another decrease of 34% after 3 months. Volume did not change between months 3 and 12. There was a significant reduction in voiding symptoms after 6 months (mean 1.2, max 2) compared with the pre-ablation values (mean 1.9, max. 5).

Conclusion

MRI showed a significant involution of the prostate gland during the first 3 months after IRE of Pca which was accompanied by a significant reduction of voiding symptoms. IRE may therefore be a treatment option for benign prostatic hyperplasia.

P-481

Extent of portal invasion in patients with HCC: the more, the worse

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Purpose

Portal vein invasion (PVI) is known to have a significant impact on the prognosis of patients with hepatocellular carcinoma (HCC). Nevertheless, the degree of invasion can vary from sub-/segmental invasion to complete occlusion of the main trunk of the portal vein (PV). The purpose of this study was to evaluate whether the degree of invasion correlates with an impaired prognosis.

Material and methods

A total of 763 patients with HCC were extracted from the clinical registry of our tertiary referral center as an ongoing effort to reevaluate the extent of PVI in all patients treated between Jan 2000 and Dec 2015. PVI was diagnosed by contrast-enhanced CT or MRI. The extent of PVI was documented by the Liver Cancer Study Group of Japan-classification ranging from Vp0 to Vp4: Vp0=no PVI, Vp1=segmental PVI, Vp2=right anterior or right posterior PVI, Vp3=right or left PVI, and Vp4=main trunk. Median overall survival (OS) was calculated for each Vp group.

Results

PVI was present in 259 patients, and 504 patients showed no sign of PVI. The patients with PVI were classified into Vp1–Vp4 in 12, 35, 88, and 124 cases. The corresponding median OS yielded 5.2, 5.6, 3.9, and 4.6 months for Vp1–Vp4, respectively. There was no significant difference between these PVI subgroups ($p > 0.05$). Median OS without PVI was 37.7 months, which was significantly longer compared to that with any type of PVI ($p < 0.001$).

Conclusion

PVI in patients with HCC is associated with a dismal prognosis. However, the extent of PVI itself has no significant impact; even a minor PVI leads to a very poor prognosis.

P-482

Percutaneous MR-guided tumour ablation of sub-centimetre hepatic metastases

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Purpose

Evaluation of feasibility, safety and effectiveness of MR-guided tumour ablation of small sub-centimetre hepatic metastases using a wide-bore 1.5-T MR system.

Material and methods

Between 02/2012 and 07/2016, 26 patients (59.8 ± 11.6 years) underwent 27 MR-guided tumour ablation procedures (17 radiofrequency ablation and 10 microwave ablation) for 27 hepatic metastases (17 colorectal carcinoma, 8 melanoma, 2 mamma carcinoma, 1 cholangiocellular carcinoma, and 1 germ cell tumour) with a tumour diameter ≤ 10 mm. The mean tumour size was 8.3 ± 1.2 (range: 6–10) mm. In 9 procedures, further metastases with a diameter > 10 mm were also treated. Planning, targeting, therapy monitoring and control imaging were performed using a 1.5-T MR system. Technical success was assessed by post-ablative contrast-enhanced MR imaging.

Technique effectiveness was assessed by a dynamic hepatic MR study after 1 month. The mean follow-up duration was 16.4 ± 11.4 (range: 4–42) months.

Results

In 3 out of 26 cases, a sub-centimetre metastasis was newly diagnosed during imaging for planning the treatment of another larger metastasis; thus, in these patients, both tumours were treated in the same procedure. Planning, targeting and therapy monitoring were conducted without application of contrast agent in 19/27 (70%) procedures. The sub-centimetre target tumour was visible in MR-fluoroscopic sequences in 16/27 (59%) procedures. Technical success and technique effectiveness were achieved in all lesions (100%). A pneumothorax occurred in one patient. Eight patients developed new tumour manifestation in the untreated liver during follow-up. Local tumour progression was not observed.

Conclusion

Besides detection of small hepatic metastases, MRI as a guidance modality enables targeting safe and effective percutaneous tumour ablation of sub-centimetre tumours.

P-483

MR-guided high-intensity focused ultrasound (MRgFUS) for the treatment of oligometastatic prostate cancer bone metastasis

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Purpose

With improvements in diagnostic modalities such as functional imaging, oligometastatic prostate cancer is being diagnosed with greater frequency than ever before. Our aim was to determine the ability of MR-guided high-intensity focused ultrasound (MRgFUS) in downstaging patients with oligometastatic bone disease with a single session of non-invasive metastasis-directed therapy.

Material and methods

The study was designed with the intention to treat metastatic bone lesions. Patients were enrolled if they had accessible bone metastasis and could safely undergo MRgFUS. Baseline measurable characteristics included dynamic contrast-enhanced MRI study (Gd-BOPTA: GE 750 3T magnet) with semiquantitative perfusion analysis, PSA level (ng/ml), and choline PET (SUV). Measurable variables were obtained during treatment and at the 3-, 12- and 24-month follow-up.

Results

Thirteen patients fulfilled the inclusion criteria and safely underwent MRgFUS for metastatic bone ablations. Lesions were located in the pelvis (9), scapula (2), and long bones (2). At baseline, all lesions showed a significant DCE perfusion (highly vascular) with mean perfusion reduction of 89% at 3 months (CI: 100–50; $p < 0.001$) which was stable in subsequent follow-up scans. Similarly PSA levels decreased from a mean baseline of 19 (ng/ml) to 6.4, 2.6, and 2 at the 3-, 12-, and 24-month follow-up, respectively. SUV values showed a similar trend with reduction from the baseline (mean 8.5 to 2.9, 2.3, and 1.7; $p < 0.001$). In all patients, a single session was appropriate without any major or minor adverse events reported.

Conclusion

MRgFUS is a totally non-invasive procedure that can obtain nearly complete bone ablation in patients with oligometastatic prostate disease. The technique can be of incremental value in a long-survivor subset of oncological patients, significantly reducing the risk of toxic effects.

P-484

Uterine fibroids treated with MRI-guided high-intensity focused ultrasound (MRgFUS): clinical outcomes in comparison to current therapeutic strategies

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Purpose

To prospectively evaluate clinical outcomes in patients affected by uterine fibroids and treated using MRI-guided high-intensity focused ultrasound (MRgFUS), uterine artery embolisation (UAE) or surgery.

Material and methods

In total, 570 women affected by symptomatic uterine fibroids were referred to our department for MRgFUS treatment. Pre-treatment evaluation assessed fibroids MR characteristics and MRgFUS eligibility. Overall, 166 of the 182 eligible patients (group A) were treated with MRgFUS, whereas 388 patients were ineligible. Of these, 33 patients underwent UAE (group B), 140 underwent myomectomy (group C) and 58 underwent hysterectomy (group D). Clinical efficacy for each treatment was determined by symptoms severity score (SSS) reduction from baseline to the 3- and 12-month follow-up. Further data concerning the number and type of complications, days of hospitalisation and days of convalescence were also compared.

Results

The MRgFUS group showed a mean SSS decrease of 24.6% at 3 months and 55.8% at 12 months. SSS decrease for UAE was 51.2% and 57.4%, for myomectomy 71.5% and 66.0% and for hysterectomy 96.6% and 94.5% at 3 and 12 months, respectively. The MRgFUS group had the least number of adverse events (1.8%), whereas the UAE group experienced the highest rate of adverse events (26.4%). Patients undergoing MRgFUS were treated in an outpatient setting, whereas the mean day for hospitalisation and convalescence were 3.1 ± 2 and 12.4 ± 9 days for group B, 4.5 ± 2 and 17.2 ± 12 days for group C and 4 ± 1 and 26.3 ± 14 days for group D, respectively.

Conclusion

The clinical efficacy of MRgFUS for uterine fibroid treatment was comparable with that of UAE and slightly lower than that of myomectomy. However, MRgFUS was performed in an outpatient setting and the complication rate was significantly lower than that of other treatments.

P-485

Renal cell carcinoma lung metastases treated by radiofrequency ablation: results based on 11 years of experience

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Purpose

To determine safety and efficacy of radiofrequency ablation (RFA) for the treatment of lung metastases of renal cell carcinoma (RCC).

Material and methods

All consecutive patients treated (over 11 years) with RFA for lung metastases of RCC were included. All sequences of treatments were considered. The endpoints were local efficacy and survivals: overall survival (OS), disease-free survival (DFS), and systemic treatment-free survival (STFS); complications were graded based on the CTCAE classification and factors associated with survival. Potential factors

analyzed were tumoral staging of TNM classification, primary tumor histology, Fuhrman grade, age, number and size of lung metastases, and extrapulmonary metastases pre-RFA.

Results

A total of 100 metastases were treated by RFA in 53 patients. Median follow-up time was 61 months (range 43–83). The 5-year OS rate was 62% [95% confidence interval (CI) 44%–75%]. Median DFS was 9.9 months (95% CI 6–16). Median STFS was 28.3 months (95% CI 17.8–83.1). Following the first RFA, 42 patients presented with disease progression; of these, 24 resumed systemic treatment, and 13 with lung recurrence could be treated by another RFA. We report 3% major complications (grade 3 and 4). Local efficacy was 91%. Of the nine patients with local recurrence, 7 received further treatment by RFA. T3/T4 tumors had poorer OS.

Conclusion

RFA is safe and effective for the treatment of lung metastasis from RCC with good OS. RFA is a safe alternative to surgery, offering the possibility of repeat procedures and enabling an STFS of 28 months.

P-486

Single-injection dual-phase cone-beam computed tomography (DP-CBCT) intraprocedural findings correlate with 1 month mRECIST results in the course of degradable starch microsphere TACE (DSM-TACE) for hypervascular HCC and metastatic colorectal cancer (mCRC)

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Purpose

To evaluate the role of dual-phase cone-beam computed tomography (DP-CBCT) in predicting 1-month mRECIST follow-up results of degradable starch microsphere TACE (DSM-TACE) for both hypervascular HCC and hypovascular metastatic colorectal cancer (mCRC).

Material and methods

DSM-TACE forecasts at least two sessions of embolization of each involved lobe. The imaging timeline included a pre-procedural MDCT within 1 month from the planned treatment, DP-CBCT prior to each session of DSM-TACE, and a final MDCT 1 month after completion of the entire embolization protocol. Lesion-to-liver contrast-to-noise ratio (LLCNR) and lesion-to-liver signal-to-noise-ratio (LLSNR) were measured on all datasets of images. Patients were categorized depending on whether they experienced a reduction in the measured value of LLCNR and LLSNR after the first and previous second embolization treatment and correlated with 1-month follow-up MDCT mRECIST response. Thirty consecutive patients (22 mCRC and 11 HCC) scheduled for DSM-TACE were prospectively enrolled in the study. DP-CBCT was performed in all cases with standard delay in acquisition (1st phase after 8 second and 2nd phase within 30 seconds) and intra-arterial injection was administered within the proper hepatic artery (parameter adjusted according to patient's vasculature caliber).

Results

Of the 33 patients, the 24 that experienced a significant reduction ($P < 0.05$) in the mean LLCNR and LLSNR values between the two sessions of DSM-TACE (measured by DP-CBCT) experienced an objective response (complete + partial response) to DSM-TACE treatment at the 1-month follow-up. The remaining 9 patients, who demonstrated no significant reduction ($P > 0.05$) in the mean LLCNR and LLSNR values between the two sessions of DSM-TACE, experienced stable or progressive disease at the 1-month follow-up imaging.

Conclusion

Intraprocedural DP-CBCT can predict the response to DSM-TACE for hypervascular mCRC and HCC indications.

P-487

Effectiveness of transarterial chemoembolization plus microwave ablation versus transarterial radioembolization in patients with hepatocellular carcinoma

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Purpose

To compare the effectiveness of TACE plus microwave ablation (MWA) versus transarterial radioembolization (TARE) in patients with hepatocellular carcinoma (HCC).

Material and methods

A retrospective study was conducted on patients treated with HCC between 2011 and 2015. TACE+MWA was used to treat 107 patients. TARE was administered to 29 patients. Twenty-nine patients from each group were matched according to tumor histology, tumor number, largest lesion size, Child-Pugh score (CPS), Eastern Cooperative Oncology Group performance score (ECOG), age, and sex. Cross-sectional imaging studies and clinical data were reviewed. Outcomes measured include the number of treatments provided, complication rate, hospital stay > 2 days, and 2-year survival. Treatment response was determined based on imaging findings.

Results

Among the overall unmatched patients, there was significant difference in the maximum lesion size (3.5 cm vs. 6.7 cm) between the TACE+MWA and TARE groups ($p < 0.0001$). There was no significant difference in tumor or treatment number in the matched patient population. Two-year survival was significantly higher with TACE+MWA (69.3%) compared to that with TARE (23.0%) in the matched population ($p < 0.0001$; HR 5.78, 95% CI 2.16 and 15.4, respectively). There was no significant difference in the complication rate or hospital stay > 2 days ($p = 0.16$ and 0.30, respectively). Partial response rate was greater in the TACE+MWA group (96% vs. 63%; $p = 0.004$). Complete response rate was also greater in the TACE group (36% vs. 0%; $p = 0.001$).

Conclusion

This study shows a greater 2-year survival and response rate, both partial and complete, in patients treated with TACE+MWA compared to those treated with TARE, without a significant difference in complication rates.

P-488

Clinical outcomes following pulmonary cryoablation utilizing a triple freeze-thaw protocol

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Purpose

To elucidate clinical variables that determine rates of recurrence and complications in patients post-cryoablation of pulmonary tumors utilizing a triple freeze-thaw protocol.

Material and methods

This retrospective case series included patients with pulmonary tumors who underwent percutaneous cryoablation utilizing a triple freeze-thaw protocol at our institution between February 2012 and June 2016. Ablation was performed using Galil Medical cryoprobes with a triple freeze-thaw protocol under CT guidance.

Results

Sixty-seven nodules were ablated in 42 patients with an average follow-up of 326 days. Pneumothorax occurred in 19 (34%) patients; 7

(13%) patients required chest tubes, the likelihood of which was significantly greater in patients with more cryoprobes ($p < 0.01$) or with emphysema ($p < 0.05$). The ablation zone correlated with the number of cryoprobes ($p < 0.01$), but not with the size of the nodule or the distance to a major vessel. Two patients underwent pulmonary function testing before and after cryoablation; the average reduction in FVC and FEV1 was 10% and 6%, respectively. Tumor recurrence/residual disease occurred in 6 (9%) patients; no contributing factor was identified for predicting recurrence (tumor pathology, number of cryoprobes, ablation volume, distance to the vessel, or distance to pleura).

Conclusion

Cryoablation of pulmonary tumors is a viable modality with low recurrence and complication rate.

P-489

Signature of survival: a pretreatment 18F-FDG PET/CT-based whole-liver radiomic score predicts survival after 90Y TARE for unresectable hepatocellular carcinoma

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Purpose

To generate a predictive radiomics scoring system for progression-free survival (PFS) and overall survival (OS) in patients undergoing transarterial radioembolization using yttrium-90 (90Y TARE) for unresectable hepatocellular carcinoma (uHCC).

Material and methods

Pretreatment 18F-FDG PET/CT of 47 consecutive patients undergoing 90Y TARE for uHCC (31 resin and 16 glass) were retrospectively analyzed. For each patient, based on radiomics signature from whole-liver semi-automatic segmentation, PFS and OS predictive PET-radiomics scores (pPET-RadScores) were obtained using LASSO Cox regression. Using X-tile software, the optimal score to predict PFS (PFS-pPET-RadScore) and OS (OS-pPET-RadScore) served as cut-off to classify high- and low-risk patients. Survival curves were estimated using the Kaplan-Meier method. The prognostic value of PFS- and OS-pPET-RadScores, Barcelona Clinic Liver Cancer (BCLC) staging system, and serum alpha-fetoprotein levels were analyzed to predict PFS and OS in multivariate analysis.

Results

The generated pPET-RadScores were significantly correlated with survival for PFS [median of 10.2 mo [95% confidence interval (CI): 7.3–13.1 mo] in the low-risk group (PFS-pPET-RadScore < 0.13) vs. a median of 6.1 mo (95% CI: 3.1–9.2 mo) in the high-risk group (PFS-pPET-RadScore > 0.13 ; $P = 0.007$] and OS [median of 30.9 mo (95% CI: 0.8–61 mo) in the low-risk group (OS-pPETRadScore < -0.07) vs. 8.9 mo (95% CI: 6.7–11.1 mo) in the high-risk group (OS-pPET-RadScore > -0.07 ; $P = 0.015$]. The multivariate analysis confirmed PFS-pPET-RadScore [hazard ratio (HR): 30.3, 95% CI: 2.89–317; $P = 0.004$] and OS-pPET-RadScore (HR: 15.4, 95% CI: 2.97–79.7; $P = 0.001$) as independent negative predictors.

Conclusion

Pretreatment 18F-FDG PET/CT whole-liver radiomics signature appears as an independent negative predictor for PFS and OS in patients undergoing 90Y TARE for uHCC.

P-490

Comparison between clinical outcomes of radiofrequency ablation and cryoablation for cT1b renal cell carcinoma: a multicenter study

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Purpose

To retrospectively compare clinical outcomes of radiofrequency ablation (RFA) and cryoablation for the treatment of cT1b renal cell carcinomas (RCCs).

Material and methods

Data of 45 patients (38 males and 7 females; median age, 74 years; range, 39–87 years) with 45 RCCs measuring 4.1–6.5 cm (median, 4.5 cm) were acquired from 3 institutions. RFA and cryoablation were performed percutaneously for 23 and 22 patients, respectively. Transarterial embolization was performed before RFA and cryoablation in 8 (35%, 8/23) and 9 (41%, 9/22, $p = 0.10$) patients, respectively. Technical success, safety, local tumor progression, and survival were evaluated. Safety was evaluated using CTCAE ver. 4.0.

Results

Tumors were completely ablated by 1st RFA and cryoablation in 15 (65%, 15/23) and 21 patients (95%, 21/22), respectively, with a significant difference in the initial technical success rate ($p = 0.02$). There was no significant difference in the secondary technical success rate achieved by an additional RFA (91%, 21/23) and cryoablation (100%, 22/22), respectively ($p = 0.49$). Transient Grade-3 liver enzyme elevation developed in 1 patient after RFA (4%, 1/23) and 2 patients after cryoablation (9%, 2/22) ($p = 0.61$). Local tumor progression developed in 5 patients (22%, 5/23) and 2 patients (9%, 2/22) after RFA and cryoablation, respectively ($p = 0.41$). No patients died of RCC progression during the median follow-up of 11.6 months (range, 1–87 months). The 2-year overall survival rates after RFA and cryoablation were 94.1% [95% confidence interval (CI), 65.0%–99.2%] and 94.4% (95% CI, 66.6%–99.2%), respectively ($p = 0.93$).

Conclusion

RFA and cryoablation showed almost the same clinical outcomes for the treatment of cT1b RCC other than the initial technical success rate.

P-491

Evaluation of CT-guided pulmonary nodule localization techniques before thoracoscopic wedge resection

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Purpose

To study a better technique for CT-guided pulmonary nodule localization before thoracoscopic wedge resection.

Material and methods

From 2013 to 2016, the patients who underwent CT-guided pulmonary nodule localization were retrospectively reviewed. An 18-G introducer needle was used for hookwire marking and 22-G Chiba needle for methylene blue labeling. Analysis was made based on the presence of background lung disease, nodule size, nodule distance from the pleural surface, location, complication, time delay from localization procedure to operation, success of intrathoracoscopic

nodule detection, operation time, and histology. Degree of complication was assessed using post-interventional CT images.

Results

In all, 20 patients (10 men; age, 60.1 ± 10.0 [M $\pm$ SD] years) underwent CT-guided pulmonary nodule localization with hookwire marking (Group A; n=13) or methylene blue labeling (Group B; n=7). The mean nodule size was 1.3 ± 0.6 cm [M $\pm$ SD] and 0.9 ± 0.6 cm [M $\pm$ SD] for Group A and Group B, respectively.

Both groups demonstrated comparable success rates (Group A=71.4%, Group B=76.9%; $p=0.073$) of intrathoroscopic nodule detection. However, the methylene blue group demonstrated significantly lower complication rates ($p<0.05$) in terms of mild hemorrhage (0% vs 15.4%), asymptomatic pneumothorax (28.6% vs 61.5%), and large pneumothorax requiring chest drain insertion (0% vs 15.4%). Reasons behind the differences in complication rates, causes of successful localization, and factors to be considered when choosing the appropriate method for localization were discussed.

Conclusion

CT-guided methylene blue labeling of pulmonary nodules is therefore as effective as hookwire marking for intrathoroscopic nodule detection and is associated with lower rate and milder degree of complications.

P-492

Clinical application of CT-guided interstitial ^{125}I seed implantation for treatment of adrenal malignant carcinoma

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Purpose

To investigate the technique of CT-guided interstitial ^{125}I seed implantation for adrenal malignancies and its clinical value.

Material and methods

Ten patients with unilateral adrenal malignant carcinoma were given CT-guided interstitial ^{125}I seed implantation treatment. A three-dimensional treatment planning system was used to simulate seed distribution before the procedure. The transhepatic approach was used in two patients, the transperirenal space by posterior approach in four patients, and the transpleural cavity after artificial pneumothorax approach in four patients. CT scans were performed every 2 months after the operation to evaluate local therapeutic efficacy according to the Response Evaluation Criteria of Solid Tumors.

Results

The average follow-up time was 17.9 months (2–46 months). The average maximum tumor diameter initially was 3.27 cm, and it was 0.35 cm at the end of the follow-up. Complete remission occurred in six cases, partial remission in three cases, and stable disease in one case, giving a remission rate (complete remission + partial remission) of 90%.

Conclusion

CT-guided ^{125}I radioactive seed implantation has significant therapeutic effects for adrenal malignant carcinoma and is a feasible, safe, effective, and minimally invasive treatment method.

P-493

Does ultrasound guidance improve the efficacy of pulsed radiofrequency therapy for the stellate ganglion in patients with refractory neuropathic pain syndromes

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Purpose

To assess the efficacy and safety of ultrasound (US)-guided techniques in pulsed radiofrequency (RF) therapy for the stellate ganglion in patients with refractory neuropathic pain syndromes.

Material and methods

Forty patients with severe chronic neuropathic pain syndromes, visual analogue scale (VAS) score > 7 , and poor response to medical treatment were randomly classified into 2 groups: group U: (20 patients) in whom US-guided pulsed RF therapy was performed and group F: (20 patients) in whom fluoroscopy-guided pulsed RF therapy was performed.

Results

Our study revealed that there was significant reduction in the VAS score and medical treatment consumption after the block compared with those before the block, but there was no statistically significant difference between the guidance techniques used in RF treatment with respect to pain relief. However, the procedure time was significantly lower in group U and with less complication rate.

Conclusion

US-guided pulsed RF blockade of the stellate ganglion in patients with refractory neuropathic pain syndromes can be performed safely and efficiently, with less procedure time, less complication rate, and no X-ray exposure.

P-494

Comparison between fluoroscopy-guided posterior approach versus ultrasound-guided anterior approach for superior hypogastric plexus neurolysis: a prospective, randomized, comparative study

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Purpose

This study compared the safety and efficacy of the ultrasound (US)-guided anterior approach for superior hypogastric plexus (SHP) neurolysis with the fluoroscopy-guided posterior approach in the management of patients with intractable pelvic cancer pain.

Material and methods

Thirty patients with advanced-stage pelvic cancer were enrolled and divided into two equal groups: group F, which included 15 patients in whom SHP block was performed using the fluoroscopy-guided posterior approach and group U, which included 15 patients in whom SHP block was performed using the US-guided anterior approach. Visual analogue scale score, patient satisfaction score, and daily morphine consumption were assessed at the following time points: before the procedure and on the 1st day, 1st month, and 3rd month after the procedure. Any adverse effects of the procedure were also recorded.

Results

Visual analogue scale score and daily morphine consumption were significantly decreased at the 1st day, 1st month, and 3rd month after the procedure compared with those before the procedure. Patient satisfaction score significantly improved on the 1st day, 1st month, and 3rd month after the procedure compared with that before the procedure.

Conclusion

The present study demonstrated a comparable efficacy of the US-guided anterior approach for SHP neurolysis in patients with advanced pelvic cancer pain with the standard, classic, fluoroscopy-guided posterior approach.

P-495

Radiofrequency ablation of malignant pleural mesothelioma plaque

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Purpose

Patients with malignant pleural mesothelioma often develop pain symptoms because of chest wall infiltration. We experienced a new palliative therapy using radiofrequency ablation.

Material and methods

We have included 15 patients in our study. Using CT guidance after placing the patient second the most suitable decubitus, a needle for radiofrequency ablation was positioned into the target lesion. The average length of each cycle of treatment was approximately 8 minutes. After removing the needle, a control CT was performed; then the patient was discharged after an observational period of approximately 2 hours.

Results

Using VAS and Karnofsky scales to assess the degree of pain and performance status before and after treatment, we obtained the following results: no mortality within 30 days after treatment nor any complications that required prolonged hospitalization or surgical or radiological intervention; only in one case (6.7 %), protracted pain symptoms required the intervention of the anesthesiologist. All patients were submitted to a CT re-evaluation at 1 month after the procedure. Dimensional stability of the treated lesion has been demonstrated in 93.3% cases. Re-evaluation by VAS and Karnofsky scales showed a good resolution of pain symptoms and reduced degree of invalidity. In the remaining case (6.7%), the CT control showed dimensional growth of the lesion with worsening of discomfort and disability.

Conclusion

The possibility to use a minimally invasive procedure repeatedly could make the radiofrequency treatment a valid tool for controlling pain symptoms in selected cases.

P-496

Multiple-electrode radiofrequency for paraesophageal tumor in rabbits: a preclinical experiment for safety and efficiency

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Purpose

To evaluate the safety and efficiency of intra-esophageal multiple-electrode radiofrequency in rabbits with paraesophageal tumors.

Material and methods

Using the percutaneous puncture technique, VX2 fragments were implanted into the space between the esophagus and trachea at the level of the thyroid in 24 adult rabbits. Then, the rabbits were equally randomized into 2 groups and treated with intra-esophageal multiple-electrode radiofrequency under image guidance (Group A) or sham radiofrequency (Group B), respectively. Rabbits were observed until their natural death. Pathological changes in the esophagus were examined for all rabbits after their deaths.

Results

Two severe complications were caused by radiofrequency, and one led to death by suffocation. There was no other severe procedure-related complication after radiofrequency. The rabbits in Group A survived longer than those in Group B (mean survival time: 23.4 ± 6.8 days vs. 18.0 ± 4.3 days, $P < 0.05$). The pathological examination showed no obvious changes in the structure of the esophagus.

Conclusion

Intra-esophageal radiofrequency could prolong the life of rabbits with paraesophageal tumors. There could be severe complications. More researches should be conducted to find an appropriate temperature range of intra-esophageal radiofrequency.

P-497

Radiofrequency ablation as an alternative minimally invasive treatment for locoregional control of recurrent thyroid carcinoma

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Purpose

In recurrences from differentiated thyroid cancer and medullary thyroid carcinoma, which do not concentrate radioactive iodine, surgery is the most effective therapeutic option. However, surgical removal is difficult for cases with previous neck dissections. The aim of our study was to evaluate radiofrequency ablation (RFA) as an alternative treatment for recurrent thyroid cancers.

Material and methods

Thirteen patients with recurrent thyroid cancer were included in our study. All patients refused or were excluded from revisional surgery or other conventional therapy because of comorbidities and/or contraindications. CT and US examinations (B-mode and contrast-enhanced US) were performed to evaluate lesion volumes and vascularization before RFA. All RFA procedures were performed using an 18-gauge, internally cooled, single-tip electrode with a 10-mm active tip. Contrast-enhanced US and CT were used to evaluate the response to therapy at 6-month intervals. Serum marker levels (thyroglobulin or calcitonin) were assessed before and 6 months after the procedure.

Results

RFA was well tolerated by all patients; in 2 cases, permanent paralysis of the laryngeal nerve was observed. In one case, a transitory hoarseness was recorded. The mean pretreatment volume was 4.18 ± 3.53 ml. The vital tumor tissue and percentage of necrosis at 6, 12, and 18 months were 0.18 ± 0.25 ml, 0.11 ± 0.13 ml, and 0.29 ± 0.40 ml, respectively, and $91.9\% \pm 11.1\%$, $90.4\% \pm 13.3\%$, and $80.8\% \pm 23.1\%$, respectively. The mean volume reduction rates at the same time intervals were $69.0\% \pm 16.6\%$, $78.6\% \pm 15.1\%$, and $67.1\% \pm 11.6\%$, respectively.

Conclusion

RFA might be considered as a reliable, alternative minimally invasive treatment for recurrent thyroid cancers when conventional therapies fail.

P-498**Effect of MRI-guided high-intensity focused ultrasound on local control of bone metastases**

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Purpose

To provide evidence regarding the effect of MRgFUS on local tumor control of bone metastases.

Material and methods

Patients with painful bone metastases were enrolled and underwent MRgFUS, with imaging (CT/MRI) before and 3, 6, and 12 months after treatment. The primary endpoint was the number of lesions with partial or complete response at 3 months according to the MD Anderson criteria.

Results

Of 105 patients, 18 were lost and missed the 3-month imaging check. Eighty-seven patients with 89 lesions were evaluated. The procedure was successful in terms of local control at 3 months in 53 lesions (49%): complete in 31 and partial in 22. A stable disease was observed in 16 lesions, and progression in 10. Lesions with an osteolytic (or mixed) pattern, with complete accessibility of the margins to the ultrasound beam, are perfect candidates for ablation with the intent to control the lesion. Results were statistically independent of histology (primary cancer) and previous radiation therapy (59%). When accessibility was guaranteed, the only element influencing the outcome was the size of the lesion (up to 16 cm), with 7 cm as a reasonable cutoff for successful ablation, $p < 0.01$. Body mass index, age, and sex did not play a role in the final outcome.

Conclusion

MRgFUS for painful bone metastases may achieve a local control of the lesion. In future, this opportunity should be further explored and addressed even in patients with a potential primary intent of tumor ablation.

P-499**Systematic review of superior vena cava stenting for malignant and benign pathology: how strong is the evidence**

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Purpose

Over the past 30 years, over 1000 cases of SVC stent placement have been described. Despite its extensive use, the evidence base for the practice is limited to case series only, with no RCT data thus far. We, herein, systematically review the literature pertaining to SVC stent placement for the treatment of both benign and malignant SVCs.

Material and methods

Studies fulfilling our search criteria were filtered from Medline, Cochrane, and Embase databases using the key terms SVC, obstruction, and stent. Inclusion and exclusion criteria were followed to select suitable studies. Selected articles were retrieved and data were extracted in accordance with the outcome parameters of interest. Individual case reports or studies that describe fewer than five patients were excluded.

Results

Fifty-seven papers met inclusion criteria, providing a cumulative patient pool of 2096 patients. A malignant etiology was present in 86.1% cases. There was a mean technical success rate of 88.6% (1857/2096), which translated into a clinical success rate of

84.9%. Majority of the stents deployed were stainless steel stents. The primary patency (until death or alternatively at 1-year follow-up in benign conditions) was observed in 83.8% of patients with a weighted average symptom-free period of 8.41 months. There was a net complication rate of 8.2% and a 30-day mortality rate of 3.6%.

Conclusion

This review encompasses the largest combined cohort of patients with SVCs thus far and allowing for variations in outcome definition, underlines the benefits of SVC stent therapy in both benign and malignant conditions.

P-500**Carbon dioxide (CO₂) as an alternative contrast agent for diagnostic angiography and vascular intervention**

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Learning Objectives

To evaluate the role of CO₂ in diagnostic angiography and vascular intervention as a contrast agent alternative to iodinated contrast in patients with renal failure or severe allergic reaction.

Background

CO₂ was used as a contrast agent, particularly in patients who were hypersensitive to iodinated contrast material or whose renal function was compromised since years. Recently, with the availability of high-resolution DSA and a reliable gas delivery system, CO₂ angiography has become widely used to guide various vascular interventions, including angioplasty and stent placement.

Clinical Findings/Procedure

In 2016, 28 patients were examined using CO₂ angiography in our department; about 20% of them underwent above-knee angioplasty. All the patients had contraindication to the use of iodinated contrast: critical renal function or previous severe reaction to iodinated contrast. Most of the angiography was performed using the transbranchial approach; selective CO₂ angiography of the iliac, femoral, and below-knee arteries was also performed. For angioplasty in the iliac artery, selective transbranchial angioplasty was performed; for angioplasty in the femoral and below-knee arteries, the ipsilateral antegrade approach was used. Image summation techniques were used to improve the quality and accuracy of the angiography image. The most important complication was pain experienced during CO₂ injection.

Conclusion

The use of CO₂ as a contrast agent for angiography and interventions pertaining to the iliac, femoral, and popliteal arteries in patients who have a contraindication to iodinated contrast material seems to be safe, useful, and effective compared with the use of iodinated contrast. However, the use of CO₂ for below-knee arteries is less effective.

P-501**How to perform hepatobiliary and gastrointestinal interventions using a transradial approach**

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Learning Objectives

1. To learn how to obtain a safe transradial access, including patient preparation, patient selection and techniques.
2. To be aware of the various limitations of this approach.

Background

The transradial approach is commonly used in coronary interventions. But its role in hepatobiliary and gastrointestinal interventions, such as transarterial chemoembolisation, transarterial radioembolisation and stenting/embolisation of mesenteric vessels, needs to be established. Although technically there may be some challenges, there are significant advantages associated with its use. It is a viable alternative to the traditional transfemoral approach.

Clinical Findings/Procedure

We will present steps involved in obtaining a safe transradial access. We will discuss the pre-procedural clinical tests needed to ensure proper patient selection along with various equipment such as sheaths and catheters that are required. The discussion will also cover the actual technique involved in obtaining the access. We will also present various challenges that one will encounter and how these can be circumvented. The latest technology will also be discussed, thereby highlighting the advances in this technique. Various images from our clinical experiences will also be presented, which will illustrate various aspects in detail.

Conclusion

For an experienced interventionalist, the learning curve for obtaining a safe transradial access is short. It offers a host of advantages that range from tackling challenging anatomy to improving patient satisfaction.

P-502

The thyrocervical trunk and its relevance in endovascular therapeutic procedures

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WITHDRAWN

P-503

Usefulness of fusion cone-beam computed tomography (CBCT) imaging for detection of residual tumor in hepatocellular carcinoma patients treated with conventional TACE

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Learning Objectives

In conventional transarterial chemoembolization (cTACE), the high attenuating retained ethiodized oil may obscure arterially enhancing tumors and limit the detection of residual tumors. Hyperattenuation within or around the treated zone can be observed after cTACE due to beam-hardening artifacts and may mimic residual tumors. Thus, many attempts have been made to improve the visualization of residual viable tumors. This report describes fusion imaging of unenhanced and contrast-enhanced arterial phase cone-beam CT (CBCT). The fusion technique was applied in 40 known hepatocellular carcinoma (HCC) patients undergoing repeated TACE; it significantly improved diagnostic performance compared with that of pre-procedural MDCT.

Background

To investigate the diagnostic efficacy of the fusion imaging of unenhanced and contrast-enhanced CBCT in comparison with that of MDCT for the detection of marginally viable tumors in HCC patients previously treated with cTACE.

Clinical Findings/Procedure

Viable tumor was depicted in 26 of the 166 study lesions by post-procedural lipiodol CBCT. The sensitivity, specificity, positive and negative predictive values, and accuracy of fusion imaging were 92.31%,

97.14%, 85.71% and 98.55%, and 96.39%, respectively. In the detection of viable tumors, the diagnostic performance of CBCT was better than that of MDCT.

Conclusion

Fusion CBCT imaging is a valuable tool to detect viable tumors in HCC patients treated with TACE.

P-504

Osteoid osteoma: state of art of the most common nonsurgical treatment

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Background

Osteoid osteoma is a bone-forming lesion (10% of all bone tumors) that has a low tendency to expand; it affects young people aged between 10 and 25 years. It is histologically characterized by a central nidus made of osteoblasts and the osteoid with peripheral nerve and vascular supply. Primary sites are the cortical long bones; 10% of lesions are in the axial skeleton, and lesions are rarely on the extremities. Clinically, osteoid osteoma is characterized by pain, mainly at night, and it typically responds to ASA or NSAIDs.

Clinical Findings/Procedure

The use of image-guided minimally invasive treatment methods is advantageous for sparing adjacent structures and locating lesions during the procedure. Percutaneous thermal ablation represents the gold standard treatment of osteoid osteoma. The procedure is performed under deep sedation. Ablation is performed for 8 minutes at a temperature of 80°C for unipolar RFA, with primary success between 87% and 96%. MWA and HIFU offer potential methodological and technical advantages, and their clinical results are similar. As far as therapeutic success is concerned, the various ablative techniques are practically the same.

Conclusion

Percutaneous ablation is the gold standard treatment of osteoid osteoma owing to the low complication rate, short rehabilitation time, and low costs combined with the high success rate.

P-505

Fibrillar collagen injection for organ protection during thermal ablation of hepatic malignancies

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Background

Fibrillar collagen has been successfully used as a hemostatic agent during surgical resections and is injected percutaneously. When mixed with fluids, including contrast medium and saline, fibrillar collagen forms an evenly consistent slurry, which may be readily controlled and delivered in a manner to enable safe organ separation during ablation. Moreover, fibrillar collagen is not absorbed as rapidly as fluid or gas and has the potential to aid in hemostasis or healing if an injury occurs.

Clinical Findings/Procedure

Fibrillar collagen, dissolved in 9 mL normal saline and 1 mL iodinated contrast medium, was injected to displace at-risk organs. Intraprocedural computed tomography imaging was performed to confirm that all at-risk organs were displaced from the ablation zone. In all cases, microwave ablation was performed under 40–60 Watts for 12–15 minutes to cover all lesions.

Conclusion

Fibrillar collagen may be advantageous because only a small volume is necessary, separation is durable, and the presence of collagen may facilitate hemostasis and healing in case of an injury.

P-506

Stereotactic body radiation therapy for oligometastatic colorectal cancer: an illustrated overview for interventional radiologists

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Learning Objectives

1. To review the clinical inductions and outcomes of stereotactic body radiation therapy (SBRT) for oligometastasis from colorectal cancer (CRC).
2. To highlight with illustrated clinical cases the role of interventional radiologists (IRs) in optimizing SBRT for oligometastatic CRC disease.

Background

Surgical resection of oligometastatic CRC disease can prolong survival. However, patients may not be ideally suited for surgery owing to the inability to discontinue chemotherapy preoperatively or due to other comorbidities or they may prefer a less invasive therapy to maintain their quality of life. Recently, SBRT has emerged as a local non-invasive ablative therapy that provides good to excellent local control with minimal morbidity in both curative and palliative settings based on published retrospective and prospective studies. IRs are playing an increasing role in collaborating with radiation oncologists in planning and delivering safe and effective SBRT. IRs with their invaluable expertise and technical skills can facilitate such a therapy by enhancing the target discrimination for precise irradiation to the target lesion volume at different disease sites while minimizing the irradiation of normal tissues.

Clinical Findings/Procedure

The poster will provide an overview of SBRT in the management of oligometastatic CRC focusing on the following: clinical indications and patient selection, clinical outcome, role of IRs with clinical cases as illustrations, and future directions.

Conclusion

SBRT is an effective and less toxic local non-invasive therapy for oligometastatic CRC. IRs should be aware of clinical indications and technical aspects of SBRT and understand their role in facilitating and optimizing such a therapy in selected patients with oligometastatic CRC.

P-507

Transarterial radioembolization of hepatocellular carcinoma: how to interpret post-treatment imaging

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Learning Objectives

1. To review the most relevant therapy-induced effects exerted by transarterial radioembolization (TARE) on hepatocellular carcinoma (HCC) and surrounding liver parenchyma.
2. To illustrate the most common imaging findings on post-treatment cross-sectional imaging (CT and MR) useful for predicting tumor responses.
3. To understand the main limitations of the current criteria for tumor response assessment (RECIST 1.1, mRECIST) and assess the role of dual-energy CT in evaluating treatment efficacy.

Background

TARE is increasingly used in selected patients with HCC when curative treatments are not indicated. TARE distinctively exploits the effects of radiation on the lesion(s) and surrounding liver parenchyma, with a reduced embolizing effect. This singular peculiarity implies unconventional findings on cross-sectional imaging following TARE, which may lead to diagnostic issues and concerns affecting the correct determination of the therapeutic response.

Clinical Findings/Procedure

The most common post-treatment findings include modification of tumoral size and densitometry (necrosis and presence/lack of contrast enhancement); however, the sole evaluation of morphological features may not reflect the efficacy of TARE. Benign treatment-related findings include peritumoral edema and ring enhancement, perivascular edema, liver hypertrophy, hepatic fibrosis with possible capsular retraction, and portal hypertension. Further elements considered suggestive of favorable responses to TARE are increased water diffusion on diffusion-weighted MR imaging and reduction of serum tumor markers. Dual-energy CT seems to be a promising tool in evaluating tumor response to TARE.

Conclusion

The proper evaluation of treated lesions following TARE may represent a challenge, but the knowledge of peculiar treatment-related imaging findings together with the evaluation of functional biomarkers allows a reliable assessment of treatment effectiveness.

P-508

Hemodynamic change in balloon-occluded transarterial chemoembolization (B-TACE): determining a good candidate for B-TACE

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Learning Objectives

1. To learn potential arterio-arterial communications in the liver.
2. To understand the hemodynamic changes after balloon occlusion.
3. To discuss the advantage and limitation of B-TACE.

Background

Recently, a selective microballoon catheter, which coaxially advances through a usual 4F diagnostic catheter, was developed, making it possible to perform selective balloon-occluded transarterial chemoembolization (B-TACE) for HCC. B-TACE is reported to show good results. However, satisfactory results have not been obtained in some cases. Hemodynamic changes through arterio-arterial communications occur just after balloon occlusion, which plays an important role in B-TACE. This presentation shows the hemodynamic changes after balloon occlusion.

Clinical Findings/Procedure

We present some typical cases of hemodynamic changes after balloon occlusion.

We performed selective arteriography before and after balloon occlusion for confirmation of tumor stains. When the tumor stain was unclear, CT during selective arteriography was additionally performed. In majority of the cases, tumor stains were enhanced or stable. They are good candidates of B-TACE. In some cases, tumor stains partially or completely disappeared after balloon occlusion compared to those before balloon occlusion. These were not considered to be good candidates. Balloon occlusion induced hemodynamic changes such that the tumor feeding artery switched to the other non-selected artery. This phenomenon preferably occurred when the tumor was in segments 1 and 4, which correspond to large arterio-arterial communications like the communicating arcade.

Conclusion

Confirmation of tumor stains after balloon occlusion by arteriography with/without CT is necessary before B-TACE.

P-509

Percutaneous microwave ablation of renal tumours: a pictorial review

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Learning Objectives

1. To demonstrate the radiological results of the new-generation microwave ablation (MWA) system (Emprint Ablation System[®] with Thermosphere Technology[®], Covidien, Boulder, CO) following treatment of a diverse range of renal tumours.
2. To highlight the importance of pre-procedural planning to obtain an adequate ablation zone and estimate the most effective ablation time and power using the Emprint Ablation System[®].
3. To describe different techniques and approaches used to effectively ablate challenging renal tumours.

Background

Thermal ablation has an important role in the management of small renal cancers. RFA is currently the most common ablative modality used to treat such tumours. Previous MWA technology had certain technical limitations resulting in unpredictable ablation zones. Recent technical improvements enable the production of more predictable spherical or oval ablation zones, with better-defined margins.

Clinical Findings/Procedure

We present our clinical experience with a new generation MWA system, which we have used to treat a wide range of renal tumours in terms of size and location using different percutaneous approaches sometimes combined with hydrodissection. All procedures were performed using the Emprint Ablation System[®] with CT guidance under general anaesthesia or conscious sedation. The system allows the ablation time and power to be adjusted according to the size of the tumour. The appearance of the resulting areas of coagulation is illustrated in this exhibit.

Conclusion

We have demonstrated that the Emprint MWA System[®] with Thermosphere Technology[®] is an effective and safe system for the management of T1a and certain T1b renal tumours. It has a relatively short ablation time and allows the adjustment of the ablation zone according to the size and location of the tumour.

P-510

Liver function tests: a primer for the interventional radiologist

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WITHDRAWN

P-511

MD-CT-guided percutaneous needle biopsy of lung lesions: anatomic considerations, different approaches, and techniques

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Background

MD-CT-guided percutaneous needle biopsy of lung lesions is a safe and effective technique for tissue diagnoses. MD-CT-guided percutaneous needle biopsy allows access to lesions at virtually all lung locations. The direct lung approach is the preferred method because it is the easiest and rapidest technique. Extraleural needle placement techniques are more complex, but they avoid the risk of pneumothorax.

Clinical Findings/Procedure

The aim of this poster is to 1) illustrate anatomic considerations of the lung and all approaches/techniques used for imaging-guided lung biopsy and 2) discuss technical aspects, advantages, limitations, and complications of each approach/technique.

Conclusion

A better knowledge of the lung anatomy by MD-CT facilitates planning of a safe and effective percutaneous access for needle biopsy, particularly in deep lesions. Various techniques such as the injection of physiological saline solution and use of positional maneuvers may avoid visceral pleura puncture, thereby decreasing the risk of possible complications.

P-512

Percutaneous image-guided thermal ablation for multifocal renal cell carcinoma: a 10-year experience at a single center

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Learning Objectives

To discuss the technical success, safety, and oncological and renal function outcomes of computed tomography (CT)-guided percutaneous thermal ablation for synchronous multiple renal masses in a single session.

Background

Surgical interventions for multifocal renal cell carcinoma (RCC) must be balanced between tumor eradication and preservation of renal function. A paradigm shift to non-surgical therapies of small renal masses (<4 cm) favors the use of thermal ablation over surgical methods. Thermal ablation with radiofrequency ablation, microwave ablation, or cryoablation may have a role in the management of multifocal RCC.

Clinical Findings/Procedure

Biopsy-proven RCC was treated in 23 patients. Mean tumor size was 2.3 cm (range=1.0–4.6 cm), with a mean RENAL nephrometry score of 6.3 (range=4.0–10.0), mean PADUA score of 7.8 (range=6.0–11.0), and mean centrality index (c-index) of 3.1 (0.7–6.8). Mean ablation time was 23 minutes (range=3–24 minutes). Technical success was achieved for 100% of tumors. There were 9/49 (18 %) Clavien-Dindo grade I complications. Complete response was achieved in 41/49 (84 %) of tumors. Local progression free, RCC-specific, and

overall survival rates during the imaging follow-up time (mean=3.1 years, range=0.1–9.6 years) were 96% (22/23), 100% (23/23), and 92% (21/23), respectively.

Conclusion

CT-guided percutaneous thermal ablation is a safe, effective, and durable treatment intervention for multifocal renal masses.

P-513

Salvage thermal ablation of locally recurrent renal cell carcinoma following nephrectomy: assessment of safety and durability of clinical outcomes

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Learning Objectives

To discuss the technical success, safety, and durability of clinical outcomes of image-guided percutaneous thermal ablation as salvage therapy for recurrent renal cell carcinoma following nephrectomy.

Background

Approximately 20%–40% of patients who undergo nephrectomy for renal cell carcinoma (RCC) develop recurrent disease. To date, no consensus treatment protocols exist for locally recurrent RCC. Image-guided thermal ablation with radiofrequency ablation (RFA), microwave ablation (MWA), or cryoablation may have a role in managing recurrent RCC after nephrectomy.

Clinical Findings/Procedure

Eleven biopsy-proven RCCs were treated with salvage ablation for partial (3/11) or radical nephrectomy (8/11). Mean tumor size was 2.8 cm (range=1.4–3.9 cm), with a mean RENAL nephrometry score of 5.6 (range=4.0–10.0), mean PADUA nephrometry score of 7.2 (range=6.0–12.0), and mean centrality index (C-index) score of 2.3 (range=0.6–4.4). No significant changes were observed between the preablation, postablation, and last follow-up values of BUN (p=0.21), creatinine (p=0.10), and eGFR (p=0.21). Technical success was achieved for 91% of tumors. There was 1/11 (9%) mild asymptomatic intraoperative hemorrhage (Clavien–Dindo grade I complication). Complete response was achieved in 10/11 (91%) tumors. Local progression-free, RCC-specific, and overall survival rates during the imaging follow-up time (mean=28 months, range=0.7–84.9 months) were 10/11 (91%), 11/11 (100%), and 11/11(100%), respectively.

Conclusion

Image-guided percutaneous thermal ablation is a safe, effective, and durable salvage treatment option for recurrent renal masses following nephrectomy.

P-514

Interventions in the caudate lobe: ways to overcome this challenge

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Learning Objectives

To understand caudate lobe anatomy and how to use its particularities for developing interventional procedures for the ablation of this difficult portion of the liver.

Background

Lesions in the caudate lobe are challenges for the interventional radiologist given its deeper location and presence of multiple noble vascular structures, such as the aorta, celiac trunk and its branches,

inferior vena cava and portal vein, and delicate organs, such as the vesicle, pancreas and duodenum, around it. The caudate lobe is composed of three parts: paracaval portion, caudate process and Spiegel's lobe.

Clinical Findings/Procedure

The first two parts can be approached by puncturing the right lobe of the liver, but the portal and inferior vena cava veins limit safe introduction of some types of electrodes (as observed in radiofrequency ablation). The Spiegel's lobe can be safely treated with these electrodes; however, in the latter access, there are some noble vessels between the left hepatic lobe and Spiegel lobe (portal branch, hepatic vein and left gastric artery). Another difficulty lies in the fact that the coronary vein is commonly dilated in patients with cirrhosis, a group in whom percutaneous approaches are most often listed. In this way, careful selection of the best caudate lobe puncture pathway to avoid lesions in the noble locoregional structures is the best and minimally invasive percutaneous approach for this anatomical site.

Conclusion

The interventional radiologist must know the possible therapeutic routes, and the radiologist at the diagnostic practice should know such approaches and guide physicians requesting such an image-guided intervention.

P-515

The role of interventional radiology in tracheobronchial stenting: clinical indications, preinterventional imaging, interventional radiological techniques and complications

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Learning Objectives

Through the pictorial illustration of clinical indications, preprocedural planning, stent types and materials, deployment techniques and very importantly tracheobronchial stenting complications, we would like to share our centre's rich experience with this very exciting, rewarding as well as technically challenging IR procedure.

Background

Profound and thorough expertise of our senior consultants, fast development of user-friendly materials and most importantly very friendly and productive long-term cooperation with thoracic surgeons makes tracheoesophageal stenting a very well-established and implemented procedure for overcoming mostly malignant and also benign debilitating tracheal and oesophageal strictures with a very low rate of complications.

Clinical Findings/Procedure

First, we would like to share the many examples of successful stenting of various tracheobronchial malignant strictures, tracheobronchial malacia, inflammatory stenoses, traumatic strictures, anastomotic strictures, extrinsic compressions and fistulas.

Second, we would like to illustrate the importance of a high-quality preprocedural imaging.

Third, we would like to discuss the different types of stents available (silicone stents, balloon-dilated metallic stents, self-expanding metal stents and covered self-expanding metal stents) and make the reader familiar with the rules of their use as well as with the exciting techniques of their deployment.

Most importantly, by sharing our complications and their management, we would like to contribute to avoidance of such potentially disastrous events.

Conclusion

Tracheoesophageal stenting provides safe and effective minimally invasive treatment for patients with an unresectable benign and malignant central airway obstruction.

P-516

Liver vein embolization to induce hypertrophy for extended hepatic surgery in ALPPS/rescue PVE cases

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Two 45- and 58-year-old males with colorectal cancer received associating liver partition (ALPPS) followed by rescue portal venous embolization (PVE) and still had insufficient hypertrophy; subsequently, right hepatic vein occlusion led to 26% and 32% sFLR hypertrophy, respectively.

P-517

Ruptured hepatoblastoma during systemic chemotherapy treated by embolization and surgery

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We report a 5-month-old boy with a huge hepatoblastoma (>10 cm) ruptured during systemic chemotherapy treated by embolization with gelfoam and additional surgical resection. No recurrence was seen in the 1-year follow-up.

P-518

A successful Y-90 glass microsphere splenic radioembolization in case of primary myelofibrosis splenomegaly

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We report a successful case of Y-90 splenic radioembolization in a 63-year-old woman with primary myelofibrosis, an enlarging splenomegaly, and the need of repeated platelet transfusions. Follow-up revealed 43% reduction of the spleen volume with increasing platelet counts without the need for further transfusions.

P-519

Severe adverse events after TAE for a symptomatic carcinoid tumor

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A patient with a symptomatic carcinoid in the liver received transarterial embolization using beads microsphere without an anticancer agent. Takotsubo cardiomyopathy occurred the next day, and the patient rapidly lapsed into cardiopulmonary arrest. Despite intensive care, the patient died.

P-520

Multidisciplinary management with TACE and EBRT for the treatment of HCC with tumor thrombus in IVC and the right atrium

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In this case report, we discuss the management of HCC with tumor thrombus in IVC and the right atrium using a combination of c-TACE and EBRT. Complete response was observed with no adverse events/recurrence.

P-521

Dramatic results of transarterial chemoembolization of massive hepatocellular carcinoma with macrovascular invasion and lung metastases (Barcelona Clinic Liver Cancer stage C): a report of 2 cases

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Two patients showed huge hepatocellular carcinomas with macrovascular vein invasion and multiple lung metastases. We used only TACE and bland embolization through PVA. Follow-up CT confirmed complete remission. Sometimes patients with massive HCC should be considered for active therapeutic intervention.

P-522

Thermal injury to the proximal ureter following microwave ablation of endophytic renal tumours distant to the pelvicalyceal system

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Image-guided thermal ablation of small renal tumours unrelated to the pelvicalyceal system is considered safe and effective. We present a case of thermally-induced proximal ureteritis, the postulated cause of which was extreme heating of the urine within the pelvicalyceal system.

P-523

Transarterial chemoembolization for lung and mediastinal metastases of HCC after failure of sorafenib treatment

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A 63-year-old man with sorafenib refractory HCC of the lung and mediastinal metastases presented with chest pain and hemoptysis. Transarterial chemoembolization was performed via the internal mammary artery, the inferior phrenic artery, and bronchial arteries. Tumor response was partial, and symptoms were resolved.

P-524**A case of advanced maxillary sinus carcinoma treated with superselective intra-arterial infusion of high-dose cisplatin with concomitant radiotherapy (RADPLAT) using 3D-DSA and fusion image**

K. Motohashi, H. Ashida, Y. Nozawa, K. Morikawa
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The patient was a 60-year-old male with T4b maxillary sinus carcinoma and Rouviere node metastasis. We treated the patient with RADPLAT using 3D-DSA and fusion cone-beam CT with MRI. We injected cisplatin according to these images without deficiency, and we could induce CR.

P-525**Massive HCC involving left and right hepatic lobes effectively treated with two subsequent SIRTs using a Y90 glass microsphere**

E. Oliboni, G. Taddei, M. Salgarello, F. Severi, G. Carbognin
Radiodiagnostica, Ospedale Sacro Cuore, Negrar - Verona, Italy

A 75-year-old male with massive HCC, BCLC C, and no PVT who was not responsive to a previous TACE was treated with two subsequent SIRTs using Y90 glass microspheres in 3 months. MR at 3, 9 and 12 months after SIRT treatments showed necrosis of the lesion.

P-526**Intraoperative ultrasound-guided transection plane with microwave ablation for staged hepatectomy**

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We describe an open-stage hepatectomy with the transection made by IR using microwave ablation under ultrasound guidance as per the surgeon's request; the distance between future liver vessels and right hepatic lesions was selected to spare as much healthy liver as possible.

P-527**Pancreatic acinar cell carcinoma liver metastases treated exclusively with selective internal radiation therapy using Y-90 resin microspheres**

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The purpose of this poster is to describe the first case in the literature of pancreatic acinar cell carcinoma liver metastases treated exclusively with SIRT using Y-90 resin microspheres. Complete response was observed in three nodules, and partial response in the remaining.

P-528**Resolution of a large arterioportal shunt in the setting of hepatocellular carcinoma after administration of sorafenib**

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In this case report, we present the complete angiographic resolution of a large arterioportal shunt in the setting of hepatocellular carcinoma after the administration of sorafenib.

P-529**HIFU for pancreatic cancer: a 5-year follow-up case report**

V.A. Solovov
Interventional Radiology, Samara Oncology Centre, Samara, Russian Federation

A 35-year-old woman with morphologically confirmed pancreatic adenocarcinoma (head 2.3 x 1.9 cm) underwent HIFU in 2011. MRI with contrast enhancement showed a pseudocyst (1.0 x 1.3 cm). After a 5-year follow-up, there were no symptoms of the disease.

P-530**Successful downstaging of HCC by cystic artery embolization**

J. Smirniotopoulos¹, D. Holzwanger¹, J. Cornman-Homonoff¹, M. Schiffman²
¹*Radiology, New York Presbyterian Hospital/Weill Cornell Medicine, New York, NY, United States of America*, ²*Interventional Radiology, New York Presbyterian Hospital/Weill Cornell Medicine, New York, NY, United States of America*

A 53-year-old male with alcoholic cirrhosis presented with a bilirubin level of 7.1mg/dL and imaging consistent with non-operative HCC. Two superselective embolization attempts failed to decrease the tumor size; however, a subsequent cone-beam CT with cystic artery embolization successfully downstaged the patient.

P-531**Long-term control of the Doege-Potter syndrome treated by thermoablation in a recurrent non-resectable solitary fibrous tumor of the pleura**

C. Allimant, A. Denys
Radiology and Interventional Radiology Unit, CHUV University Hospital, Lausanne, Switzerland

A 92-year-old woman presented with Doege-Potter syndrome (refractory hypoglycemia related to paraneoplastic IGF-2 secretion) due to a non-resectable 12cm pleural solitary fibrous tumor. After a single session of microwave ablation, 80% of the tumor was treated and hypoglycemia was controlled.

P-532**Complete response (CR) of transarterial chemoembolization with doxorubicin-eluting beads in a ruptured hepatocellular carcinoma: a report of 2 cases**Y.J. Kang¹, B.C. Lee¹, N.Y. Yim², H.O. Kim², J.K. Kim³¹Diagnostic Radiology, Chonnam National University Hwasun Hospital, Jeollanam-do, Korea, ²Diagnostic Radiology, Chonnam National University Hospital, Gwangju, Korea, ³Radiology, Chonnam National University Hospital, Gwangju, Korea

Two patients had a single hepatocellular carcinoma with active bleeding and hemoperitoneum. We used only transarterial chemoembolization with DC beads. Follow-up CT confirmed complete response without viable tumor and hemoperitoneum. Chemoembolization with DC beads is very safe and an effective method for ruptured HCC.

P-533**Transarterial embolisation of liver metastasis in the management of severe Cushing syndrome in a patient with end-stage adrenocortical carcinoma**C. O'Rourke¹, M.P. Brassil², E. O'Dwyer², P. Govender², W. Torreggiani²¹Radiology, AMNCH (Tallaght Hospital), Dublin, Ireland, ²Radiology, The Adelaide and Meath Hospital, Dublin, Ireland

Transarterial embolization of hyperfunctioning adrenal metastasis can completely alleviate symptoms of Cushing syndrome in patients who are unfit for surgical resection. We present a case of embolization of adrenal metastasis in the liver with the resolution of symptoms and normalization of serum cortisol.

P-534**Combination interventional techniques for advanced HCC**

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Advanced HCC (BCLC C) with arteriportal shunting (AP) precludes TARE. We present a case where the coiling of AP shunt and TACE followed by TARE in subsequent sittings effectively downstaged the tumor to CR category (mRECIST) at the 2-year follow-up.

P-535**Leiomyosarcoma gluteal metastases embolization**

F. Petrocelli, A. Utili, G. Bovio

Radiology, San Martino, University Hospital, Genoa, Italy

A 58-year-old woman with vena cava leiomyosarcoma developed multiple gluteal metastases 1 year after surgical intervention: endovascular embolization and 1-year follow-up.

P-536**Successful salvage cryoablation of a urothelial cell carcinoma in a solitary kidney**

L. Colleter, C. de Margerie-Mellon, C. de Bazelaire, E. de Kerviler

Radiology, Saint-Louis Hospital, Paris, France

An 87-year-old patient with a solitary kidney had a bleeding urothelial carcinoma of the lower calix refractory to laser ureteroscopy. Cryoablation of the tumour followed by needle tract cauterisation stopped the bleeding. The patient is disease-free at 2 years.

P-537**Duodenal stenting through the biliary access**J.V. Del Cerro González, N. Mimica Haasz, C.L. Martínez Higueros
Interventional Radiology Unit, Hospital Guadalajara, Guadalajara, Spain

We show duodenal stent deployment through a percutaneous biliary access in an 81-year-old man diagnosed with biliary and duodenal stenoses due to an inoperable pancreatic head neoplasm.

P-538**PET-MRI and ultrasound imaging fusion in transrectal prostate biopsy: a diagnosis of prostatic tumor residue in the ductus deferens**

L.G.M. Valle, A.A.P. Azevedo, A.R. Junior, J.R. Andrade, P.R.B. Silverio, O. Smaletz, R.G. Garcia

Interventional Radiology, Hospital Israelita Albert Einstein, São Paulo, Brazil

A case report of an 86-year-old male who had intense caption of the deferens ducts in PSMA-⁶⁸Ga PET-CT and was diagnosed with infiltrative adenocarcinoma (prostatic neoplasm relapse) due to the use of real-time imaging fusion-ultrasound and gallium PET-CT.

Others**P-539****Aortic aneurysm screening using an oscillometric device equipped with a novel algorithm analyzing pulse wave transfer**S. Ichihashi¹, T. Hashimoto¹, S. Iwakoshi¹, K. Saeki², K. Obayashi², K. Kichikawa¹¹Radiology, Nara Medical University, Kashihara, Japan, ²Community Health and Epidemiology, Nara Medical University, Nara, Japan**Purpose**

Detection of aortic aneurysms prior to rupture is crucial to decrease deaths. Toward this purpose, a novel aneurysm screening method has been developed using an oscillometric device, which can measure the pulse wave velocity (PWV), ankle-brachial index (ABI), and pulse volume recording (PVR) simultaneously. Basic idea is that aortic aneurysms can cause propagation loss of pulse wave due to the abrupt expansion of the aortic wall, possibly enabling aneurysm detection. The aneurysm detection algorithm had been established from PVR data obtained from the learning cohort, and its diagnostic ability was evaluated in this prospective study.

Material and methods

Patients who had been referred to our vascular center from January 2012 to July 2016 under the diagnosis or suspicion of having aortic aneurysms were recruited prospectively. PWV, ABI, and PVR were measured for 30 seconds using the oscillometric device. The algorithm judged automatically according to the decision tree whether patients likely had aneurysms. CT angiography was used as a referential standard. Sensitivity and specificity of the algorithm were evaluated.

Results

The mean diameter of all aneurysms was 47.2±10.3 mm. After measurements, 121 aneurysm patients and 33 non-aneurysm control subjects were judged by the algorithm as having and not having aneurysms, respectively, resulting in the sensitivity of 80% and specificity of 52%. The sensitivity tended to be higher for larger aneurysms with the sensitivity for detection of aneurysm > 55 mm being 93%.

Conclusion

The new algorithm for aortic aneurysm detection installed in the oscillometric device may offer a high diagnostic sensitivity, especially for larger aneurysms.

P-540

Balloon pulmonary angioplasty for treating chronic thromboembolic pulmonary hypertension: initial experience at a North American centre

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Purpose

To evaluate the safety and efficacy of percutaneous balloon pulmonary angioplasty (BPA) in the treatment of chronic thromboembolic pulmonary hypertension (CTEPH).

Material and methods

A retrospective review of seven patients who underwent 29 BPA sessions at a North American tertiary care centre was performed. Success was defined as an improvement in the mean pulmonary arterial pressure (PAP). Pre- and post-mean PAP were compared using a paired t-test ($\alpha=0.05$). Safety was determined based on procedure-related complications, which were classified according to the Society of Interventional Radiology Standards of Practice. Technical parameters, including fluoroscopy and procedure time, were assessed.

Results

Mean PAP follow-up data were available for four patients at the time of abstract submission. Average mean PAP was 55.75 mmHg pre-BPA and decreased by 23.4% to 42.5 mmHg post-BPA treatment ($P=0.03$). In 29 BPA sessions, there were two major complications (6.9%) of distal pulmonary artery perforation, which were successfully treated with microcoil embolization. Six minor, self-limiting, intra-procedure complications occurred (20.6%), including five cases of minor hemoptysis and one case of arrhythmia. Mild reperfusion pulmonary edema occurred following three procedures (10%), none of which required mechanical ventilation. One patient developed contrast-induced nephropathy, with subsequent return to their baseline renal function. Mean fluoroscopy and procedure time were 39.9 minutes and 144.4 minutes, respectively.

Conclusion

Balloon pulmonary artery angioplasty is a promising treatment option for reducing pulmonary artery hypertension and improving mean PAP in CTEPH patients who have failed pulmonary endarterectomy or who are not surgical candidates.

P-541

Ultrasound-assisted catheter-directed thrombolysis versus systemic fibrinolysis in intermediate-risk pulmonary embolism: a meta-analysis

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Purpose

Intermediate-risk pulmonary embolism has a high mortality and morbidity, and its treatment is still a subject of debate. Anticoagulation therapy is the mainstay, but systemic and catheter-directed fibrinolysis show promising results. In recent years, ultrasound-assisted thrombolysis (USAT) has been researched as a superior form of treatment. The purpose of this meta-analysis was

to evaluate the effectiveness of USAT in intermediate-risk patients compared with that of systemic fibrinolysis.

Material and methods

A PubMed and Cochrane Library search was conducted for randomized controlled trials (RCTs) and case series. Primary outcomes were all-cause mortality and bleeding (minor and major), and secondary outcomes were right ventricle/left ventricle end-diastolic dimensions (RV/LV ratio) and pulmonary artery systolic pressure (PASP) up to 24h after treatment. Six USAT and 13 systemic fibrinolysis studies were selected.

Results

USAT has a lower risk of minor bleeding (OR: 0.52, 95% CI: 0.32 to 0.87, $p=0.01$) but no statistical difference for major bleeding (OR: 0.48, 95% CI: 0.18 to 1.22, $p=0.12$). There was also no improvement in all-cause mortality (OR: 0.24, 95% CI: 0.03 to 1.80, $p=0.16$). PASP was increased in the USAT group (SMD = 0.3, 95% CI: 0.1 to 0.5, $p=0.001$), while the RV/LV ratio decreased (SMD = -1.1, 95% CI: -1.4 to -0.8, $p<0.001$).

Conclusion

Intermediate-risk pulmonary embolism continues to be a difficult pathology. USAT shows improvement in certain areas, but mortality and major bleeding remain pressing issues. Small populations and differing criteria may cause bias; thus, larger RCTs are needed to directly gauge the full benefits and disadvantages of USAT compared with those of other therapies.

P-542

Endovascular thrombolysis for extremity frostbite decreases digital amputation and hospital length of stay (LOS)

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Purpose

To report outcomes of intra-arterial thrombolysis versus non-thrombolytic management of severe frostbite with respect to digital amputation rates and length of hospital stay (LOS).

Material and methods

17 patients with severe frostbite were identified from 2000 to 2017. 8 patients with mean age of 40 years underwent intra-arterial thrombolysis and served as the treatment group. 9 patients with mean age of 53 years received non-thrombolytic management and served as the control group. 2/8 (25%) treatment and 3/9 (33%) control patients had underlying vascular comorbidities ($p=0.25$). Number of digits at risk, duration of thrombolysis, thrombolytic agents used, digits amputated, hospital LOS, and complications were recorded.

Results

7 upper and 9 lower extremities for a total of 80 digits were at risk in the treatment cohort. 8 upper and 12 lower extremities for a total of 100 digits were at risk in the control group. Mean duration of thrombolysis was 26 hours. All treatment patients received tissue plasminogen activator in addition to systemic heparin. 4/16 (25%) limbs received intra-arterial alprostadil, 2/16 (13%) received nitroglycerin, and 2/16 (13%) received nicardipine. 12/80 (15%) treatment digits and 77/100 (77%) control digits required amputation ($p=0.003$). Average hospital LOS was 14 days in the treatment group and 38 days in the control group ($p=0.011$). No major complications occurred in the treatment group; however, 2/9 (22%) patients in the control group required extended hospitalizations secondary to amputation complications.

Conclusion

Intra-arterial thrombolysis reduces digital amputation rates and hospital LOS in the setting of severe frostbite.

P-543

Regional intra-arterial steroid treatment in 120 patients with steroid-resistant or -dependent hepatic and/or gastrointestinal graft-versus-host disease: evaluation of safety, efficacy, predictors of response, and survival

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WITHDRAWN

P-544

Percutaneous mechanical thrombectomy in patients with high-risk pulmonary embolism and contraindications for thrombolytic therapy

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Purpose

High-risk pulmonary embolism is associated with a high early mortality rate. If contraindications for thrombolytic therapy are present, the therapeutic alternatives include surgical embolectomy and percutaneous mechanical thrombectomy. We report our experience with percutaneous mechanical thrombectomy in patients with high-risk pulmonary embolism and contraindications for thrombolytic therapy.

Material and methods

From November 2005 to September 2015, we treated 25 patients with a mean age of 63±13 years (men, 64%). Majority of the patients were in a state of obstructive shock at presentation with maximum lactate levels of 7.7±8.3 mmol/l. Vasopressors were used in 77% of patients, and 75% of patients needed mechanical ventilation. VA-ECMO was used in one patient. Mean simplified Pulmonary Embolism Severity Index was 2.9. Treatment included thrombus fragmentation (52%), aspiration (76%) or additional surgical embolectomy (8%).

Results

Systemic blood pressure (100±41 mm Hg vs 119±34 mm Hg, p=0,100) and heart frequency (99±35 min⁻¹ vs 87±31 min⁻¹, p=0,326) did not differ before and after treatment. We achieved a drop in the tricuspid regurgitation gradient from 57±14 mm Hg to 31±3 mm Hg (p=0,018) after the therapy. Percutaneous mechanical thrombectomy was successful in 20 patients (80%), and 17 patients (68%) survived to hospital discharge.

Conclusion

In critically ill patients with high-risk pulmonary embolism who cannot receive thrombolytic therapy, percutaneous mechanical thrombectomy is a promising alternative to effectively reverse acute pulmonary arterial hypertension with right ventricular dysfunction and improve the clinical outcome.

P-545

Contrast-enhanced ultrasonography-guided elective prostate artery embolizations: a case series

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Purpose

This pictorial case series aims to highlight the utility of contrast-enhanced ultrasound (CEUS) for intraoperative guidance of endovascular prostatic artery embolizations (PAEs). Although PAE has been established as a safe and effective nonsurgical technique for the treatment of benign prostatic hyperplasia, using CEUS to guide and confirm the embolization is novel in the realm of PAE. Transabdominal CEUS allows for adequate anatomical characterization of the prostatic vasculature. Furthermore, the lack of renal involvement and radiation exposure make CEUS an attractive alternative to methods currently described in the literature (e.g., cone-beam computed tomography) as intraoperative imaging adjuncts to digital subtraction angiography (DSA).

Material and methods

Four cases of CEUS-guided PAE were performed at a single center by interventional radiologists. Relevant pre- and postprocedural clinical information was collected to evaluate the context and utility of CEUS. Patients underwent preprocedural computed tomography angiography for the preoperative assessment of the prostatic vasculature and patient suitability for PAE. CEUS was performed using the Definity (Lantheus Medical Imaging, North Billerica, MA) microbubble agent as an adjunct to DSA.

Results

Two of four cases used both cone-beam computed tomography and CEUS during PAE to evaluate technical success. All four cases achieved technical success with an average PAE procedure time of 180 minutes.

Conclusion

CEUS can be used alone or as an adjunct with cone-beam computed tomography to visualize the prostatic vasculature and confirm technical success of PAE. CEUS may be particularly valuable in supplementing technically challenging cases to reduce the dose of ionizing radiation or to decrease renal toxicity in high-risk patients.

P-546

The role of CT perfusion volumetry in post-traumatic splenic artery embolization

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Purpose

Proximal splenic artery embolization (SAE) has become the standard of care for traumatic splenic injury in hemodynamically stable patients. This retrospective study's purpose is to evaluate the outcome and complications of proximal embolization in spleen trauma and to suggest perfusion spleen volumetry as a vital parenchyma index.

Material and methods

Between January 2009 and August 2016, 34 patients aged 16–84 years were treated with proximal or combined proximal+distal splenic embolization after blunt injuries. Lesions between II and IV degree of AAST classification were treated in hemodynamically stable or borderline polytrauma patients. Embolization was performed by occlusion of the splenic artery with spirals, Amplatzer plug, or POD. Patients were subjected to strict clinical and instrumental

monitoring (CEUS/MDCT immediately after procedure and at 48/72 hours). We proceeded to calculate and compare the total volume and perfuse volume on CT images pre- and post-embolization.

Results

Technical success was 100% with an intra- and peri-procedural mortality rate equal to 0%. Fever associated with abdominal pain was the only minor complication observed in 2 cases (5.89%). No rebleeding, surgery, or major complications were recorded. Total non-perfused splenic volume after embolization was 3.05%, 16.9% related to proximal+distal embolization technique, and only 1.1% to proximal embolization.

Conclusion

The results of our study demonstrate that this procedure is safe and has to be the first option in II–IV degree of AAST classification of splenic injury. Proximal splenic artery embolization does not cause a significant loss of parenchyma. Perfusion spleen volumetry seems to be an appropriate method to quantify vital parenchyma.

P-547

Diagnosis and treatment of non-traumatic chylothorax using advanced lymphatic imaging and percutaneous lymphatic embolization

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Purpose

Non-traumatic chylothorax is notoriously difficult to treat because identification of the source of the chyle leak is challenging. The purpose of this study is to describe the use of a dynamic contrast-enhanced MR lymphangiography (DCMRL) and T2-weighted MR imaging to identify the etiology of non-traumatic chylous leaks and subsequent treatment with percutaneous lymphatic embolizations.

Material and methods

Nineteen (F:M/16:5, mean age 50 years) patients with non-traumatic chylothorax presented for lymphatic imaging and intervention between 2012 and 2016. For all patients, T2-weighted imaging was performed to exclude the presence of lymphatic masses and ascites. Next, DCMRL was performed to define the lymphatic anatomy and site of leak. In cases of abnormal pulmonary lymphatic flow, TD embolization was performed. In cases of normal TD and presence of multiple lymphatic masses, direct percutaneous access and embolization of the masses was performed.

Results

In 4 patients, only T2-weighted MRI was performed, while in 14 patients, T2-weighted MRI and DCMRL were performed. In 1 patient, the MRI was contraindicated because of a cardiac pacemaker. All patients underwent intranodal lymphangiogram and TD catheterization. The MRI demonstrated presence of the abnormal pulmonary lymphatic flow in 10 patients, normal TD and presence of retro-mediastinal masses in 7 patients, and a chylous leak from the cisterna chyli in 1 patient. In these 18 patients, TD embolization or lymphatic mass embolization was performed. Using this algorithm, the non-traumatic chylous leaks resolved in all patients.

Conclusion

Advanced lymphatic imaging using T2-weighted MRI and DCMRL is essential to diagnose the site of non-traumatic chylous leaks. Use of a treatment algorithm comprising these techniques guides lymphatic interventions and results in a successful treatment.

P-548

A territorial model for radioembolization activity and dose calculation

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Purpose

Planning the activity and absorbed dose inside a normal liver and tumor tissue is crucial for successful radioembolization. The widely used dose calculation method based on BSA or the partition model (PM) provides values for the whole liver or for three partitions (lung, liver, and tumor) only. Because radioactive microspheres are often selectively applied to arterial vessels, we proposed a more local dose distribution based on arterial supply territories.

Material and methods

Individual patient arterial territories and local tumor areas are the basis for the new territorial model (TM) for radioembolization planning. Additionally, a specific tumor margin was excluded from the normal liver dose calculation to account for the emitted local radiation. TM was retrospectively compared with the classical PM in five patients undergoing radioembolization.

Results

Calculated activities are typically limited by a threshold for mean normal liver dose. Thus, higher activities can be achieved using the TM compared to the PM. This results also in higher tumor doses for TM. The exclusion of a tumor range from the normal liver had a significant impact on the average dose in the normal liver tissue. The quantification of the liver tissue at risk and the visualization of territorial doses in 3D allowed for conclusions on the spatial distribution and thereby helped in a more detailed planning.

Conclusion

TM enabled a more local dose calculation based on individual patient arterial territories. Additionally, several tumors could be individually considered and local application could be planned more precisely. Evaluation of TM on a larger patient cohort is ongoing.

P-549

Proof of concept of a gene-directed enzyme prodrug therapy with intra-arterial delivery of mesenchymal stem cells in a rabbit VX2 hepatic tumor model

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Purpose

Gene-directed enzyme prodrug therapy (GDEPT) is a cancer gene therapy using a gene (optimized by mutations) encoding for an enzyme delivered to tumor cells and followed by the administration of a prodrug, which is converted locally into a cytotoxic by the mutated enzyme. The goal of our study was to assess the feasibility and efficacy of a suicide gene therapy using transduced mesenchymal stem cells intra-arterially delivered in a rabbit VX2 hepatic tumor model.

Material and methods

Eleven rabbits with a VX2 hepatic tumor were randomly assigned to 3 groups. Control group A (1 rabbit) was free of any treatment, Control group B (2 rabbits) received intravenous injection of 80mg/kg cyclophosphamide at days 3 and 9, and group C (8 rabbits)

received the GDEPT treatment consisting of an intra-arterial injection of transduced MSCs successively at days 0 and 11, followed by a CPA injection at days 3 and 14. Animals were followed until sacrifice (day 25) by ultrasound scan and blood examination. An all-organ pathological examination was performed after sacrifice.

Results

A significant tumor volume difference between control groups and group C was observed at day 7 ($p=0.024$), day 11 ($p=0.024$), and day 25 ($p=0.048$). Tumor necrosis was significantly higher in rabbits who received GDEPT (78% of total tumor surface) compared with control animals (22% of total tumor surface) ($p=0.006$).

Conclusion

Intra-arterial delivery of transduced MSCs with a suicide gene is feasible and induces significant tumor necrosis in a rabbit VX2 hepatic tumor model.

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Prophylactic temporary occlusion of the cystic artery using a fibered detachable coil during ^{90}Y radioembolization

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Purpose

To address the feasibility of prophylactic temporary occlusion of the cystic artery using a detachable coil during ^{90}Y radioembolization.

Material and methods

From January 2012 to October 2016, nine patients underwent prophylactic temporary occlusion of the cystic artery during ^{90}Y radioembolization. Based on the planning technetium-99m macroaggregated albumin ($^{99\text{m}}\text{Tc}$ -MAA) SPECT/CT imaging and hepatic angiography, a detachable coil was deployed into the proximal cystic artery, but the proximal 1 cm was left inside the microcatheter. ^{90}Y microspheres were infused proximal to the cystic artery where the $^{99\text{m}}\text{Tc}$ -MAA had been infused, and then, the detachable coil was retrieved. Afterward, the patients underwent PET/CT imaging. Medical records and follow-up imaging acquired 1 and 3 months after the procedure were reviewed. The differences in the uptake of $^{99\text{m}}\text{Tc}$ -MAA and ^{90}Y microspheres in the gallbladder were evaluated using Wilcoxon's signed-rank test.

Results

Temporary placement of a detachable coil was feasible in all cases. On the angiograms obtained after a detachable coil placement, the distal cystic artery and gallbladder were partially visible in eight of the nine (88.8%) patients but were fully restored after the removal of the coils in all cases. The proportional uptake of $^{99\text{m}}\text{Tc}$ -MAA (mean, 4.35%) and ^{90}Y (mean, 0.90%) in the gallbladder was significantly different due to the temporary occlusion of the cystic artery ($p=.004$). No clinical complications or radiological abnormalities were identified for three months after the procedure.

Conclusion

Temporary occlusion of the cystic artery using a detachable coil appeared to be feasible and effective in reducing ^{90}Y uptake in the gallbladder.

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Planning and simulation of cryoablation in the prostate

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Purpose

We present a software planning tool for cryoablation in the prostate. At its core, the software utilizes numerical simulation of the heat diffusion to predict the region of the necrosis. Because cryoablation is currently not performed under image-based temperature monitoring, a planning software provides a noticeable benefit both to the operator as well as the patient. The needle can be placed interactively while the planning software presents the simulated necrosis taking into account heterogeneous material, including risk structures (colon, ureter, and bladder).

Material and methods

To simulate the process of a freeze-thaw cryoablation cycle, the planning tool allows to interactively place the needles on a planning image (e.g., MR). At the needle's active zone, a constant temperature of -180°C is assumed. The simulation computes the temperature distribution over time, from which a damage model is computed. The numerical solver is massively parallelized and implemented on the graphics processing unit (GPU) such that the planning software can immediately present the predicted result.

Results

The numerical simulation of 15-minute freeze-thaw cryoablation on a computational grid of $128 \times 128 \times 128$ with a voxel size of 0.5 mm can be performed within 2 seconds on a standard PC. Therefore, the simulation is fast enough to support planning of the needle placement to find a position that optimally destroys the tumor as well as spares risk structures.

Conclusion

We have demonstrated a software planning tool for cryoablation in the prostate. The planning software is able to visualize the simulated necrosis taking into account risk structures, thereby enabling cryoablation in various target organs.

P-552

Smartphone apps as a source of information on interventional radiology

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Purpose

Smartphone applications (apps) are being increasingly used to disseminate healthcare-related information. However, no studies have been conducted to evaluate the availability and content of apps related to IR. The purpose of this study was to identify and analyze IR-related apps available on the Apple iTunes store.

Material and methods

The Apple iTunes store was searched for IR-related apps on 12th September 2016 using 47 keywords associated with IR procedures. Only apps in English were included. The content of the apps was analyzed by two radiology residents in consensus. The parameters included cost, uploading agency (healthcare vs. non-healthcare), target audience (healthcare professional vs. general public), and usefulness.

Results

A total of 85 IR-related apps were identified, of which 84.7% were available free of cost. A total of 65.8% apps were categorized as moderate to very useful. A majority of apps were based on scientific

studies (89.4%), were published by healthcare agencies (70.6%), and were released in the year 2015/2016 (63.5%). Apps that were scientifically valid were more likely to be useful ($p < 0.009$). Healthcare agencies were more likely to publish apps targeting healthcare professionals, whereas apps targeting the public were mostly published by non-healthcare agencies ($p < 0.03$). There was no difference between apps published by healthcare and non-healthcare agencies in terms of usefulness. The cost of apps (free or paid) did not show significant variation with respect to their usefulness or scientific validity.

Conclusion

An increasing number of IR-related apps are being developed every year. There is room for apps directed toward general public that could be better informed about IR procedures through apps.

P-553

Interventional radiology activation score for trauma: early prediction of need for emergency endovascular therapy in trauma care

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Purpose

To devise a new scoring system for the early activation of interventional radiology (IR) team before CT scan in trauma care.

Material and methods

We searched the medical record with the words emergency department, hospitalization, and non-contrast- and contrast-enhanced CT scan and found 236 patients who underwent trauma care between April 2015 to October 2016. Among them, 65 patients were excluded due to the following: laparotomy ($n = 13$), mild disease ($n = 28$), and changing hospital ($n = 24$). The remaining 171 patients' vital signs, laboratory tests, the findings of focused assessment with sonography for trauma (FAST) and pelvic X-ray were reviewed. Univariate and multivariate analyses were performed to determine factors related to the need for IR and create the interventional radiology activation score (IRAS) for trauma. Areas under the receiver operating characteristic curve (AUC), sensitivity, and specificity for the need of IR were evaluated.

Results

Thirty-one patients needed IR intervention. Univariate analysis showed that the sBP, lactate level, hemoglobin level, D-dimer, FDP, Fib, and findings of FAST and pelvic X-ray were related to the need for IR intervention. Multivariate analysis showed that the sBP and findings of FAST and pelvic X-ray were related to this need. IRAS was calculated by the sum of each score of the three relevant parameters that were calculated based on their odds ratios in the analysis. The AUC, sensitivity, and specificity for IRAS greater than 4 points were 0.885, 80.6%, 89.3%, respectively.

Conclusion

IRAS is a simple scoring system and may be useful to activate IR team early in trauma care, especially before CT scan.

P-554

Let's bridge the gap: changing current misconceptions of female medical students about the field of interventional radiology

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Purpose

Female physicians continue to be underrepresented in the field of interventional radiology (IR), particularly on a global scale. The purpose of this project was to assess the effects of elective IR on gender-specific perceptions about the field of IR and pursuit of a career in the field.

Material and methods

In 2016, a 10-session elective for pre-clinical medical students was instituted. Student perceptions of IR careers were electronically surveyed anonymously at the end of the final session. In 2017, students were surveyed before the elective started and after mid and final sessions. All statistical analyses were performed using Fisher's exact test.

Results

The 2016 post-elective data demonstrated that students who attended the elective compared with those who did not attend the elective viewed IR as being inclusive of female and minority physicians. Gender-specific and pre-elective perceptions, however, were not assessed. The 2017 pre-elective survey data taken from students planning to attend the elective showed that compared with males, females perceived the length of training and male predominance within the specialty as deterrents to pursuing a career. Furthermore, female students were less likely to view IR as being inclusive of female physicians (all results were statistically significant; $p < 0.05$). The elective is ongoing and changes in perceptions will be characterized via mid and final session surveys.

Conclusion

Early IR exposure may positively influence gender-specific perceptions, which will be critical in ensuring a diverse and well-informed applicant pool. From a global perspective, this may result in the recruitment of additional women into the specialty.

P-555

Perceptions and awareness of interventional radiology amongst medical students and junior doctors

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Purpose

To investigate the perceptions and awareness of interventional radiology (IR) amongst medical students and junior doctors.

Material and methods

A purposive sample of 100 medical students and junior doctors at the Leeds Teaching Hospital Trust were interviewed using a mixed questionnaire. A focus group was then formed to discuss strategies for improving awareness. Statistical analysis using ANOVA and t-test was conducted using STATA-13.1.

Results

When investigating perceptions of IR, 85% of the participants were found to believe that they did not have an adequate exposure to IR, with no significant increase in exposure across the training grade ($p = 0.258$). Overall, 95% of the participants had never worked alongside an IR specialist. In total, 15% of the participants considered a career in IR; participants with adequate exposure were more likely

to consider a career in IR than those without any exposure ($p < 0.05$). Furthermore, 90% of the participants were unaware of the IR training pathway.

The focus group quoted that most medical students had never worked alongside IR specialists; inadequacy of exposure combined with deficient knowledge on the role of IR was the most prevalent reason behind non-consideration.

Conclusion

Although the study is limited by its sample size and population representation, the results strongly indicate the need for a holistic approach to improve IR awareness as a significant proportion of medical students are unaware of the role of IR. Teaching by IR specialists in the non-clinical years with mandatory firms and elective opportunities during clinical years is likely to raise awareness during medical school. This fortified with mentorship schemes for junior doctors is likely to raise awareness and uptake of IR.

P-556

Improving hard stop safety time-out in interventional radiology using a verbal electronic surgical safety checklist linked to electronic health records

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WITHDRAWN

P-557

Reach out and educate someone: evaluating outreach and impact of an online webinar-based interventional radiology elective

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Purpose

To evaluate the efficacy of a webinar-based interventional radiology (IR) elective for outreach to institutions without access to preclinical IR education.

Material and methods

In 2016, a 10-session elective for preclinical medical students was instituted. In 2017, eight of the 10 sessions were broadcasted over the Internet in the form of a webinar-based elective. Lectures were broadcasted using GoToWebinar software, and audio/visual aids were made available online to registered attendants. To maximize outreach, the SIR Connect Portal and social media platforms Twitter, Facebook, and LinkedIn were used for advertising. The SIR-RFS committee also provided their followers with weekly reminders.

Attendance was measured at each session, including the location of all registrants/attendants. This information was cross-referenced with a list of IR interest groups (IRIG), SIR directory, and list of IR residency/fellowship programs. Additionally, student perceptions of IR

careers were surveyed before the elective started and after the mid and final elective sessions. All statistical analyses used Fisher's exact test.

Results

Total registration included 66 distinct institutions viewing from 29 states and 8 countries. Of these institutions, 74% did not have their own IRIG, 58% did not have faculty listed in the SIR directory, and 76% did not have an integrated IR residency. An average of 48 male (70%) and 22 female (30%) students registered for the weekly sessions.

Conclusion

The number of attending institutions suggests that a webinar-based elective is an effective method for increasing exposure to IR, particularly in students at institutions without robust IR exposure.

P-558

Randomized controlled trial comparing simple light dressing (transparent film dressing) versus pressure dressing (Elastoplast dressing) after femoral arterial sheath removal

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Purpose

To evaluate the clinical effectiveness of a simple light dressing (transparent film dressing) and a conventional pressure dressing (Elastoplast dressing) in terms of incidences of hematomas, bleeding, skin loss, and level of comfort experienced.

Material and methods

A randomized controlled trial study design was adopted. Patients scheduled for radiologically guided invasive procedures with retrograde femoral artery puncture were recruited. The CRIB granted ethical approval for the study. All researchers were involved in obtaining informed consent from the patients.

A gauze swab (7.5 cm × 7.5 cm), Elastoplast (10 cm × 4.5 m, 3M Health Care), and Tegaderm film (10 cm × 12 cm, 3M Health Care) were used in this study.

Results

A total of 260 patients were enrolled, and most patients had undergone visceral intervention with insertions of 5 Fr vascular sheaths. There was no significant difference in bleeding and formation of hematoma ($p > 0.7$) and loss of skin integrity ($p = 0.1$). However, 39% patients in the Elastoplast dressing group experienced discomfort compared with 5% patients in the transparent film dressing group ($p < 0.01$). Results of this study supported the use of transparent film dressing.

Conclusion

The results showed that the incidence of bleeding/hematoma and loss of skin integrity did not differ significantly between the Elastoplast and transparent film dressing groups. Moreover, patients with transparent film dressing also reported significantly greater level of comfort than those with Elastoplast dressing. Other advantages of transparent film dressing also included a decrease in the incidence of skin allergy, easy inspection of the puncture site, and early detection of bleeding or hematomas.

P-559

The role of interventional radiology in the management of pediatric patients following living donor liver transplant (LDLT): a 10-year single-institution experience

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Purpose

Pediatric liver transplantation has markedly changed in the last decade given the increased utilization of living-donor liver transplant (LDLT). The role of interventional radiology (IR) in treating complications of LDLT over the past decade has been evaluated.

Material and methods

Over a 10-year period from 2006 to 2016, 41 consecutive pediatric patients were identified to have undergone LDLT at a single institution. Patient demographics, complications involving vascular thrombosis, biliary obstruction, or fluid collection and all procedures performed by the IR and surgical teams following transplant were reviewed. The primary endpoint of the study was death or retransplantation within 1 year of transplant. Data were partitioned into the first half (2006–2010) and second half (2011–2016) of the time period for statistical analysis.

Results

From 2006 to 2010, 41.2% (7/17) of pediatric LDLT patients required intervention by the surgical team for vascular, biliary, or fluid collection complications within 1 year of transplant, while only 17.6% (3/17) of patients with similar complications were managed by IR. From 2011 to 2016, IR management more than doubled to 37.5% of patients, surpassing surgical interventions, which reduced to 33.3% (8/24). Average time to intervention by IR post-LDLT decreased significantly from 84.3±36.1 to 29.0±6.3 days ($p=0.0295$), while time to intervention by surgery increased from 5.3±1.3 to 91.6±50.2 days. During this time period, death or retransplantation within 1 year of LDLT significantly decreased from 23.5% (4/17) to 0% (0/24; $p=0.0135$).

Conclusion

Our data suggest that an increased and earlier role of IR for pediatric patients following LDLT over the last decade is associated with improved outcomes and reduced need for early surgical intervention.

P-560

Risk factors for oversedation in interventional radiology

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Purpose

To evaluate the preoperative and intra-procedural risk factors for oversedation during interventional radiology (IR) procedures. Patients may have inherent risk factors for oversedation; additionally, the choice of medications administered for sedation may increase the risk of oversedation. Procedure-related administration of opioid and benzodiazepine reversal agents, such as naloxone and flumazenil, may be considered as a marker for oversedation-related respiratory depression events. The aim of this study was to determine factors associated with the use of naloxone and flumazenil in the IR population as a marker for oversedation events.

Material and methods

A retrospective analysis was performed on patients who were administered sedation reversal with naloxone and/or flumazenil during IR procedures. Seventy-one unique reversal events (occurring on 70 patients) were identified from March 2012 to August 2016 (52 months). Patient electronic medical records were reviewed and patient demographics, procedure type, comorbidities, intra-procedural medications administered, and pre-procedure laboratory values were retrieved for analysis.

Results

Of our study population, 60% patients were females. The average patient age was 62 years and the average BMI was 27.2. The average number of medications administered to each patient was 3.3, with 44% patients receiving 4 or more medications. A total of 32.4% patients were administered diphenhydramine; 27% patients were administered 4 or more drugs including diphenhydramine. In total, 45% patients had creatinine levels equal to or greater than 2.0.

Conclusion

Oversedation in IR procedures is associated with the administration of 4 or more unique medications, administration of diphenhydramine, and elevated creatinine levels.

P-561

Safety of radiofrequency ablation of benign thyroid nodules and recurrent thyroid cancers: a systematic review and meta-analysis

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Purpose

To evaluate the safety of radiofrequency ablation (RFA) for the treatment of benign thyroid nodules or recurrent thyroid cancers using a systematic review and meta-analysis.

Material and methods

Ovid-MEDLINE, EMBASE, and Cochrane Library databases were searched until July 12, 2016 for studies on the safety of RFA in treating benign thyroid nodules or recurrent thyroid cancers. Pooled proportions of overall and major complications were assessed using random-effects modeling. Heterogeneity among studies was determined using the χ^2 statistic for the pooled estimates and the inconsistency index I^2 .

Results

A total of 24 eligible studies were included, giving a sample size of 2421 patients and 2786 thyroid nodules. In total, 41 major complications and 48 minor complications were reported from RFA, giving a pooled proportion of 2.38% for overall RFA complications (95% CI: 1.42%–3.34%; adjusted 1.84%) and of 1.35% for major RFA complications (95% CI: 0.89%–1.81%; adjusted 1.22%). There were no heterogeneities in both overall and major complications ($I^2 = 1.24\%$ – 21.79%). On subgroup analysis, the overall and major complication rates were significantly higher in malignant thyroid nodules than in benign thyroid nodules ($p = 0.0011, 0.0038$).

Conclusion

RFA shows an acceptable complication rate for the treatment of benign thyroid nodules or recurrent thyroid cancers.

P-562

Catching breath: a feasibility study to monitor respiratory motion directly using a novel ultrasound-based monitor

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Purpose

Currently available respiratory motion monitors for image-guided punctures use indirect measures for respiratory motion, such as chest wall or abdominal. We developed a monitor employing ultrasound to register respiratory motion directly and provide real-time readily interpretable feedback to the patient. The purpose was to assess the feasibility, accuracy, and limitations of this technique.

Material and methods

Respiratory motion was monitored in nine healthy volunteers. The monitor consisted of four 3.5 MHz transducers with each eight piezoelectric elements small enough to be fitted between the ribs and monitor the pleural line. Signals were correlated to the diaphragm movement derived from M-mode recordings using a clinical ultrasound system. B-mode recordings from the ultrasound system were acquired for correlation analyses of the pleura position, measuring the monitor accuracy. To define the monitor limitations, a BMI increase was simulated (16-mm-thick polymer flap between the skin and transducer) and the transducer was positioned on the back with the volunteer in the prone position.

Results

A strong correlation was found between the monitor signal and diaphragm movement derived from M-mode recordings (Pearson $r = 0.91-0.99$). The monitor showed a median accuracy of 2.8 mm (range 1.8–5.2 mm). Increasing the BMI by 5 kg/m² decreased the mean signal intensity by 17% (15.2 ± 1.4 vs. 17.8 ± 1.6 ; $P = 0.002$) but remained well distinguishable. Position of the transducer did not affect signal intensity ($P = 0.719$).

Conclusion

The proposed technique appears to be an accurate, non-invasive, real-time respiratory monitor. Future work will involve improvement of the monitor interface for easier signal interpretation.

P-563

Feasibility of transrectal and transperineal fiducial marker placement for prostate cancer before proton therapy

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Purpose

To compare the feasibility of transrectal and transperineal fiducial marker placement for prostate cancer before proton therapy.

Material and methods

From January 2013 to March 2015, 353 patients underwent fiducial marker placement. Transrectal placement was performed in 262 and transperineal placement was performed in 91. In all patients, one fiducial marker was inserted into each lobe. Technical success, clinical success, and complications were evaluated. Technical success was defined as successful placement of the fiducial marker at the aimed position. Clinical success was defined as successful completion of proton therapy with fiducial markers. Moreover, migration of the marker and the distance between the two placed markers in the prostate were evaluated.

Results

Technical success rate of the transrectal group and transperineal group were 100% (262/262) and 99% (90/91), respectively ($P > 0.05$). Clinical success rate of the transrectal group and transperineal group were both 100% ($P > 0.05$). There were no major complications such as sepsis and uncontrollable bleeding in both groups. Migration of the marker was observed in 3 of 524 markers (0.6%) of the transrectal group and 2 of 182 markers (1.1%) of the transperineal group ($P > 0.05$). The distance between two placed markers was 25.6 ± 7.1 mm (mean $\pm$ SD) in the transrectal group and 31.9 ± 5.2 mm in the transperineal group ($P < 0.05$).

Conclusion

Both transrectal and transperineal fiducial marker placement methods were feasible and safe. When a long distance between markers is necessary, transperineal placement might be useful.

P-564

Fluoroscopy-guided artificial pneumoperitoneum formation for the management of air leak after pulmonary resection

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Purpose

To evaluate the effectiveness of fluoroscopy-guided artificial pneumoperitoneum formation for the management of air leak after pulmonary resection.

Material and methods

From July 2008 to April 2015, we performed fluoroscopy-guided artificial pneumoperitoneum formation (mean air 1500 cc, range 1100–2000 cc) in 32 patients. Among them, a total of 24 patients (M:F = 17:7; mean age, 48 years; range, 16–75 years) who fulfilled the inclusion criteria (prior pulmonary resection, presence of postoperative air leak, and adequate medical records) were enrolled in this study. We retrospectively reviewed patient characteristics and clinical and radiological features. Technical success, clinical success, and complication rates were evaluated. Technical success was defined as successful artificial pneumoperitoneum formation. Clinical success was defined as air leak resolution and chest tube removal in the hospital without complications.

Results

During the study period, a total of 28 fluoroscopy-guided artificial pneumoperitoneum formations were performed in 24 patients. The technical success rate of the fluoroscopy-guided artificial pneumoperitoneum formation was 100% (28/28). The clinical success rate was 75% (21/28). In the clinical success group, air leaks stopped after a mean time of 5.6 days (range, 0–20 days) and chest tubes were removed after a mean time of 16 days (range, 4–46 days) after the procedure. There were no significant immediate or delayed complications.

Conclusion

Fluoroscopy-guided artificial pneumoperitoneum formation is effective, safe, and easy to perform for the management of postoperative air leak after pulmonary resection.

P-565

Radiofrequency ablation for benign non-functioning thyroid nodules: results at the 6-month follow-up

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Purpose

Radiofrequency ablation (RFA) is a mini-invasive technique for treating benign non-functioning thyroid nodules. Compared with surgery, RFA shows fewer complications, preservation of thyroid function, reduced hospitalization days.

We aimed to evaluate the feasibility, safety, and efficacy of RFA for benign non-functioning thyroid nodules.

Material and methods

Fourteen benign nodules in 12 patients were treated (male:female ratio 1:1; median age 61 years). Nodule dimensions and characteristics, thyroid function, symptoms, and cosmetic scores were recorded preliminarily and at the 1-, 3-, and 6-month follow-ups. RFA was performed in a day-hospital regimen under bland sedation and local anesthesia. An 18-gauge antenna (7–10 mm active tip) was used with trans-isthmus approach and moving-shot technique. Preliminary aspiration with a thin needle was performed in mixed/mainly cystic lesions. The ablation time and power energy were recorded. Primary endpoints were >50% reduction in nodule volume and reduction in symptoms and cosmetic score.

Results

Eleven solid and 3 cystic/mixed nodules were treated. Thyroid function did not differ before and after the procedure. The mean RFA time was 7.5 min per nodule. The mean power was 38.3 W per nodule. The procedure was well-tolerated by all, except 1 patient with an unknown history of tracheomalacia who suffered from dyspnea and recurrent laryngeal nerve palsy that were resolved with steroid therapy in 24 h and 1 month, respectively. One patient showed a 3 mm subcapsular hematoma. Volume reduction at 6 months was 55.1% (range 22.2%–98.5%); 7/14 patients showed >50% reduction. The symptom score was reduced in all symptomatic patients; the cosmetic score ameliorated in 10/12 patients.

Conclusion

RFA is a feasible, safe, and effective mini-invasive technique for treating benign non-functioning thyroid nodules.

P-566

Congenital heart disease complicated by protein-losing enteropathy: redefining pathophysiology and providing novel therapy

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Purpose

Protein-losing enteropathy (PLE), characterized by loss of proteins in the intestine, is a devastating complication in patients with congenital heart disease (CHD). The cause of PLE is unknown, but lymphatic involvement is suspected. In this study, we will review the findings of liver lymphatic imaging and outcomes of liver lymphatic embolization in treating PLE in our patient population.

Material and methods

A retrospective review of liver lymphangiography and outcomes of liver lymphatic embolization in 8 (M/F=5/3, median age 21 years) consecutive patients with CHD and elevated CVP complicated by PLE.

Results

Liver lymphangiography was performed in all patients. In 7/8 patients, it demonstrated a leakage of liver lymph into the duodenum through abnormal hepatoduodenal lymphatic communications. This was confirmed by duodenoscopy with simultaneous injection of isosulfan blue into the liver lymphatics in 6/7 patients. Embolization of the liver lymphatics with lipiodol in 2 patients resulted in a temporary increase in albumin levels and improvement of symptoms in one patient but was complicated by duodenal bleeding in both. Liver lymphatic embolization with n-BCA glue resulted in sustained normalization of serum albumin levels and improvement of symptoms in 3/6 patients, temporary improvement in 2/6 patients, and no change in 1/6 patient at a mean follow-up of 363 days (range 84–1005 days).

Conclusion

In this study, we demonstrated focal liver lymphatic leakage in the duodenum of patients with CHD and elevated CVP complicated by PLE. Lymphatic embolization can lead to improvement in albumin levels and relief of symptoms. Further experience with the technique is needed to improve the long-term outcome of this procedure.

P-567

Utilization of magnetic resonance lymphangiography to determine the etiology of chylothorax and predict the outcome of lymphatic embolization in patients with congenital heart disease

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Purpose

Postoperative chylothorax in patients with congenital heart disease (CHD) is a challenging problem with substantial morbidity and mortality. Dynamic contrast-enhanced magnetic resonance lymphangiography (DCMRL) is a novel technique to visualize the lymphatic system.

Material and methods

This study is a retrospective review of 18 patients with CHD and postoperative chylothorax who presented for lymphatic intervention at our institution

Results

All 18 patients had T2W MR, and 17 patients had DCMRL. We identified three groups: 2 patients with traumatic leak, 9 patients with abnormal pulmonary lymphatic perfusion, and 7 patients with central lymphatic flow disorder (CLFD). We defined CLFD as lymphatic effusions in multiple compartments and a dermal cutaneous flow. The patients with traumatic leak and abnormal pulmonary lymphatic perfusion were combined into a group of 11 patients without CLFD, of which 10 (91%) had an intact central TD. All 11 patients underwent lymphatic intervention, including selective or complete TD embolization. All 11 patients had resolution of chylothorax, with a median of 18 days (IQR 6–47) from intervention to discharge. Of the 7 patients with CLFD, 6 patients underwent lymphatic intervention, and there was no difference in the median chest tube with no change in the output from the chest tube. All 7 patients died, with a median of 79 days (IQR 33–187) from intervention to death.

Conclusion

DCMRL was essential to differentiate between causes of chylothorax. Percutaneous embolization should be the first-line treatment for

traumatic leaks and abnormal pulmonary perfusion. Interventions in patients with CLFD were not successful, and alternate approaches need to be developed.

P-568

Percutaneous image-guided cryoablation as a second-line therapy for soft-tissue venous vascular malformations of extremities: a prospective study of safety and 6-month efficacy

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Purpose

To report the safety and short-term efficacy of percutaneous image-guided cryoablation performed as a second-line therapy for venous vascular malformations (VVM) of extremities.

Material and methods

In this non-blinded, non-randomized trial, cryoablation was proposed in 14 patients presenting with symptomatic VVM (mean age: 31 years, range: 18–65) for recurrences after treatment. Five were male and 9 female. Eligibility criteria were feasible cryoablation, localization at least 5mm from the skin and nerves, and absence of contraindication for anesthesia. Safety was evaluated by the common terminology criteria for adverse events (AEs). Pain was assessed on day 7, months 2 and 6 using the visual analogic scale. Quality of life was evaluated before cryoablation and at 2 and 6 months after cryoablation. Evolution of volume was evaluated by MRI at 6 months. Comparison was performed using the Wilcoxon test.

Results

Technical success was observed in all cases. Although 11 patients (78.6%) presented AEs (13 grade 1–2 and 3 grade 3), only two severe AEs (grade 3) related to cryoablation occurred in 2 patients (14.3%) during the 6-month follow-up: one immediate sciatic paralysis and one delayed paresthesia. A clinical response was observed in 12 patients (85.7%) at 6 months. Pain decreased significantly from 42.5±14.2 mm before the intervention to 11.8±17.9 mm at 6 months ($P=0.002$). A significant decrease of the mean volume from 12.8±14.3 cm³ to 3±2.7 cm³ was observed at 6 months ($P=0.002$).

Conclusion

Percutaneous cryoablation appears effective in treating venous vascular malformations, but careful selection of patients is mandatory to avoid AEs.

P-569

Percutaneous cryoablation of symptomatic venous vascular malformations as the second-line therapeutic option: a 5-year single-institution experience

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Purpose

To report the mid-term outcomes of percutaneous cryoablation (PCA) performed as a second-line therapeutic option of venous vascular malformations (VVMs).

Material and methods

From 2011 to 2015, PCA was performed in 24 patients (mean age: 31 years, range: 12–64) as the second-line treatment for recurrences of

symptoms after sclerotherapy and when resection was not possible (due to lesion location or previous failure) or refused by the patient. Adverse effects were recorded, and disease-free survival (DFS) and local tissue control (LTC) rates were calculated based on symptoms and volume evolution.

Results

Mean follow-up was 18.7 months (6–48). Nine (37.5%, 9/24) adverse effects occurred, but only three (12.5%, 3/24) were severe. Mean pain assessed by visual analogic scale (VAS) was 41.7mm (0–80) before treatment and 20.3mm (0–80) ($P=0.01$) after treatment. Mean volume decreased significantly after treatment from 22.4cm³ (0.9–146) to 8.35cm³ (0–81.3) ($P<0.001$). Pain recurred in nine patients and size of one lesion increased. The DFS and LTC rates were 54% (95% CI: 22.94–77.27) and 93.33% (61.26–99.03) at 24 months, respectively. Only VVM volume > 10cm³ was associated with a higher risk of local recurrence ($P=0.05$).

Conclusion

Percutaneous cryoablation as second-line treatment appears to be safe and effective for local control of venous vascular malformations according to these mid-term results.

P-570

Quantification of balloon pulmonary angioplasty (BPA) results in patients suffering from inoperable chronic thromboembolic pulmonary hypertension (CTEPH) using 2D-perfusion angiography (2D-PA)

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Purpose

Evaluation of the feasibility of 2D-PA based on a proximal reference region of interest (ROI) and a distal target ROI to quantify perfusion changes pre- and post-BPA.

Material and methods

Thirty consecutive BPAs in 16 patients with a total of 99 treated pulmonary artery segments were included. Selective digital subtraction angiographies (DSAs) by manual contrast injection were performed during the intervention. For quantification of changes in pulmonary blood flow using 2D-PA, the DSA series were post-processed. A reference ROI measuring the arterial input in the treated pulmonary artery and a distal target ROI in the lung parenchyma were placed in corresponding areas on DSA runs pre- and post-BPA. Time–density curves were generated [time to peak (TTP), peak density (PD), and area under the curve (AUC)]. The reference ROI/target ROI ratios ($TTP_{\text{parenchyma}}/TTP_{\text{inflow}}$, $PD_{\text{parenchyma}}/PD_{\text{inflow}}$, and $AUC_{\text{parenchyma}}/AUC_{\text{inflow}}$) pre- and post-BPA were calculated. The pulmonary flow grade score (PFGS), a visual score to assess the therapeutic effect of BPA, was used for assessing the correlation among the relative changes in the 2D-PA parameters.

Results

PFGS improved after BPA (1 vs. 3; $p<0.01$). Similarly, the $TTP_{\text{parenchyma}}/TTP_{\text{inflow}}$ ratio decreased by 10% (1.6 vs. 1.4; $p<0.01$), the $PD_{\text{parenchyma}}/PD_{\text{inflow}}$ ratio increased by 46% (0.2 vs. 0.4; $p<0.01$), and the $AUC_{\text{parenchyma}}/AUC_{\text{inflow}}$ ratio increased by 36% (0.2 vs. 0.4; $p<0.01$). Moreover, a positive correlation between changes in PFGS and changes in $PD_{\text{parenchyma}}/PD_{\text{inflow}}$ ($r=0.5$, $p<0.01$) and $AUC_{\text{parenchyma}}/AUC_{\text{inflow}}$ ($r=0.3$, $p<0.01$) ratios was observed. In contrast, no correlation between changes in PFGS and changes in the $TTP_{\text{parenchyma}}/TTP_{\text{inflow}}$ ($r=-0.1$, $p>0.1$) ratio was observed.

Conclusion

Quantification of pulmonary perfusion following BPA by 2D-PA is feasible and has the potential to improve the monitoring of BPA.

P-571

Analysis of venoplasty in pediatric Budd–Chiari syndrome: an 8-year experience

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Purpose

To analyse the efficiency, safety, patency maintenance, failure rates and re-intervention requirement after venoplasty for pediatric Budd–Chiari syndrome.

Material and methods

Eighty-two children (<12 years) with Budd–Chiari syndrome who were treated by venoplasty in the period between June 2008 and June 2016 were included in this retrospective descriptive study. Clinical data, mode of diagnosis, interventional procedure and access used, procedure end points and available clinical and imaging follow-up data were analysed from case records.

Results

All patients in the study presented with ascites, and BCS was diagnosed on USG and Doppler studies demonstrating hepatic venous/IVC stenosis/occlusion; most patients had hepatic venous lesions. Balloon venoplasty without stent placement under general anaesthesia with an intent of recanalising at least one hepatic vein was performed in 80 (97.6%) cases; all 3 hepatic veins could be recanalised in 15 cases, 2 could be recanalised in 59, and 1 could be recanalised in 6. All IVC lesions could be recanalised. Transjugular access was used in all cases for venoplasty; transhepatic access was additionally required for wire negotiation across hepatic venous lesions, which could not be accomplished through the transjugular route in 4 cases. The procedure could not be performed in 2 cases secondary to failure in access after repeated attempts. No serious peri-procedural complications were seen in any of the cases. All patients were anticoagulated for life. Follow-up was available in 67 (83.7%) cases treated, follow-up period ranged between 3 months and 5 years. Patency rate at 3 months was 88%, and 8 patients (12%) required and underwent repeat venoplasty. Patency rate was 100% at the 6-month (available in 61 cases), 1-year (available in 46 cases), 3-year (available in 38 cases), and 5-year (available in 36 cases) follow-ups in at least 1 hepatic vein, and there was no symptom recurrence in any of these cases.

Conclusion

Percutaneous venoplasty alone without stenting for pediatric Budd–Chiari syndrome has been shown to have excellent technical success and patency rates with a low re-intervention rate and no complications in this retrospective study.

P-572

Outcomes of 143 cases of percutaneous hydrodynamic rheolytic thrombectomy (Angiojet) with a long-term follow-up: an endovascular first approach

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Purpose

To evaluate the long-term outcomes of occluded vascular accesses treated with hydrodynamic rheolytic thrombectomy (Angiojet) as the first-line therapy.

Material and methods

Over a 3-year period, all consecutive patients with occluded dialysis accesses treated with hydrodynamic rheolytic thrombectomy were identified retrospectively. In our institution, all occluded dialysis accesses were treated endovascularly unless the access was less

than 6-week old. All procedures were performed with the AngioJet DVX catheter (Boston Scientific) alongside other adjunctive procedures, and the underlying stenotic lesions were treated with high-pressure balloons. Stents and stentgrafts were deployed to treat persistent recoil and venous ruptures. Endpoints of the study were technical success and primary and secondary patency rates. All patients were enrolled into an ultrasound Doppler surveillance program. Follow-up data was analyzed using Kaplan–Meier survival curves.

Results

Overall, 143 thrombectomy procedures were performed in a 3-year period. Eighty-eight procedures were on autogenous AVF and 55 on arteriovenous grafts. We achieved 89% technical success. The average thrombus length was 29.5 cm. The primary patencies at 6 months, 1 year, and 5 years were 40%, 24%, and 11%, respectively. The secondary patencies at 6 months, 1 year, and 5 years were 80%, 76%, and 56%, respectively.

Conclusion

Hydrodynamic rheolytic thrombectomy is an effective first-line treatment for re-establishing dialysis access following thrombotic occlusion with satisfactory long-term secondary patencies.

P-573

Lymphangiography and thoracic duct embolization (TDE) following unsuccessful thoracic duct ligation: imaging findings and outcomes

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Purpose

To summarize the imaging findings and outcomes of TDEs performed on patients with chylous leaks persisting after TD ligation.

Material and methods

Review of 47 patients (27M, median age 60 years) referred for TDE following an unsuccessful surgical TD ligation from 1997 to 2014 was performed. Records were reviewed for mechanism of leak, lymphangiographic findings, technical success of TDE, and resolution of leak. Patients were categorized based on the mechanism of chylous leaks and lymphangiographic findings.

Results

Fifty-six lymphangiograms in 47 patients with persistent chylous leaks after surgical TD ligation were included. Etiologies were 40 post-surgical chylous and 7 non-traumatic chylous leaks. Lymphangiography identified technically successful TD ligations in 13 patients (28%), with 11 having a complete ligation near the diaphragm with collaterals extending around the ligation and 2 having a complete ligation in the mid-TD. TD ligation missed TD completely in 19 patients (40%), and ligation was incomplete (non-occlusive) in 15 patients (32%). Resolution of the chylous leak occurred in 40 patients overall (89%). Resolution of the chylous leak did not differ based on etiology ($p=0.99$). Resolution of the chylous leak was significantly higher in patients with missed ligation or incomplete occlusion (94%) compared with that in patients with complete ligation (62%; $p=0.015$).

Conclusion

After a failed TD ligation, missed or incomplete ligation is the most common finding on lymphangiography. Patients with complete ligation of TD were significantly less likely to show resolution of their effusion after TDE compared with patients with missed or incomplete ligation. These observations support the use of imaging-guided closure of TD as opposed to surgical ligation.

P-574

Catheter-directed intra-arterial thrombolysis of frostbite injuries of hands and feet

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Learning Objectives

To demonstrate angiographic and clinical findings of frostbite injuries, technique of intra-arterial thrombolysis, and correlation of angiographic response with clinical outcome.

Background

Microvascular thrombosis plays a dominant role in the vascular stasis phase of frostbite and is the pathophysiological basis for tissue ischemia and late necrosis. Intra-arterial thrombolysis can be used as a part of multidisciplinary approach for severe frostbite injuries of hands and feet. Six patients with altogether 12 extremities (9 hands and 3 feet) and 60 affected digits were treated.

Clinical Findings/Procedure

A 5 F diagnostic catheter is navigated from common femoral artery access into brachial artery in case of hand ischemia, or superficial artery in case of foot ischemia, correspondingly. The infusion rate of t-PA is 0.3 mg/hour and with urokinase 30 000 units/hour, correspondingly. Control angiography is scheduled every 12–24 hours. Concurrent low molecular weight heparin is administered, and in selected cases, intravenous infusion of eptifibatide is also used during and after thrombolytic therapy for 24–36 hours. Thrombolytic therapy is terminated when the angiographic response is complete or after 48 hours. Among the 12 treated extremities, good or excellent angiographic response was achieved in 10 extremities (83%). The clinical recovery was good in all these 10 limbs, with no amputations. In 2 limbs, the angiographic response was only fair, resulting in the amputation of 5 digits at the interphalangeal level, with the total rate of amputations being 8.3%.

Conclusion

Intra-arterial catheter-directed thrombolysis has an important role in tissue preservation and salvage in frostbite and should be available in centers treating deep frostbite injuries of hands and feet.

P-575

Principles and techniques for endovascular embolization in urgent trauma cases

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Background

Percutaneous embolization is an established technique that is useful in the treatment of many urgent trauma injuries. Percutaneous embolization is a lifesaving procedure that can control bleeding in an expeditious and minimally invasive manner compared with standard surgical interventions. The aim of percutaneous embolization in trauma is the intentional and controlled occlusion of vessels to stop hemorrhage.

Clinical Findings/Procedure

The aim of this poster is to illustrate principles and techniques for endovascular embolization in urgent trauma cases: 1) isolation (sandwich) technique, 2) packing technique, 3) coiling technique, and 4) stenting technique.

Conclusion

Percutaneous embolization is a minimally invasive procedure with an established role for the management of urgent trauma cases. The knowledge of possible endovascular techniques can lead to a more effective and safer procedure, particularly in urgent trauma cases.

P-576

Role of interventional radiology in the management of post-sleeve gastrectomy complications

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Learning Objectives

1. To identify the common and rare laparoscopic sleeve gastrectomy (LSG) complications in diagnostic imaging modalities.
2. To identify the role of IR management in treating LSG complications.
3. To perform follow-up of treated complications and demonstrate IR procedural effectiveness.

Background

- Bariatric surgery is considered the best long-term treatment for weight loss in patients with conditions, including hypertension, type II diabetes mellitus, cardiovascular disease, sleep apnea, respiratory insufficiency, arthritis, cancer, and psychiatric disorders, and it causes significant improvement in comorbid conditions.
- LSG has recently gained popularity in the management of morbid obesity because of its simplicity, safety, and good outcomes compared with other techniques, which makes it more preferred than other procedures. Therefore, the number of patients undergoing this procedure will continue to rise. With the increasing number of LSG cases, the number of complications will also increase.
- In our poster, we are presenting the common and rare postoperative complications and the efficient role of interventional radiology in their management.

Clinical Findings/Procedure

In our poster, we are presenting a single-center experience in the management of post-LSG complications.

- 1- Staple line leak: treated with a stent placed at the site of suspected leak under fluoroscopic guidance.
- 2- Abdominal collection: treated with percutaneous drainage under CT guidance.
- 3- Portal/superior mesenteric vein thrombosis: treated using catheter-directed thrombolysis/thrombectomy under fluoroscopic guidance, either through the splenic or portal approach.
- 4- Aorto-enteric fistula: treated through aortic stent placement and coiling of the fistulous tract.

Conclusion

Most LSG complications can be identified by diagnostic radiology and treated efficiently using specific interventional radiology techniques.

P-577

The first interventional radiology training programme in the United Kingdom: set-up, implementation and lessons learnt

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Learning Objectives

1. How an interventional training programme can be developed.
2. How trainees can collaborate across regions to enrich their learning experience.
3. How a training programme can create the best learning experience.

Background

As senior trainee representatives for the North West School of Radiology, we worked in conjunction with the Dean of Radiology for the North West and Liverpool School of Radiology to devise an interventional radiology teaching programme, the first of its kind in the United Kingdom and possibly Europe.

Clinical Findings/Procedure

A new training programme was created to specifically cater to the needs of IR trainees. The collaboration between leading experts in various fields of IR and the health industry resulted in regular full teaching days spread throughout the year to deliver a comprehensive teaching day that meets the curriculum requirements. The need for a structure, outlined educational needs and support from leading experts along with industrial engineers/product managers helped establish a better understanding for the trainees and develop a foundation of building blocks for appreciating troubleshooting techniques in the future.

Conclusion

The feedback obtained from trainees was positive. Our recent BSIRT echoed the national need for a structured IR teaching programme. Our new IR training program within the Northwest-Mersey Deanery has been successful in delivering the educational needs of future IR doctors; creating a network of collaboration between trainees, leading experts and the health industry and building blocks pertaining to understanding the best IR management techniques that can be safely used for our patients.

P-578

Obtaining consent for interventional radiology procedures: a primer for radiology residents

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Learning Objectives

1. Describe the essential components of an informed consent.
2. Discuss the common, uncommon, and rare but significant complications of common vascular and non-vascular IR procedures, such as CVL, biopsies and drainages, ablations, and embolizations.
3. Provide updated complication rates from literature as a ready reckoner.
4. Answer some of the commonly asked questions by patients during the consent process (e.g., "What is the chance of bleeding?" "How long will the procedure take?" "How long will I stay in recovery?" "What is the radiation dose and risk?").

Background

Obtaining consent is one of the most important step before any IR procedure. This is an opportunity for the patients to ask questions

about the procedure with respect to what to expect and for the IR physician to educate the patients with respect to IR. Informed consent is also an important medicolegal and patient safety issue. Diagnostic radiology residents, usually the first-year ones, are entrusted with this important responsibility at the academic training hospitals. However, many a times the first-year residents have limited prior exposure to IR; thus, they may not be well-equipped to obtain informed consent from patients.

Clinical Findings/Procedure

This exhibit will serve as a primer for new radiology residents to grasp the essential components of obtaining consent for IR procedures.

Conclusion

This exhibit will serve as a primer for new radiology residents to grasp the essential components of obtaining consent for IR procedures.

P-579

Entrustable professional activities for interventional radiologist trainers

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Learning Objectives

1. To define entrustable professional activities (EPAs) in the context of competence-based medical education, as applied to interventional radiology training.
2. To identify the key components and sequencing of effective EPAs in the context of workplace-based assessment and decisions regarding competence acquisition.
3. To explain the role of EPAs in the appropriate "licensing" of procedural responsibilities.

Background

CIRSE has lead the way in developing the European Syllabus and Curriculum for Interventional Radiology and has established the European Board of Interventional Radiology (EBIR) examination as the principle means of assessing the required knowledge base. Consistent with other examinations, EBIR does not assess the trainee's competence in day-to-day activities in the IR suite, on the ward, or in the outpatient clinic; nor does it inform an IR trainer's decisions regarding signing off a trainee as "competent" in a given procedure/skill.

Clinical Findings/Procedure

Workplace-based assessments such as mini-individual patient exercise and direct observation of procedural skills have been used to assess actual competence in these practical settings. EPAs are a recent concept in assessing "units of professional practice" for evaluating a number of competencies simultaneously and providing trainers with a framework within which a trainee's competence and level of required supervision can be assessed based on observed levels of proficiency. EPAs can be used to inform "licensing decisions" within a program.

Conclusion

EPAs are a useful means of assessing a trainee's competence in the workplace and can aid trainers in decision-making regarding required levels of supervision and in informing "licensing decisions".

P-580

Do not let hemodynamics shock you: understand the variables and the available tools

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Learning Objectives

1. Review the major tools available for hemodynamic monitoring.
2. Understand and interpret the variables these tools measure.
3. Present an update on the current evidence evaluating the merit of these tools.
4. Outline the utility and practicality of these tools for the practicing interventional radiologists.

Background

Interventional radiologists play an integral role in the care of patients in all clinical settings. Therefore, it is not uncommon for the interventionalists to be involved with critically ill patients in tenuous hemodynamic states. In addition, many of the medications administered during an intervention have additional direct effects on already fragile hemodynamics. As a result, having a fundamental understanding of hemodynamic monitoring allows the interventional radiologist to ensure safety throughout patient care.

Clinical Findings/Procedure

Appropriate treatment of shock requires prompt determination of the etiology of the hemodynamic instability. This educational exhibit aims to help achieve this by reviewing the major physiological variables and labs utilized to assess and analyze a patient's hemodynamic status and descriptions of major non-invasive and invasive tools available for hemodynamic monitoring. For each tool, we will present how it measures various hemodynamic parameters and any relevant research or evidence for that specific tool.

Conclusion

While many IR interventions are performed on an elective basis, at times critically ill patients may require interventions or a patient may become hemodynamically compromised during or after a procedure. A fundamental understanding of hemodynamic monitoring and the available tools will allow the interventional radiologist to safely monitor patients at all stages of procedural care.

P-581

Yale interventional radiology periprocedural coagulation management guidelines

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Learning Objectives

To propose a rational and practical system of periprocedural coagulation parameters based on Yale interventional radiology guidelines.

Background

Increasing prevalence of antiplatelet and anticoagulation agents complicates periprocedural care. Present guidelines frequently lead to unnecessary delays in care, increased cost, and overuse of reversal agents.

Clinical Findings/Procedure

Category 1: No lab requirement. Do not hold anticoagulants.

Non-tunneled venous line, IVC filter placement/retrieval, dialysis intervention, para-/thoracentesis, catheter or venous line exchange/removal, thyroid FNA, and superficial node biopsy.

Category 2: INR 1.7–2.0, platelets 25,000–50,000. Hold anticoagulants except ASA. Restart in 6 hours.

A. Correct intraprocedurally: Tunneled line/peritoneal/pleural catheter, transjugular liver biopsy, angiography (≤ 7 Fr), cholecystostomy, and abscess drainage.

B. Correct preprocedurally: Port placement, gastrostomy/jejunostomy placement, and percutaneous biopsy (except renal or spleen).

C. Tunneled central venous lines: INR < 2 and platelets $> 20,000$

Category 3: INR < 1.7 , platelets $> 50,000$. Hold all anticoagulants. Restart in 24 hours.

Renal/spleen biopsy, nephrostomy, biliary drain placement, TIPS, and percutaneous ablation.

Conclusion

1. Present guidelines lead to delays, increase cost, and expose patients to needless risks. Our protocols aim to optimize patient care and minimize unnecessary usage of reversal agents.

2. No need to transfuse FFP for INR ≤ 1.7 .

3. Hold anticoagulants for five half-lives (i.e., 97% elimination) for near complete reversal in a non-emergent setting.

4. For emergent reversal of warfarin, provide periprocedural infusion of 4 U FFP or Kcentra. Do not recheck INR.

P-582

Radiology in social media: a 15-month trend

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Learning Objectives

To evaluate and quantify the current presence of diagnostic and interventional radiology journals and organizations on social media and professional networking sites.

Background

Social media is the most popular means of interpersonal communication worldwide, with a heavy influence and distribution of major global events. Success of patient-centered interaction with their radiologist is predicated on its use. Archived lists of current diagnostic and interventional radiology journals (n=199) and organizations (n=150) across the globe were obtained from SCImago Journal & Country Rank and RNSA.org, respectively, to investigate their presence on three major social media networking websites (Facebook, Twitter, and LinkedIn). The activity of each entity was determined by documenting the following metrics of popularity: "likes" on Facebook, "followers" on Twitter, and "members" on LinkedIn. Data was collected on Oct 4, 2015 and Feb 10, 2017, with changes in percentages observed.

Clinical Findings/Procedure

Among all major radiology journals, there was a 4% increase in the presence on Facebook (from 37% to 40%), 1% increase on Twitter (from 9% to 10%), and 3% increase on LinkedIn (from 6% to 9%) between 2015 and 2017. CVIR and JVIR were the only IR journals found on all three platforms. There was a 6% increase in the presence of radiology organizations on Facebook (from 45% to 51%), 8% increase on LinkedIn (from 34% to 46%), and 4% decrease on Twitter (from 37% to 33%) between 2015 and 2017. The most popular radiology organizations in 2017 were ACR (86,416 likes on Facebook; 25,300+ followers on Twitter), RSNA (79,124 likes on Facebook; 28,700+ followers on Twitter), and the European Society of Radiology (156,000+ likes on Facebook; 7434 followers on Twitter).

Conclusion

Lack of social media assimilation currently exists in radiology.

P-583

Minimally invasive interventional procedures in patients with complications after lung transplantation

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Background

Lung transplantation is an accepted treatment option for severe end-stage pulmonary parenchymal and vascular diseases. It increases the quality of life and survival of patients; however, recipients are at a high risk of developing many different complications, with a severe impact on morbidity and mortality.

Clinical Findings/Procedure

Representative cases of minimally invasive interventional procedures among lung transplant recipients will be described, such as the following: radiology-assisted balloon dilation and/or stent placement in bronchial stenosis after failure of the standard bronchoscopic approach, combined percutaneous (CT-guided) and bronchoscopic approach for the treatment of airway occlusive stenosis after endobronchial debridement failure, radiology-assisted endobronchial lung abscess drainage after failure of standard endobronchial drainage, diagnosis and management in recipients with massive hemoptysis due to pulmonary arteriovenous malformations and subsequent endovascular embolization, radiology-assisted selective recruitment for lobar atelectasis, CT-guided biopsy of solid nodules, and image-guided percutaneous drainage of pleural fluid collection.

Conclusion

Minimally invasive interventional procedures play a key role in the management of patients with complications after lung transplantation.

P-584

Lymphangiography and interventional techniques in diagnosis and treatment of lymphatic leaks

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Learning Objectives

1. To understand the anatomy and physiology of the lymphatic system.
2. To know the different techniques for evaluating the lymphatic system.
3. To describe the different methods that can be used to access the lymphatic ducts.
4. To review the indications of lymphatic duct embolization.

Background

Lymphangiography is a technique that allows the study and treatment of the lymphatic system and diseases related to it. Previously, lymphangiography was the gold standard to stage many cancers. However, its use declined as cross-sectional techniques became the standard for cancer staging. Recently, the development of

intranodal lymphangiography has improved and simplified the technique, expanding its availability and performance.

Clinical Findings/Procedure

Lymphatic leaks may occur as a complication of congenital diseases and after trauma to the lymphatic system, mainly after oncological or cardiothoracic surgery. If a conservative approach is not effective in managing the leak, surgical and interventional treatments may be the only options to treat chylorrage and its complications. When leaks are below 500 cc/24 h, lipiodol itself can act as a contrast and therapeutic agent. When leaks are larger, direct embolization may be required. Access to the lymphatic leak can be obtained through various techniques, including ultrasound for retrograde thoracic duct access, fluoroscopy, and CT or cone beam CT for the cisterna chyli.

Conclusion

Lymphangiography and lymphatic embolization should ideally be performed after the use of noninvasive imaging and multidisciplinary team discussion. Imaging-guided radiological techniques can be considered the treatment of choice for patients suffering from lymphatic leaks because their safety and efficacy have been widely demonstrated.

P-585

Novel use of optical coherence tomography (OCT) for paediatric airway assessment following bioabsorbable bronchial stenting

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Learning Objectives

1. To learn the indications and contraindications of bioabsorbable bronchial stenting in paediatric patients.
2. To learn about the tips, tricks and technical challenges of stenting the paediatric airway.
3. To learn about the value of optical coherence tomography (OCT) in paediatric airway assessment following stenting with images as examples.

Background

Acquired laryngeal stenosis in a newborn is frequently associated with prolonged endotracheal intubation. Diagnosis may be made during endoscopy because other non-invasive modalities lack the spatial resolution to elicit the underlying pathology. OCT produces dynamic, very-high-resolution, non-invasive cross-sectional images to a tissue depth of up to 2 mm using a filament just 1–2 mm in diameter. It is increasingly used for the initial assessment and surveillance of the paediatric airway.

Here we describe the novel use of OCT in the surveillance of laryngeal stenosis after stenting as well as the role of bioabsorbable stenting with its key technical aspects.

Clinical Findings/Procedure

The procedure is performed in a paediatric interventional suite with general anaesthetics. The lesion and stent may be initially assessed with bronchoscopy. The OCT filament is advanced across the lesion over a 0.14 guidewire, and images are automatically gathered over a short (e.g. 5 cm) length and instantly displayed on the OCT terminal. We present the imaging appearances of laryngeal stenosis, the stent at various stages of absorption and stages of cartilage formation gathered from our experience with the patients we have treated.

Conclusion

OCT is a novel technique that is increasingly adopted in specialist centres for the assessment and monitoring of the paediatric airway before and after bioabsorbable stenting.

P-586

Efficacy and safety of ethanol ablation for branchial cleft cysts

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Learning Objectives

We tried to evaluate the efficacy and safety of ethanol ablation (EA) for the treatment of branchial cleft cysts (BCCs).

Background

Both chemical ablation with OK-432 and EA are widely used to treat cystic lesions of the neck and oral cavity. However, except for a case report by Fukumoto et al., there have been no studies on the efficacy and safety of EA in BCCs.

Clinical Findings/Procedure

Between September 2006 and October 2016, EA was performed in 22 patients who refused surgery for a second BCC. After the exclusion of two patients who were lost to follow-up, the data of 20 patients were retrospectively evaluated. All index masses were confirmed as benign before treatment. Ultrasound-guided aspiration of the cystic fluid was followed by injection of absolute ethanol (99%) into the lesion. The injected volume of ethanol was 50%–80% of the volume of fluid aspirated. The mean index volume of the cysts was 26.4 ± 15.7 mL (range: 3.8–49.9 mL). After ablation, the mean volume of the cysts decreased to 1.2 ± 1.1 mL (range: 0.0–3.5 mL). The mean VRR at last follow-up was $93.9\% \pm 7.9\%$ (range: 75.5%–100.0%, $P < 0.001$). Therapeutic success was achieved in all nodules (20/20; 100%), and the symptomatic ($P < 0.001$) and cosmetic ($P < 0.001$) scores had improved significantly by the last follow-up. In one patient, intracystic hemorrhage developed during the aspiration; however, no major complications occurred in all patients.

Conclusion

EA is an effective and safe treatment for patients with BCC who refuse or are ineligible for surgery.

P-587

“Mind your saw” popliteal artery pseudoaneurysm post-knee replacement and management strategies

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On day 3 after total-knee replacement, an ultrasound for suspected deep vein thrombosis showed a popliteal pseudoaneurysm. We discuss various clinical presentations of popliteal artery injury after orthopaedic procedures, the different imaging modalities and diverse treatment approaches.

P-588

The father of interventional radiology Dr. Charles T. Dotter

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Presenting a biographical case study of Dr. Charles Theodore Dotter. “Crazy Charlie” was a true pioneer in the field of arterial intervention.

This poster will explore the historical aspects underlying his work, including perspectives from his contemporary colleagues.

P-589

Successful removal of a malpositioned intrahepatic chest drain via tract embolization with n-butyl-2-cyanoacrylate

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We report the case of an 85-year-old woman with pyothorax in whom a 20-Fr chest drain was malpositioned into the liver, with right hepatic vein penetration. To address severe coagulopathy, we removed the drain via tract embolization with n-butyl-2-cyanoacrylate.

P-590

Fenestration of the portal vein: a rare anomaly

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Fenestration of the portal vein was revealed between the anterior and posterior branches of the right portal vein during portal vein embolization. Although it is an unusual anomaly, we should care for it because it could cause non-targeted embolization.

P-591

Cinacalcet induced parathyroid hemorrhage in a patient with chronic renal failure

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Cinacalcet is used to treat secondary hyperparathyroidism due to chronic renal failure. A 30-year-old woman taking cinacalcet complained of sudden shortness of breath and neck pain due to parathyroid hemorrhage. Transarterial embolization of the superior thyroid artery with glue was successfully performed.

P-592

Percutaneous treatment of an idiopathic chylopericardium

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We present the case of a 16-year-old patient diagnosed with an idiopathic chylopericardium and treated with nodal lymphangiography, followed by percutaneous embolization of anomalous pericardial lymphatic vessels.

This is a new and less-invasive technique in the treatment of this pathology.

P-593

Hemosuccus pancreaticus due to splenic artery aneurysm associated with segmental arterial mediolysis (SAM) successfully treated with transcatheter arterial coil embolization: a case report

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A 53-year-old male presented with recurrent melena. Abdominal CT revealed arterial dilatation extending from the celiac trunk to the splenic artery, a part of which protruded into the pancreatic duct. Transarterial embolization was successfully performed using coils with the isolation and packing technique.

P-594

Treatment of refractory chylothorax and lymphocele by intranodal lymphangiography with lipiodol injection

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We present four patients with a refractory chylous leakage despite conservative treatment, including two cases of chylothorax after esophageal cancer surgery and two cases of lymphocele after hysterectomy surgery, who were treated successfully by percutaneous intranodal lymphangiography with lipiodol injection.

P-595

Percutaneous cryoablation of reninoma

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A 21-year-old female with hypertension; CT scan revealed a small solid lesion in the right kidney. Venous renal sampling showed hyperreninemia. We performed percutaneous cryoablation of the renal mass without complications and normalization of blood levels of hormones.

P-596

Two cases of neonatal refractory chylothorax after surgery for congenital heart disease treated with percutaneous intranodal lymphangiography

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We recently encountered two cases of neonatal refractory chylothorax treated with percutaneous intranodal lymphangiography after surgery for congenital heart disease. In both cases, a beneficial therapeutic effect was obtained with only percutaneous intranodal lymphangiography.

P-597

Atypical approach to male infertility in a severely oligozoospermic patient

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We treated a 28-year-old male patient with post-surgical left varicocele recurrence and suspected accidental left deferens duct ligation by ascending sclerotherapy; vesiculo-deferentography showed verum montanum stenosis. Through retrograde urethrography, left ejaculatory duct retrograde recanalization was successfully performed.

P-598

A novel catheter fragment snaring technique without freeing the catheter end: successful retrieval of a dislodged catheter stuck to the coronary sinus

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The catheter pinch-off syndrome is a rising complication increasing with central venous port catheter implants. We report a successful retrieval of a dislodged catheter stuck to the coronary sinus using a novel snaring technique without freeing the catheter end.

P-599

An unusual cyanosis after a Fontan operation

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In a woman with a history of Fontan surgery (single ventricle and common atrioventricular valve) and a 12-year-old dyspnea, TC detected shunt between hepatic and pulmonary vein. A covered stent was implanted. Oxygen saturation increased until 95%. Fontan operation may trigger hemoglobin deoxygenation.

P-600

Percutaneous sclerotherapy for penile venous malformation presenting with per urethral bleeding

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Venous malformation (VM) of the penis is a very rare cause of per urethral bleeding. We report two cases of penile VM presenting with painless per urethral bleeding and anemia. Both the patients underwent two sessions of percutaneous sclerotherapy without any procedure-related complications.

Peripheral vascular disease intervention

P-601

Twenty-four-month results of the Tack Optimized Balloon Angioplasty (TOBA) study demonstrate the benefits of minimal metal implants for dissection repair after angioplasty

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Purpose

Angioplasty often results in dissections and remains a significant problem. Dissections are typically managed with stents, which are associated with high rates of in-stent restenosis. The Tack Optimized Balloon Angioplasty (TOBA) study evaluated the safety and efficacy of a novel minimal metal system for the treatment of post-PTA dissections with an up to 24-month follow-up.

Material and methods

This prospective, single-arm study evaluated patients with Rutherford category (RC) 2–4 caused by lesions of the superficial femoral and popliteal arteries. Patients were treated with standard balloon angioplasty, and post-PTA dissections were treated with Tacks. The primary endpoints were device technical success (ability of the Tack implants to resolve post-PTA dissection) and device safety (absence of new-onset major adverse events). Patients were followed up for 24 months after implantation.

Results

Tacks were used in 130 patients with post-PTA dissections (74.0% grade C). Technical success was achieved in 128 (98.5%) patients with no major adverse events at 30 days. Twelve-month patency was 76.4%, and freedom from target lesion revascularization (TLR) was 89.5%. Significant improvement from baseline was observed in Rutherford clinical category and ankle-brachial index at 12 months ($P < .0001$). Twenty-four-month follow-up was performed on a subset of 11 patients from a single site, with no loss of patency from the 12-month follow-up.

Conclusion

Tack implant treatment of post-PTA dissection was safe and resulted in low rates of TLR. Tack treatment represents a new, minimal metal paradigm for dissection repair that can safely improve the clinical results associated with PTA.

P-602

Six-month patency of the Eluvia drug-eluting stent for long SFA occlusions: initial experience

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Purpose

Existing data from the Majestic trial shows improved freedom from TLR at 2 years for the Eluvia drug-eluting stent (92.5%) in severely diseased or occluded SFA/proximal popliteal arteries < 11 cm compared with the data for the drug-eluting Zilver PTX (87%) and bare-metal stents (75%–84%). The purpose of this study was to assess the primary patency of the Eluvia drug-eluting stent in long (>10 cm) SFA occlusions at an initial follow-up of 6 months.

Material and methods

Institutional review board approval was gained prior to enrolment. Patients were enrolled prospectively in the study if there was SFA/

proximal popliteal artery occlusion >10 cm treated with an endovascular approach comprising placement of 1 or more Eluvia stents. Patency was assessed at 30 days post-stent insertion and again at 6 months.

Results

Twelve patients (6 male, 6 female) with a mean age of 70 years were included. The mean Rutherford score was 5 and occlusion lengths ranged from 10 to 32cm, mean 24cm. The mean stented diameter was 6mm, and $>50\%$ of patients were treated with overlapping stents.

Follow-up was obtained for 9/12 patients at 30 days and showed 100% patency. At 6 months post-stent insertion, follow-up was obtained for 6 patients, of which 5 patients had patent stents and 1 had occluded stent.

Conclusion

This is the first study to assess performance of the Eluvia drug-eluting stent in long SFA/proximal popliteal occlusions. Our initial experience with the Eluvia drug-eluting stent in this challenging patient cohort is promising, albeit with a small number of patients and a short follow-up. We will update our data as we enrol patients and gain further follow-up.

P-603

Is catheter directed thrombolysis obsolete for the treatment of acute limb ischemia with the new available mechanical thrombectomy devices?

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Purpose

With the introduction of percutaneous mechanical thrombectomy (PMT) techniques, more rapid reperfusion can be achieved for treating acute lower limb ischemia (ALLI). Data comparing the traditional treatment with catheter-directed thrombolysis (CDT) versus PMT is scarce. Our study aims to compare CDT and PMT for the treatment of ALLI.

Material and methods

A retrospective review consecutive cases between 2006 and 2015 was performed. The technical success, clinical success, 30-day amputation rate, 30-day mortality, complication rate, and hospitalization duration were calculated and compared between the groups. Binary logistic regression analysis was performed to identify predictors of technical and clinical success.

Results

Overall, 29 cases of PMT and 88 cases of CDT were included. Groups were comparable, except for more previously stented vessels ($p < 0.001$), more proximal thrombosed segments ($p = 0.029$), and lower Rutherford scores ($p = 0.001$) in the PMT group.

Higher technical success was observed in the PMT group (69% vs. 47%) ($p = 0.036$). Similar clinical success (76% vs. 73%) ($p = 0.740$) and 30-day amputation rates (10% vs. 15.9%) ($p = 0.556$) were observed in both groups. Hospitalization duration was shorter in the PMT group (6.6 vs. 12.5 days) ($p = 0.001$).

Patients treated with PMT were 3.2 (95% CI 1.1–9.3, $p < 0.035$) times more likely to achieve technical success.

PMT is not a predictor of clinical success ($p = 0.695$). Patients without ESRF had a higher tendency of achieving clinical success [HR 3.3 (95% CI 0.809–13.592) ($p = 0.096$)].

A comparable 30-day mortality and bleeding complications were observed in both groups.

Conclusion

PMT achieves a higher technical success and requires a shorter hospitalization duration compared with CDT; they show a comparable clinical success, limb salvage, and safety profile. ESRF seems to be a risk factor for a poor clinical outcome.

P-604

Real-world experience with a paclitaxel-coated balloon for the treatment of atherosclerotic infrainguinal arteries: 12-month results of the BIOLUX P-III all-comers registry

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WITHDRAWN

P-605

Previously failed endovascular or surgical revascularization in the setting of non-healing ulcer and/or foot gangrene: endovascular salvage of a long-standing occluded (>1 year) fem-pop arterial graft via retrograde tibial access

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Purpose

To report endovascular outcomes of salvaged long-standing occluded (>1 year), abandoned, fem-pop arterial graft via retrograde tibial access and long-covered stents.

Material and methods

IRB approval was obtained. A retrospective review was performed. Inclusion criteria: patients who needed lower extremity revascularization for leg/foot ulcer or gangrene (Rutherford 5 and 6). All patients had previously failed multiple endovascular and surgical revascularization, otherwise they were no longer surgical revascularization or antegrade endovascular candidates. No patients were thrombolysis candidates because of long-standing occluded grafts. Exclusion criteria: patients with rest pain and claudication. Technical success (creating inline flow to the foot), clinical success rates (ulcer healing), limb salvage rates, and planned (for gangrene) and unplanned amputation rates were reported.

Results

Twelve lower extremities were attempted to be treated in 12 patients. All patients had covered self-expanding stents within the previously abandoned fem-pop graft. The technical success rate for inline flow to the foot was 92% (one patient had prior bypass surgery with ligation). Primary patency rates of inline flow at 6 and 12 months were 92% and 83%, respectively. Of the 12 patients, one patient had undergone above the knee and one had undergone below the knee amputation. Major amputation rates at 6 and 12 months were 92% and 83%, respectively. Planned minor

amputations were 8 patient amputations and 2 metatarsal amputation due to gangrene (Rutherford 6 patients).

Conclusion

In patients with prior failed revascularization (antegrade endovascular or conventional surgical revascularization), salvage of the previously abandoned fem-pop graft is a viable option using self-expanding covered stents and antegrade/retrograde crossing tibial access.

P-606

Randomized clinical trial to compare ultrasound-enhanced delivery of paclitaxel and DEB in patients with critical limb ischemia and femoral-popliteal disease: outcome of the PACUS trial after 18 months

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Purpose

Treatment of femoral-popliteal calcific lesions and CTO is characterized by poor clinical outcomes. The biggest challenge in treating patients with calcific lesions is the inability of therapeutic drugs to penetrate through the media-intima calcium to reach the vessel wall. In this study, ultrasound plasty associated with local paclitaxel delivery was compared with drug-eluting balloon for the treatment of femoral-popliteal disease in patients with critical limb ischemia.

Material and methods

This single-center, single-blinded randomized trial included 56 patients with critical limb ischemia randomly assigned to 2 treatment groups: 28 patients (control group) were treated with DEB and 28 patients (study group) were treated with ultrasound followed by local administration of paclitaxel in liquid mixture with iopromide 370 at 1µg/mm³. In the study group, the mean lesion length was 168.8mm and 21 patients had calcifications. In the control group, the mean lesion length was 164mm and 23 patients had calcifications.

Results

No adverse procedural events were observed. At the 6-month follow-up, no patient suffered from myocardial infarction, underwent amputation, or died in either group. At 18 months, the rate of TLR was 7.6% (2/26) and the rate of amputation was 0% (0/26). In the control group, the rate of TLR was 44% (11/25) and the rate of amputation was 20% (5/25).

Conclusion

Ultrasound-enhanced delivery of paclitaxel was associated with improved patency, less need for TLR, and less amputations.

P-607

Possible risk factors for restenosis after kissing stenting of iliac arteries

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Purpose

To determine long-term patency rates following reconstruction of the aortoiliac bifurcation with kissing stents and to identify predisposing factors for development of restenosis.

Material and methods

In total, 108 patients [67 females; median age: 61 (55.5–69) years] with symptomatic aortoiliac steno-occlusive disease who underwent kissing stenting of the iliac arteries between 2001 and 2015 at our department were retrospectively analyzed. Symptoms, atherosclerotic risk factors, comorbidities, anatomic variations in the aortic bifurcation, lesion characteristics, and balloon/stent parameters

were examined. The follow-up included clinical exams and duplex scans. Kaplan–Meier analysis, Mann–Whitney U test, Fisher's exact test, and multivariate logistic regression were performed.

Results

In total, 221 stents (12% balloon-expandable and 88% self-expandable stents) were deployed in 108 patients (Fontaine IIA: 3%, IIB: 81%, III: 7%, and IV: 9% and TASC A: 56%, B: 24%, C: 2%, and D: 18%). The median follow-up time was 65 (36–126.5) months. Primary patency rates were 97%, 95%, 91%, 85%, and 81% at 6, 12, 24, 60, and 120 months, respectively. Symptomatic restenosis/reocclusion developed in 17 patients (16%). The restenosis rate was significantly higher among younger patients ($p=0.0012$), in cases with mismatch between the balloon/stent and vessel diameters (irrespective of age) [sum of balloon and stent diameters exceeded the aortic diameter ($p=0.0017$ and $p=0.0149$)], and in patients with high aortic stent length/iliac arterial stent length ratio (right side: $p=0.0065$ and left side: $p=0.0331$).

Conclusion

The kissing stent technique can be used with good patency rates for endovascular treatment of aortoiliac steno-occlusive disease. Age and balloon and stent parameters seem to have an impact on development of restenosis.

P-608

Percutaneous deep venous arterialisation (limflow procedure) for end-stage critical limb ischaemia: early experience from 2 European centres

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Purpose

To report early technical and clinical results of completely percutaneous deep venous arterialisation (DVA) (LimFlow) for the treatment of critical limb ischaemia (CLI) after failed distal angioplasty.

Material and methods

Percutaneous DVA was performed creating a direct shunt between a BTK artery and its satellite deep vein using a dedicated puncture system supported by ultrasound catheters, followed by deployment of a stentgraft covering the anastomosis and distal venous stenting/valvulotomy/angioplasty.

In this early experience, only patients with failed prior interventional attempts at establishing flow ('no-option CLI') with no distal targets for an arterial bypass were selected.

Early technical success was defined as successful shunt creation and retrograde venous perfusion of the wound site.

Patient demographics, procedural details, morbidity/mortality and wound outcomes were assessed prospectively.

Patients were followed up in wound care centres and graft patency was documented on duplex ultrasound.

Results

All 5 consecutive patients (mean age 58 years) underwent successful DVA creation without any procedural complication.

There were no 30-day major adverse limb events or cardiovascular events.

Three out of the five patients (60%) had clinical improvement as observed by resolution of rest pain and complete wound healing. Two patients had yet to achieve clear signs of improvement at the time of reporting as the procedure was performed recently.

The median wound healing time was 39 weeks.

Conclusion

Percutaneous DVA using the LimFlow device is a safe and feasible alternative in patients with end-stage/no-option CLI. The early experience highlights the need for a holistic approach including a dedicated wound care service.

P-609

The 6-month clinical experience with the novel multi-LOC multiple stent delivery system for focal stenting in femoro-popliteal lesions

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Purpose

This observational study assessed the 6-month clinical outcomes in patients with femoro-popliteal lesions suitable for focal stenting with a novel multiple stent delivery system (MSDS). The aim of this study was to use shorter stent segments to avoid longer stents particularly in motion segments.

Material and methods

First results of this novel MSDS (VascuFlex Multi-LOC®) in terms of procedural data as well as preliminary safety and efficacy data are documented in the LOCOMOTIVE All Comers study (ClinicalTrials.gov identifier: NCT02531230). Briefly, LOCOMOTIVE is an observational multicenter study with the primary endpoint target lesion revascularization rate at 6 months. Femoro-popliteal lesions were prepared with uncoated and/or paclitaxel-coated peripheral balloon catheters. When flow-limiting dissection, elastic recoil, or calcification required stenting, up to 9 short individual stents (each 13 mm in length) were implanted. Sonographic follow-ups and clinical assessments are scheduled at post-interventional months 6 and 12.

Results

A total 75 patients (72.9±9.2 years) were enrolled. Cardiovascular risk factors were male gender 64.0% (48/75), diabetes 49.3% (37/75), hypertension 81.3% (61/75), CAD 38.7% (29/75), and history of smoking 70.7% (53/75). The 176 target lesions were TASC C/D (51.1%, 90/176) with reference vessel diameters of 5.6±0.7 mm and an overall total lesion length of 13.7±8.7 cm. With an expected clinical follow-up rate of at least 80%, TLR rates in CLI and non-CLI groups appear to be low compared with those in patients treated with conventional self-expanding peripheral stents.

Conclusion

The first clinical experience at 6 months revealed that the novel MSDS strategy was safe and effective.

P-610

Reperfusion with mechanical aspiration thrombectomy is more efficient than intra-arterial thrombolysis for peripheral arterial occlusions

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Purpose

Treatment of peripheral visceral and arterial occlusions is associated with significant risks of incomplete revascularization and bleeding events. We aimed to compare the time-to-reperfusion and safety of mechanical thrombectomy by aspiration (MTA) versus intra-arterial thrombolytic infusion (IAT) in a patient population with peripheral or visceral occlusion.

Material and methods

In this single-center study, 43 patients with peripheral or visceral occlusion met analysis criteria for frontline treatment with MTA or IAT. Seventeen patients (39.5%) underwent MTA using the Penumbra/Indigo system. Twenty-six patients (60.5%) underwent IAT. The primary endpoint was proportion of patients achieving a thrombolysis myocardial infarction (TIMI) score of 2-3. Serious adverse events (SAEs) and bleeding events within 24 h post procedure were recorded to monitor safety.

Results

All patients presented with TIMI scores of 0-1 and the mean onset-to-hospitalization time was 7 days (IQR: 2-14). Of the patients with reported claudication, none were mild, 30% (6/20) were moderate, and 70% (14/20) were severe. Although the proportion of patients achieving post-procedure TIMI scores of 2-3 were not significantly different for patients who underwent MTA or IAT (88.2% versus 84.6%), the median time-to-reperfusion for patients who underwent MTA and IAT were 69 min (IQR: 55, 149) and 1408 min (IQR: 1072, 1552), respectively ($p < 0.001$). In patients who underwent MTA, there were 0 device-related SAEs and 2 bleeding events within 24 h, whereas there were 4 thrombolytic-related SAEs and 2 bleeding events within 24 h in patients who underwent IAT.

Conclusion

MTA with the Penumbra/Indigo System was safe and effective while achieving significantly shorter time-to-reperfusion than that in patients who underwent IAT, potentially leading to reduced costs because of a shorter hospital stay.

P-611

Technique of percutaneous direct needle puncture of calcified plaque (PIERCE technique) in superficial femoral and tibial arteries

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Purpose

Angioplasty plays an important role in the treatment of PAD. However, even if the guidewire passed through the lesion successfully, we could not advance the catheter or dilate the target lesion successfully because of the heavily calcified plaques, particularly in patients undergoing hemodialysis. No special crossing or debulking devices are available in JAPAN. Therefore, we developed a novel method of percutaneous direct needle puncture of calcified plaque (PIERCE technique).

Material and methods

After local anesthesia, the calcified plaque was directly punctured using 16-23-G needles under fluoroscopic guidance. The needle was selected considering the vascular size, degree of calcification, and depth from the skin.

Between May 2012 and September 2016, recanalization using the PIERCE technique was tried in 11 cases (13 legs).

The PIERCE technique was performed because no device could pass through the calcified plaque after guidewire crossing.

Results

Successful device passage was obtained in 11 lesions (85%) after the PIERCE technique.

Failed device passage was observed in 1 lesion at the lateral tarsal artery (8%).

In one case of ATA (8%), continuous bleeding occurred and we had to embolize the target artery using gelatin sponge particles.

Conclusion

The PIERCE technique is a simple procedure, requires only commonly used needles, and is extremely cost-effective compared with the other crossing devices available in the market. The PIERCE technique plays an important role during recanalization of heavily calcified arteries.

P-612

Does chronic outward force of nitinol stents in SFA trigger restenosis? Interim report of the BIOFLEX-COF study

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Purpose

Self-expanding nitinol stents exert a chronic outward force (COF) on the vessel wall, depending on stent oversizing (ratio of vessel diameter/stent diameter) and stent material ("stiffness" of the stent). In animals and humans, high COF has been linked to neointimal hyperplasia and lumen loss. The BIOFLEX-COF study is the first randomized study to address the influence of COF on neointimal hyperplasia and restenosis.

Material and methods

De novo SFA lesions were treated with nitinol stent implantation. Eighty patients were randomized into high and low COF groups. Stent diameters were chosen after measuring the SFA diameter according to a pre-defined sizing table. To obtain low COF, a soft stent (Pulsar, Biotronic) was implanted with little oversizing. To obtain high COF, a harder stent (Lifestent, Bard) was implanted with ample oversizing. Between the two groups, a 2-3x difference in absolute COF is expected.

The outcome parameter is the volume of the in-stent-neointima measured by CT angiography 1 and 2 years after the implantation.

Results

A total of 50 patients have been recruited and undergone stent implantation. The technical success rate was 100%, and no major complications occurred. All stents could be implanted with the pre-planned amount of oversizing.

Conclusion

The BIOFLEX COF study was scheduled to complete recruitment in 07 2017, and 1 year outcome data are expected in 09-2018. By measuring the actual volume of neointima at every mm along the stent axis rather than only giving a binary restenosis rate, more detailed correlation analyses of COF and neointima formation will be possible.

P-613

Supervised exercise therapy versus percutaneous angioplasty versus combined angioplasty and exercise for intermittent claudication: systematic review and Bayesian network meta-analysis of randomized controlled trials

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Purpose

The authors report the results of a Bayesian network meta-analysis of randomized controlled trials (RCTs) comparing supervised exercise therapy (SET) alone, percutaneous transluminal angioplasty (PTA) alone, or a combination of SET and PTA for the treatment of intermittent claudication.

Material and methods

Medical databases were searched with the PRISMA statement, and 39 RCTs (including five 3-arm studies) comprising 2,983 patients with a 12-month median follow-up (range, 3–24 months) were analyzed in total. Outcome measures included improvements in the maximal walking distance capacity (MWD; meters on treadmill) and quality of life (QoL; SF-36 and EQ-5D instruments) compared with the best medical therapy (BMT) as the anchor control treatment. Bayesian random effects models were employed (WinBUGS).

Results

There were significant improvements in MWD with PTA (+85m, 95%CrI: +4 to +170), SET (+180m, 95%CrI: +130 to +230), and PTA+SET (+290m, 95%CrI: +180 to +390). SET was better than PTA alone (MWD difference +85m, 95%CrI: +16 to +170). PTA+SET was the best treatment with an MWD difference over SET of +110m (95%CrI: +16 to +200). QoL was significantly and strongly improved only in case of PTA+SET (QoL Cohen's d standardized effect size 1.8; 95%CrI: 0.21 to 3.4). Results were stable on sensitivity and consistency analyses without any significant publication bias.

Conclusion

Healthcare systems need to invest in supervised exercise programmes as the first standalone treatment for intermittent claudication and in order to augment the results of peripheral revascularization.

P-614

Factors predicting outcome following catheter-directed thrombolysis in lower limb arterial occlusion

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Purpose

Catheter-directed thrombolysis (CDT) is a well-recognised treatment for acute lower limb ischaemia. Our aim was to analyse factors independently influencing outcomes.

Material and methods

We analysed outcomes in consecutive patients undergoing CDT for limb ischaemia at a single institution. The primary endpoints were amputation-free survival (AFS) and limb salvage (LS) at 1 year. Secondary endpoints included primary, assisted primary and secondary patency using Kaplan–Meier analysis at 1 year.

Results

CDT was performed in 91 (56.5%) native vessel and 70 (43.5%) bypass grafts. Median CDT infusion duration was 28 hours (1–96 hours) with a technical success rate of 68.9%. Major complications included retroperitoneal haematoma (n=2, 1.2%), haematemesis (n=4, 2.5%) and acute renal failure (n=2, 1.2%). AFS and LS at 1 year were 66.9% and 74.8%, respectively. Primary, assisted primary and secondary patencies were 38.2%, 43.7% and 51.2%, respectively, at 1 year. Cox regression analysis identified CKD (P=.04), poor run-off (P<0.001) and lack of antiplatelet therapy (P=.01) as independent factors predicting worse AFS.

Conclusion

CDT had a high technical success and low complication rate, resulting in good LS rates. Better renal function, arterial run-off and the use of aspirin were associated with better outcomes.

P-615

Tigris® stent in ilio-femoro-popliteal advanced disease: mid-term follow-up at a single centre

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WITHDRAWN

P-616

"Angioplasty first" approach for critical limb ischemia: a 10-year experience at the Singapore General Hospital

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Purpose

To review the outcome of patients with critical limb ischemia (CLI) who underwent percutaneous transluminal angioplasty (PTA) as the first-line treatment.

Material and methods

A retrospective cohort study analyzing a total of 1936 patients with 2378 limbs who underwent 3271 PTA procedures for CLI (Rutherford IV–VI) at the Singapore General Hospital between 2005 and 2015 was performed. The mean age of the patients was 68±11 years, and 1036 (54%) patients were male. Diabetes mellitus was present in 1709 patients (88%) and end-stage renal failure (ESRF) in 567 patients (29%). Majority of the patients (2950 patients, 90%) had tissue loss, i.e., Rutherford V–VI.

Results

During the follow-up period, 685 (35%) patients died and 602 (25%) limbs underwent major amputation. Bail-out stenting was required in 383 procedures (11%). Repeat PTA of the same limb was needed in 30% (965 procedures). The limb salvage rate at 12 months was 76%, whereas the survival rate at 12 months was 81%. For ESRF patients, the 12 months limb salvage and survival rates were lower at 69% (p=0.0001) and 68% (p<0.0001), respectively. Major complications included distal embolizations (2.3%, 76 cases) and vessel perforations (2.5%, 81 cases). The 30-day mortality rate was 5.7%.

Conclusion

PTA as first-line treatment for CLI is safe and effective. ESRF patients had significantly poorer limb salvage and survival rates.

P-617

Multicenter feasibility study of microwave radiometry thermometry for noninvasive differential diagnosis of critical limb ischemia in diabetic patients

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Purpose

Diagnosis of vascular involvement in diabetic foot ulcer (DFU) disease remains challenging. We conducted a proof-of-concept study to investigate the feasibility of microwave radiometry (MWR) thermometry for the noninvasive differential diagnosis of critical limb ischemia (CLI) in patients with DFU.

Material and methods

This prospective, multicenter study included 80 patients divided into four groups (group N: normal control subjects; group DN: diabetic patients with verified neuropathic ulcers without vascular involvement; group DC: diabetic CLI patients; and group NDC: non-diabetic CLI patients). Vascular disease was confirmed with angiography. All subjects underwent MWR (RTM-01-RES: University of Bolton, UK) to record mean tissue temperatures at various predetermined foot sites. Comparisons of temperature measurements between study groups were performed using the one-way ANOVA and Dunn tests. ROC analysis was used to determine sensitivity, specificity, and cut-off value of MWR for CLI diagnosis.

Results

Temperatures recorded in diabetic CLI patients were similar to those in non-diabetic CLI patients but significantly lower than those in patients with neuropathic ulcers without vascular involvement and normal controls (group DC: 29.30°C ± 1.89°C vs. group NDC: 29.18°C ± 1.78°C vs. group N: 33.01°C ± 0.45°C vs. group DN: 33.39°C ± 1.37°C; P<.0001). According to ROC analysis, cut-off temperature value to diagnose CLI was <31.8°C (area under the curve: 0.984; 95%CI: 0.965–1.005; P<.001), with a sensitivity of 100.0% (95%CI: 90.26–100.0) and specificity of 88.37% (95%CI: 74.92–96.11).

Conclusion

MWR detected significantly lower tissue temperatures in diabetic and non-diabetic CLI patients compared with non-ischemic controls. MWR could be used as an adjunct for differential diagnosis of arterial ischemia in patients with DFU.

P-618

Peripheral endovascular interventions using human Thiel-embalmed cadavers with extracorporeal flow for medical device testing, development, and training

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Purpose

The numerous benefits of the Thiel method of embalming human cadavers over alternative methods of preservation include a patent

vascular system. A femoral artery model was used to demonstrate peripheral interventions within the anatomy of the human arterial system with the texture, tactile feel, and additional function of extracorporeal driven flow. Applied to clinical training simulations and pre-clinical testing, this model is designed to offer a superior alternative to benchtop and virtual simulations.

Material and methods

In six cadavers, extracorporeal flow was introduced into the femoral artery of both legs. A distal port was most commonly located within the dorsalis pedis artery to form a circuit. Antegrade pulsatile flow introduced within the circuit (200–400 mL/minute) facilitated fluoroscopically guided endovascular interventions such as angioplasty and stenting at various arterial locations. Interventions are assessed using fluoroscopic, CT imaging, and ultrasound imaging.

Results

The results demonstrated that this model can be used to effectively assess the delivery, device apposition, and device-induced effects on flow patterns to the extracorporeal perfused circuit.

Conclusion

The model's versatility and robust preparation and durable over long periods provide the basis to repeatedly assess devices in numerous leg positions, such as knee bend, facilitating options not viable in fresh cadaveric models or animal models. In addition to multimodal imaging providing the tools to assess the device, it also provides the basis for the application of this model for training purposes in full simulation of clinical interventions.

P-619

Comparison of two drug-eluting balloons: Mid Yorkshire Hospital's experience

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Purpose

Previous studies have shown drug-eluting balloons (DEB) to have lower re-intervention rates than traditional percutaneous transluminal balloon angioplasty (PTA) in peripheral angioplasty. However, different manufacturers use different transfer agents to fix the active drug paclitaxel to the balloon. This study aims to compare re-intervention rates of two different manufacturers' DEBs (balloon A and B) at our centre.

Material and methods

All patients who had a DEB deployed from 2013 to 2016 were included. The patients' notes, RIS and PAC records were reviewed to assess the re-intervention rates.

Results

One hundred sixty-nine procedures were performed using DEBs: 81 used balloon A and 88 used balloon B. Fourteen patients required further endovascular treatment; of these, 11 were treated with balloon A (mean = 400, range 0–1050 days) and 3 were treated with balloon B (mean = 30, range = 0–61 days).

Balloon B was introduced more recently to our centre and there are only 18 months of follow-up data available. Within the first 18 months after balloon A deployment, there were 7 patients who required further endovascular treatment.

Nine patients required further surgical management (9 amputations, 1 bypass and 1 endarterectomy) all of which were associated with balloon A deployment.

Conclusion

Overall, our study demonstrates low re-intervention rates for DEBs in peripheral angioplasty. Balloon A was associated with higher rates of re-intervention than balloon B. However, there is lack of long-term

data for balloon B. Relatively small numbers limit the ability to form definite conclusions. This study highlights the idea that different fixation agents on balloons could lead to different efficiency.

P-620

Endovascular distal venous arterialization for critical foot ischemia in patients with diabetes and undergoing dialysis with extremely calcified BTK vessels: a new frontier in limb salvage

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Purpose

This retrospective analysis aims to evaluate the safety and feasibility of distal venous arterialization (DVA) in 5 patients with "end-stage" CLI (Rutherford 5-6) with no remaining open or endovascular options. The rationale was to create an arteriovenous fistula (AVF) shunting arterial blood to the deep veins creating an alternative conduit for perfusion of the peripheral ischemic tissue.

Material and methods

In 5 cases, conventional intraluminal recanalization attempts have been performed from September 2015 to October 2016 to engage the occluded extremely calcific distal target vessel. When subintimal approaches also failed, a "bail-out" alternative re-entry in the lateral plantar vein was obtained. All patients were evaluated for preprocedural and postprocedural TcPO₂.

Results

Technical success was achieved in all patients (100%). In the distal segment of the lateral plantar vein, the presence of valves is rare; therefore, adjunctive techniques were not required to limit valvular competency. The foot salvage rates were 80% and 80% at the 1- and 6-month follow-up, respectively. One (20%) patient underwent reintervention after 3 months and then trans-metatarsal amputation at 6 months. The average TcPO₂ increased at 1 month from 16.7 ± 1.4 to 45.7 ± 1.2 mmHg ($p < 0.001$) and remained stable at the 6-month follow-up.

Conclusion

Although further investigations are needed, DVA is an alternative technique that could have some clinical impact on limb salvage procedures. Increased use of this procedure may help in lowering the amputation rates in patients with CLI, particularly those with diabetes and undergoing dialysis with extremely calcified BTK vessels.

P-621

Two-year results from the IN.PACT global studies and outcomes in patients with diabetes

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Purpose

To expand the clinical evidence with the IN.PACT™ Admiral™ drug-coated balloon (DCB) in the treatment of patients with symptomatic (Rutherford 2-4) femoropopliteal disease.

Material and methods

In total, 1406 subjects were treated with the IN.PACT™ Admiral™ DCB and analyzed as part of the consecutively enrolled clinical cohort. A subset of the clinical cohort, referred to as the imaging cohort,

underwent duplex ultrasound imaging at 12 months and at the time of any reintervention within 12 months to assess target lesion patency. The imaging cohort consisted of three prospectively pre-specified sub-groups, and data for the subjects in each group have been presented: de novo in-stent restenosis (n=131), long lesion ≥ 15 cm (n=157), and chronic total occlusion ≥ 5 cm (n=126).

Results

The mean age of subjects in the clinical cohort was 68.6 ± 10.1 years and 67.8% were males. The mean lesion length was 12.09 ± 9.54 cm, including 18.0% in-stent restenosis, 35.5% total occlusions, and 68.7% calcified lesions. Freedom from CD-TLR within 12 months was 92.5%. Primary safety, defined as freedom from device- and procedure-related mortality through 30 days and freedom from major target limb amputation and clinically-driven target vessel revascularization within 12 months, was 92.1%. The rates of major target limb amputations and thrombosis within 12 months were 0.2% and 2.9%, respectively.

Conclusion

The 12-month results confirm the safety and effectiveness of the IN.PACT™ Admiral™ DCB in femoropopliteal lesions. Detailed 2-year results will be available at the time of this meeting.

P-622

Fractional flow reserve in below-the-knee arteries with critical limb ischemia: validation against the gold standard morphological and functional measures and long-term clinical outcomes

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Purpose

The aim of this study was to assess the applicability of fractional flow reserve (FFR) measurement in below-the-knee (BTK) arteries and to evaluate its correlation with non-invasive functional parameters before and after angioplasty.

Material and methods

For this prospective study, we enrolled 39 patients with critical limb ischemia and BTK stenosis. The trans-stenotic pressure ratio was measured under resting (Pd/Pa) and hyperemic (FFR) conditions and was compared with quantitative angiography-, laser Doppler-, and duplex ultrasound-derived measurements before and after angioplasty. The intervention was performed under routine angiographic guidance.

Results

The intervention was performed with good angiographic results in all patients. On comparing measurements before and after angiography, significant improvement was found in both the resting Pd/Pa [0.79 (0.67–0.90) vs 0.90 (0.85–0.97); $p < 0.001$] and FFR (0.60 ± 0.19 vs 0.76 ± 0.15; $p < 0.001$) conditions. At baseline, the Pd/Pa ratio and FFR were significantly correlated with percent area stenosis ($r = -0.31$, $p = 0.05$ and $r = -0.31$, $p = 0.05$, respectively). After intervention, neither the Pd/Pa ratio ($r = 0.10$; $p = 0.58$) nor FFR ($r = -0.15$; $p = 0.41$) were correlated with area stenosis. Neither FFR nor the resting Pd/Pa ratio showed correlation with laser Doppler- or duplex ultrasound-derived measurements. One year MAEs and MACCEs were observed in 7 (17.9%) and in 9 (23.1%) patients, respectively.

Conclusion

Peripheral FFR measurement was feasible and correlated with the standard morphological but not with indirect functional parameters. Additional studies with larger patient series are necessary to clarify the true clinical value of FFR for guidance in BTK interventions.

P-623

Dense coil packing in peripheral embolizations: a determinant of long-term occlusion in aneurysms and vessels

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Purpose

The aneurysm coiling efficiency (ACE) trial was designed to validate whether high packing density (PD) produces stable long-term embolizations in vessels and aneurysms. High PD was achieved using soft, bare platinum, large-volume detachable embolization coils.

Material and methods

Patients underwent embolizations of peripheral aneurysms and vessels. Vessel embolization included AVMs, fistulae, varices, and other abnormalities. Endpoints included PD, number of coils implanted, serious adverse events within 24h of the index procedure, and occlusion stability at 6 months.

Results

A total of 78 embolizations were performed in 67 patients. Specifically, 25 patients underwent coiling of a single aneurysm, 41 patients required a total of 50 vessel embolizations, and 1 patient required both an aneurysm coiling and 2 vessel embolizations. Zero device-related SAE's were observed; 3 (4.5%) patients had non-device related SAE's.

In aneurysms, the median PD and coils implanted were 26.8% (IQR 18.6–33.0) and 6.5 (IQR 4.0–12.8), respectively. In the 22 patients who underwent 6-month follow up, 90.9% maintained a persistent occlusion. At the 1-year optional follow-up, 100% (n=15) patients achieved complete occlusion.

Median coils implanted for vessel embolization in patients was 3 (IQR 2–5). The 6-month follow-up exhibited 94.7% occlusion stability in 19 patients; 1 patient required retreatment.

Conclusion

Soft, bare platinum, large-volume detachable embolization coils achieve high PD and stable occlusion in aneurysm embolization and vessel sacrifice. Long-term follow-up supports embolization stability in both cohorts.

P-624

Autologous bone marrow progenitor cell transplantation for therapeutic angiogenesis in critical lower limb ischemia

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Purpose

Peripheral arterial disease (PAD) is common in India. Surgical or endovascular revascularization is the current treatment option. Approximately 30% of PAD cases are not amenable to surgery or

angioplasty. Amputation is the treatment strategy. Neoangiogenesis using stem-cell transplantation has recently been described. The research question is whether only bone marrow progenitor cell transplantation can be used for the treatment of PAD.

Material and methods

All selected patients received granulocyte colony-stimulating factor 5 days prior to the procedure. In total, 50 ml of bone marrow was aspirated (BMA) from the posterior superior iliac spine. Two third of the aspirate was injected intra-arterially and one third was injected intramuscularly.

Data analysis was performed at the 3-month follow-up. Subjective outcome was evaluated on the basis of pre- and post-procedure clinical profile of the patients based on Rutherford categories and amputation. Objective outcome was evaluated on the basis of improvement of ABI by at least 0.1 and angiographic evidence of capillary neoangiogenesis or major collateral development.

Results

Autologous bone marrow progenitor cell transplantation was performed in 20 patients. At 3 months, 14 (77.7%) patients improved clinically, 2 patients needed amputation, and another 2 patients required repeated bone marrow transplantation. ABI was improved in 10 (55%) patients. Mean baseline ABI was 0.66 and increased to 0.75 after procedure. Angiography was performed in 10 patients. No major new collateral development was documented; however, capillary angiogenesis was seen in all patients.

Conclusion

From our result, we can propose that autologous bone marrow has a beneficial effect on therapeutic angiogenesis in the treatment of PAD, thereby reducing amputation.

P-625

Quality of life in patients with iliac vein compression syndrome or iliac vein occlusion after endovascular treatment

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Purpose

Deep venous thrombosis (DVT) induced by iliac vein compression syndrome (IVCS) often interferes with patients' work or daily living. This study aims to focus on the quality of life (QoL) in patients with IVCS after endovascular treatment.

Material and methods

From October 2011 to June 2016, 113 patients with acute DVT were enrolled in this prospective study. Of these, 51 patients with IVCS underwent balloon dilation and stent insertion (group A); 62 patients with IVCS received thrombolysis or balloon dilation without stenting (group B). The Medical Outcomes Study Short Form-36 (MOS SF-36) was used to assess the QoL preoperatively and after endovascular treatment. The follow-up of SF-36 questionnaire was obtained within 12.13±12.04 months after repair.

Results

There was no operative mortality in all groups, and technical success was achieved in 47 (92.2%) patients in group A. Forty-four (86.3%) patients were cured in group A; this was significantly higher than the number of patients cured in group B (46.2%, $p=0.042$). Except for "role emotion," the scores of all domains were significantly improved in group A when compared with their preoperative scores ($p<0.01$). The scores of "physical functioning," "role physical," and "general health" in group A were significantly higher than those in group B ($p<0.05$).

Conclusion

Endovascular stenting in patients with IVCS has excellent clinical outcomes and improves QoL.

P-626

The role of non-thrombotic iliac vein compression syndrome in patients with venous reflux disease

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WITHDRAWN

P-627

Distal leg venous arterialization using limflow technology to treat critical limb ischemia: step-by-step procedure and tips and tricks to address immediate failure

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Learning Objectives

To learn indications and step-by-step procedure of distal leg venous arterialization in patients presenting with critical limb ischemia without surgical or percutaneous options.

Background

Arterial revascularization in patients with critical limb ischemia is a main issue, particularly in patients with renal failure or severe diabetes. Involvement of distal foot vessel with impaired perfusion limits the possibilities of a percutaneous/surgical revascularization.

Clinical Findings/Procedure

The procedure starts with an arterial and venous angiography in order to evaluate the ideal crossing point between the below-the-knee artery and its satellite vein. A direct shunt using a dedicated puncture system supported by ultrasound sensors is then created. A stentgraft is released to cover the anastomosis. The procedure ends with distal venous stenting, valvulotomy, or angioplasty to improve the direct retrograde venous flow to the foot.

This presentation will review the step-by-step performance of limflow and present the various potential immediate failure rescue interventions.

Conclusion

Distal leg venous arterialization using the limflow technology could be an interesting approach for patients without surgical or percutaneous options.

P-628

Development and initial evaluation of PICC placement unit

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Learning Objectives

1. To review the current literature regarding peripherally inserted central catheters (PICCs), including their proper technique, indications, advantages, and disadvantages in the context of the creation of a PICC placement unit at our institution.
2. To evaluate the experience of creating a PICC placement unit.
3. To assess differences before and after the instalment of the unit.

Background

PICCs are being increasingly used for the administration of chemotherapy, parental nutrition, and antibiotics in both ambulatory and intrahospitalary settings, with a complication rate lower than that of central venous catheters. We believe that the availability of trained

radiology technicians as well as dedicated teams for PICC placement using ultrasound-guided insertion techniques is mandatory for creating both safe and cost-effective procedures for venous access.

Clinical Findings/Procedure

The placement of a PICC unit is a versatile concept that may be associated with a reduction in costs and improvement in the quality of life of patients. After installation of the unit, we found an increase in the number of PICCs placed, with a high rate of early placement being observed for both ambulatory and bedridden patients. The rate of complications remains unchanged. We also uncover issues that need improvement: lack of documentation, particularly with respect to the dates of the last dressing change and PICC removal, as well as gaps in training for the proper care of PICCs.

Conclusion

Our experience suggests that the instalment of a PICC placement unit is advantageous for the radiology department, our hospital, and the patient. In addition, it is a cost-effective approach. We need to make improvements in education and training regarding device care.

P-629

Kommerell's diverticulum causing the subclavian steal syndrome

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A 48-year-old patient presenting with the subclavian steal syndrome showed Kommerell's diverticulum, right-sided aortic arch, and left aberrant subclavian artery with a punctuate opening; an 8-mm balloon-expandable stent was placed with complete resolution of symptoms.

P-630

Balloon angioplasty of the donor artery after microvascular flap transplantation

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Sometimes critical limb ischemia appears again after microvascular flap transplantation. Restenosis of the donor and recipient arteries is one of the main reasons of this complication.

PTBA helps us treat the patient and save the lower extremities.

P-631

A case of a complex combination of femoropopliteal occlusive disease and aortovenous fistula treated under the guidance of the quantitative assessment of blood flow using color-coded digital subtraction angiography

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A 70-year-old female with an ulcerated leg was treated by balloon angioplasty and embolization of the aortovenous fistula under the guidance of the parameter (area under the curve) given from color-coded digital subtraction angiography, which reflected the blood flow.

P-632**Dissection and acute common femoral artery occlusion after antegrade femoral puncture****B. Rudenko**, A. Shanoyan, F. Shukurov*Cath Laboratory, National Center for Preventive Medicine, Moscow, Russian Federation*

SFA stenting. The antegrade femoral puncture resulted in the dissection of SFA and thrombosis. The guiding catheter was placed through the right femoral retrograde access. Recanalization was performed using the coronary technique. The long dissection was covered by self-expanding stents in SFA and coronary stents below the knee.

P-633**Use of a percutaneous puncture needle for true lumen re-entry during subintimal recanalization of the superficial femoral artery****A.M. Aborahma***Vascular Surgery, Tanta Faculty of Medicine, Tanta, Egypt*

Re-entry is achieved by a percutaneous needle inside the lumen at the proposed re-entry point, which creates an aperture in the intima. Then, the antegrade wire is directed to this gap to slide beside the needle for entering the true lumen.

P-634**Simultaneous antegrade/retrograde arterial access technique for endovascular treatment of popliteal artery transection****Y.T. Kim¹**, N.Y. Yim², H.O. Kim², J.K. Kim²¹*Radiology, Mokpo Hankook Hospital, Mokpo, Jeollanamdo, Korea,*²*Diagnostic Radiology, Chonnam National University Hospital, Gwangju, Korea*

Despite the recent widespread use of endovascular treatment for arterial traumas, the treatment/revascularization of popliteal artery transection remains challenging. In this presentation, we report two successful complex endovascular treatments for popliteal artery transection through simultaneous retrograde/antegrade arterial access and by snaring.

P-635**Endovascular treatment of a true tibioperoneal trunk aneurysm with balloon-assisted coiling****H.A. Durmaz¹**, S. Akçalar², K. Yavuz²¹*Radyoloji, Dışkapı Yıldırım Beyazıt EAH, Ankara, Turkey,* ²*Radyoloji AD, Ankara Üniversitesi İbni Sina Hastanesi, Ankara, Turkey*

A 59-year-old female presented right leg claudication. Peripheral artery occlusive disease and a wide-neck tibioperoneal trunk bifurcation true aneurysm were detected by computed tomography angiography and treated with balloon-assisted coiling. Final angiogram showed complete occlusion of the aneurysm without complications.

P-636**Testicular atrophy following femoral artery pseudoaneurysm: a rare complication****C.R. Williams**, C. Chick, N. Goyal*Radiology, Royal Gwent Hospital, Newport, United Kingdom*

A retrograde common femoral access was established in a patient for SFA angioplasty. Post-procedure, the patient developed a large inguinoscrotal haematoma and a pseudoaneurysm, which was treated with a thrombin injection. We report an unusual complication of a pseudoaneurysm resulting in testicular atrophy.

P-637**Immediate mechanical closure of femoral artery pseudoaneurysm with the MicroVascular Plug® in the setting of intra-arterial thrombolysis****Y. Aboufirass¹**, H. Jalaeian², D. D'Souza², J. Goltzarian², R. Talaie²¹*Faculty of Medicine, Université libre de Bruxelles, Brussels, Belgium,*²*Interventional Radiology and Vascular Imaging, University of Minnesota, Minneapolis, MN, United States of America*

Treatment of common femoral artery pseudoaneurysm (FAP) in the setting of concomitant intra-arterial thrombolysis is challenging. We describe a novel technique of mechanically closing FAP with the MicroVascular Plug® in a patient undergoing thrombolytic therapy with successful clinical and angiographic results.

P-638**Needle connection technique for long Fem-pop occlusion****T.Y. Wu***Peripheral Vascular Medicine Department, Shin Kong Wu Ho-Su Memorial Hospital, Taipei City, Taiwan*

The 37 year-old male suffered from left big toe gangrene for years. The arteriography revealed left SFA to tibial arteries long occlusion and only collateral arteries to middle PTA and distal ATA observed. The previous angioplasty attempt was failed and transfer to our hospital. We used the confluent balloon technique but still failed to re-enter. We used needle puncture through the two balloons and introduced the wire to make a connection.

P-639**Successful endovascular treatment of external iliac artery dissection causing renal allograft dysfunction****R.S. Sagoo¹**, A. Diamantopoulos², C. Imray³, F. Lam³, J. Harding¹¹*Department of Radiology, University Hospitals Coventry and Warwickshire NHS Trust, Coventry, United Kingdom,* ²*Interventional Radiology, Guy's and St. Thomas' NHS Foundation Trust, King's Health Partners, London, United Kingdom,* ³*Department of Surgery, University Hospitals Coventry and Warwickshire NHS Trust, Coventry, United Kingdom*

We describe the diagnosis and endovascular treatment of external iliac artery dissection shortly following renal transplantation; this is a rare complication. This case emphasizes the high level of clinical suspicion needed to diagnose rare postoperative vascular complications and the importance of early interventional radiology involvement.

P-640

Post-traumatic acute occlusion of the brachial artery in a child: management with an absorbable coronary stent

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A 9-year-old girl presented with traumatic Gartland III fracture and short occlusion of distal brachial artery persistent after closed reduction. Because of the arterial lesion location and calibre and patient's age, an absorbable coronary stent (3x28mm) was successfully deployed.

P-641

Creation of a percutaneous iliofemoral arterial bypass graft in a patient with a history of ligated left iliac arteries and failed fem-fem surgical bypass due to gunshot injury

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Patient presenting with non-healing toe ulcer and a failed fem-fem after ligation of the external iliac artery due to a gunshot wound. Using a steerable sheath and a snare, an extravascular retroperitoneal connection was achieved and a successful iliofemoral bypass was created.

P-642

Peaceful peripheral angioplasty turned bad

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At PTA of the peripheral bypass graft anastomosis stenosis, the balloon tire migrated distally and was retrieved. Rupture of the anastomosis occurred and was sealed with SG. At the ward, distal anastomosis ruptured, and a second SG was placed. Gangrene worsened, and amputation was performed.

P-643

Complex subclavian artery aneurysm treated with flow-modulating stent

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A patient presented with complex left subclavian artery aneurysm and the vertebral artery, internal thoracic artery, and thyrocervical trunk arising as its branches. The patient was treated using a flow-modulating stent, with excellent results and good flow through the stent and aneurysm branches.

P-644

Recanalization of iliac vein thrombosis to treat pelvic congestion syndrome

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We observed pelvic congestion syndrome with a non-refluent gonadic vein after common iliac vein thrombosis with pelvic collateral path and antegrade opacification of the gonadic veins. Recanalization of the thrombosis permitted a complete relief of the pelvic congestion syndrome.

Radiation safety

P-645

Patient radiation exposure during 4537 vascular interventional procedures

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Purpose

Radiation exposure of patients who underwent different vascular interventional procedures during the 3-year period in a high-volume tertiary center was assessed.

Material and methods

Dosimetric data for 4537 patients undergoing vascular interventional procedures between January 2012 and December 2014 were assessed. Approximately a quarter of the procedures were diagnostic (1232 patients, 27.2%); angiography was performed in 1009 patients, followed by venography and adrenal venous sampling (AVS). The most common therapeutic procedures were PTA (1169 patients, 25.8%), followed by stenting, embolization, TACE, and others.

The aim of this study was identifying patients who could develop skin injuries during vascular IR procedures. Air-kerma at the interventional reference point (K_{IRP}) was used as the peak skin dose (PSD) estimate; questionnaires about possible skin changes were sent to patients with PSD exceeding 3 Gy in May 2015.

Results

The threshold was exceeded in 145 patients (3.2%); 72 being alive at the conclusion of the study have received questionnaires. Thirty-five responded, with 10 reporting skin changes. The highest PSD reached 19.96 Gy in a patient with three interventions; PSD exceeded 6 Gy in a single procedure in 40 patients. AVS was the only diagnostic procedure exceeding threshold (12.6% patients). The most common therapeutic procedure, exceeding 3 Gy, was Tc application and embolization before SIRT (30%), followed by TIPS, EVAR, TEVAR, and endovascular embolization in the abdominal/pelvic area (21.4%, 13.4%, 9.6%, and 3.5%, respectively).

Conclusion

Peak skin doses exceeded 3 Gy in 3.2% patients, most often in TIPS, followed by EVAR, SIRT, TEVAR, and embolizations in the abdomen/pelvic area. Some reported skin changes might be consistent with radiation injuries.

P-646

Proximal embolization of splenic artery in acute trauma: a retrospective study comparing the Penumbra occlusion device with other conventional coils or plugs

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Purpose

To compare intervention duration and scopy time for proximal embolization of splenic artery in acute trauma using the Penumbra occlusion device (POD) versus those using coils or plugs.

Material and methods

From February 2011 to October 2016, we retrospectively and consecutively included a total of 29 embolizations in 29 patients with splenic injury grade I–IV of the American Association for Surgery of Trauma classification (assessed by enhanced CT) without vascular injury and treated by proximal splenic artery embolization using POD (n=12), coils (n=9), or plugs (n=8). To overcome bias in treatment choice, propensity score was used using inverse probability weighting. Intervention duration and scopy time, treatment success, complications, and cost were compared between the three groups.

Results

After weighting, the median intervention duration was significantly lower using POD (30 min) than using coils (60 min, $P=0.0001$), but not using plugs (47 min, $P=0.269$). The median scopy time was significantly lower using POD (11.5 min) than using coils (23.6 min, $P=0.0076$) or plugs (16.5 min, $P=0.049$). Intervention duration, but not scopy time ($P=0.109$) was higher using coils than using plugs ($P=0.004$). The primary efficacy rate of vessel occlusion was 100%. Six complications occurred: 2 regressive abscesses with POD, 1 with plugs, and 2 material migrations with coils.

Conclusion

The POD system allows proximal embolization of splenic artery in acute trauma with lower intervention duration or scopy times than conventional coils with similar technical success.

P-647

Residual radioactivity in microcatheters after Y-90 radioembolization with glass and resin microspheres

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Purpose

To determine the amount and distribution of residual radioactivity within microcatheters after radioembolization.

Material and methods

Radioactivity within the microcatheter was measured after 15 resin and 10 glass radioembolizations. Applied radioactivity ranged from 0.8 to 2.2GBq (mean 1.51GBq) for resin microspheres and 0.5 to 5.7GBq (mean 1.86GBq) for glass microspheres.

After microsphere application, microcatheters were flushed with different flush volumes in groups of five catheters (group A: resin spheres with 10cc, B: resin spheres with 50cc, C: resin spheres with 100ml, D: glass spheres with 100cc, and E: glass spheres with 200cc; 25 catheters in total). Microcatheters were then extracted and cut into two segments [proximal 1/3 (45cm including hub) and distal 2/3]. Residual activity was measured in a calibrated activimeter and compared between different amounts of flush volumes, radioembolization devices, and catheter segments.

Results

Retained radioactivity was generally low (<0.1% and <1% of injected activity for resin and glass microspheres, respectively). Applied therapeutic activity did not correlate with retained activity. The amount

of flush volume did not influence the level of retention. Retained activity was significantly lower for resin than for glass microspheres [proximal: mean 0.5MBq (range 0.1–1.9MBq) vs. 12.4MBq (1.8–33.4MBq), $p<0.0001$; distal: 0.04MBq (0.0–0.2MBq) vs. 0.4MBq (0.01–1.7MBq), $p=0.008$]. Significantly more radioactivity was retained in the proximal than in the distal catheter segments (resin: $p=0.007$; glass: $p=0.005$).

Conclusion

Residual radioactivity of microcatheters after radioembolization is generally low and does not depend on the post-radioembolization flush volume. Higher activity was observed after glass radioembolization compared with resin radioembolization. Residual activity is mainly caused by retention in the proximal catheter, which should therefore be handled with special care.

P-648

Measurement of radiation dose during a pulmonary percutaneous ablation procedure: a comparison between CT and CBCT

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Purpose

To compare radiation skin dose while performing CT- (GE Optima 660) or CBCT-guided (Allura Philips) lung ablation procedures.

Material and methods

This study was conducted on an anthropomorphic RANDO ALDERSON thoracic phantom. This phantom is made of tissue-equivalent material for an X-ray of diagnostic quality.

Two dose detectors were used:

- MOSFETS detectors
- GAFCHROMIC films

The measurements were performed taking into consideration the ablation of an easy-to-treat tumor (supine position, tumor less than 2 cm, and intraparenchymatous).

With CT: 3 helical acquisitions to cover the thorax (before, during, and after ablation) and 6 acquisitions « smart step » to guide the placement of the ablation device (3 slices of 2.5 mm around the entry point).

With CBCT: 3 acquisitions of a volume set of images (roller mode C-arm rotation of 180°, before, device in position, and after ablation) and 5 min of scopy mode during device positioning.

Mean doses measured during the different acquisitions were cumulated to obtain the overall dose.

Results

Using CT, the measured dose was 7 mGy per helical acquisition and less than 1 mGy during the guide mode (smart step).

Using CBCT, the measured dose was 4.75 mGy during each volume set and 10.5 mGy for 5 min of scopy mode.

Conclusion

Considering a standard lung ablation procedure, radiation skin doses measured on a phantom were similar (~25 mGy) irrespective of the guidance method, CT or CBCT.

P-649

Factors affecting the efficacy of protection glasses during interventional procedures

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Purpose

To analyse the protection efficacy of goggles during interventional procedures.

Material and methods

A phantom study is presented simulating the typical interventionalist position in an angiography laboratory. Optically stimulated luminescence (OSL) dosimeters were located at the phantom's eye surface to measure the scatter dose with and without goggles when the phantom head took different orientations. Four models of goggles equivalent to 0.75 mm Pb were tested. The efficacy for different X-ray beam qualities (fluoroscopy and DSA) was studied.

Results

For the geometries tested, the right eye received half the dose received by the left eye, and the dose protection factors (without/with goggles) were between 1.5 and 1.8 for the right eye and between 3.6 and 4.0 for the (most exposed) left eye. When the phantom head was rotated 35° opposite to the scatter radiation source, the protection factor for the left eye dropped to 1.2 (goggles without lateral protection) and to 1.8 (goggles with lateral protection), and for the right eye, the protection factor fell to 1.0–1.1 (i.e., no real effective protection).

Conclusion

Measured protection factors are lower than expected for an equivalent thickness of 0.75 mm Pb, but geometric or head-scattered radiation substantially limits the goggle efficacy depending on the design of the goggle and the position of the physician's head. For the most exposed eye, a conservative reduction factor of 2 could be appropriate to estimate eye lens dose using a non-protected dosimeter. A ceiling-suspended screen, if regularly and properly used, allows better protection than goggles.

P-650

Are X-ray safety glasses mandatory for complex radiological vascular interventions

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Purpose

The annual permissible radiation ocular lens dose has been reduced to 20 mSv in the current European directive 2013/59/Euratom and is to be implemented from February 2018. The aim of this study was to evaluate the personal radiation dose for vascular interventions in our department with special focus on ocular lens dose.

Material and methods

From May 2016 to October 2016, the personal radiation doses of 2 interventional radiologists and 4 angiography technicians were prospectively recorded during a total of 206 interventions, which included procedures such as TIPS, thoraco-abdominal stent-grafts and complex Revascularizations. The position of the interventionalist and the technicians, type of intervention and fluoroscopy time were recorded. Parameters evaluated were effective total body dose measured by film dosimeter placed under the 0.5-mm lead apron, hand dose measured by a ring thermoluminescent dosimeter (TLD) and ocular lens dose measured by TLD placed in front of the safety glasses.

Results

The ocular lens doses of the 2 interventionalists were 5 and 11 mSv respectively in 6 months. Similarly, the hand dose of the 2 interventionalists was 47 and 56 mSv respectively. The total body dose for both interventionalists was 0.6 mSv. Amongst the 4 technicians, only the first assistant showed recordings of 0.3 mSv body dose, 2 mSv ocular lens dose and 4 mSv hand dose.

Conclusion

The yearly ocular lens dose, particularly for interventionalists dealing with complex interventions could cross the permitted yearly

limit set by the new Euratom directive. Therefore, X-ray safety glasses would become mandatory for complex radiological vascular interventions.

P-651

Fluoroscopy time, air kerma, complexity, and safety of the 10 most common procedures in an IR unit at a tertiary care center

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Purpose

To study the radiation dose received in patients in the 10 most common procedures performed in an IR unit of a tertiary care center.

Material and methods

During the years 2015 to 2016, a total of 6,675 IR procedures were carried out in a tertiary care center (HCU Zaragoza). Ten most frequent procedures were selected: Portacath(PC) 20.3%, biliary drainage(BDr) 13.6%, bronchial embolization(BE) 5.0%, carotid stenting(CAS) 11.8%, Percutaneous Gastrostomy (PEG) 5.0%, Chemoembolization(ChE) 10.3%, Vascular recanalization(VR) 8.7%, Colonic Stenting(CS) 10.5%, Embolization of pelvic varicose veins(EPV) 4.6% and TIPS 4.8%. In all cases data were collected regarding age, sex, body mass, PDA, Air Kerma (AK), fluoroscopy time (FT), procedure time (PT), procedure difficulty and complications. All cases that exceeded 2,000 mGy of AK were reviewed within two weeks to investigate possible lesions in exposed areas.

Results

A total of 130 cases exceeded a radiation dose of 2,000 mGy of AK, in which the CS had a higher radiation exposure (42.3%) in comparison with all procedures. The ChE, CS and TIPS were the most complex procedures in relationship with PT and difficulty, also presented the higher FT (59.56 ± 233.00 , 41.05 ± 31.03 , 39.10 ± 28.16 minutes) respectively. Only 4 patients presented pruritic erythematous-type skin lesions (AK $7,177.50 \pm 2,759.00$ mGy, high difficulty grade, TF 119.50 ± 27.58 minutes). Both were completely resolved in the course of 15 days without any sequelae.

Conclusion

Dosimetric evaluation and close follow-up of patients in whom a 2,000 mGy of AK have been exceeded, is recommended to avoid deterministic effects. In the other hand, in the case of higher complexity procedures a staff turnover is needed to reduce the total radiation dose in the exposed personnel.

P-652

What interventional radiologists need to know about radiation protection

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Learning Objectives

To learn about patient and occupational radiation protection.

Background

In this poster, we provide a literature review of the radiation protection recommendations for patients and staff based on the most recent articles.

Clinical Findings/Procedure

- Definition of basic terms in radiation protection
- Measure of occupational and patient dose and its management

- Radiation protection tools, including architectural shielding and equipment and personal protective devices
- Techniques that reduce occupational exposure
- Guidelines for patient radiation dose management, including preprocedural planning, intraprocedural techniques, and post-procedural care

Conclusion

All interventional radiologists should have extensive knowledge of radiation protection before entering the interventional laboratory in order to protect patients, staff, and themselves by reducing the radiation dose.

P-653

ALARA principles for CT-guided infiltrations at DLP $\leq$ 30 mGycm

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Learning Objectives

To understand and implement as low as reasonably achievable (ALARA) principles for CT-guided infiltrations.

Background

Reduction of radiation exposure is a major goal in diagnostic and interventional radiology. However, CT-guided infiltrations of spinal nerves, facet joints, and sacroiliac joints are frequently performed using unnecessary high doses.

Clinical Findings/Procedure

CT-guided infiltrations usually follow this sequence: application of a scout image, selection of the target area to be scanned by a helical or axial planning scan, and targeting using step-wise needle control scans. When using a planning scan at 120 kV/80–85 mAs (CTDIvol 6.8–7.3 mGy) and control scans at 120 kV/33–40 mAs (CTDIvol 2.9–3.5 mGy), dose length products (DLPs) of 62–78 mGycm are achieved. In contrast, application of low-dose protocols using planning and control scans at 80 kV/49 mAs (CTDIvol 1.4 mGy) may provide DLPs of 12–22 mGycm, which allow for a substantial dose reduction. The 80 kV/49 mAs images are sufficient for visualization of the relevant bony landmarks.

Conclusion

CT-guided infiltration of the spine should be performed using a reference DLP of $\leq$ 30 mGycm. This is possible by the careful selection of the scanned target area on the scout image and use of protocols with 80 kV/49 mAs images.

Renal and visceral artery intervention

P-654

Treatment of inferior pancreaticoduodenal arcade aneurysms in the setting of MALS: a 5-year experience

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Purpose

Median arcuate ligament syndrome (MALS) is a rare but often underdiagnosed cause of chronic celiac occlusion. Flow-related inferior pancreaticoduodenal arcade (IPDA) aneurysms can often be challenging to manage.

Material and methods

Retrospective review of a single institution EMR from 1/1/2011 to 1/1/2016. Database included cases of pancreaticoduodenal arcade

aneurysm, MALS, or idiopathic celiac stenosis. Eighty-seven cases met primary criteria. MALS was seen in 21 cases.

Results

Of twenty-one (n=21) patients with aortography-confirmed MALS, IPDA aneurysm was present in 6 (29%; mean age 58.7 years). Median aneurysm size was 2.1 cm (1.6–3.2 cm). All cases presented symptomatically (6/6): 4 retroperitoneal hemorrhage and 2 acute abdominal pain. Additional visceral aneurysms other than IPDA (splenic, right phrenic, and gastroepiploic) were identified in 3/6 cases of IPDA aneurysm. Overall, 9/9 (100%) aneurysms were treated successfully (6 coil embolization, 2 coil/plug embolization, and 1 coil/stent-graft) and without procedure-related complications. All cases terminated with preserved collateral flow to the celiac axis.

MALS with chronic abdominal pain was successfully managed in 7/21 (33%, mean age 58 (36–84) years) cases via surgical ligament release. Overall, 5/21 (24%) cases of MALS were incidentally identified post-hepatic transplant on routine surveillance imaging (sonography or MR angiography) [24%; mean age 57 (43–69) years] and confirmed with subsequent aortography. Overall, 0/5 cases demonstrated incidental visceral aneurysms.

Conclusion

IPDA aneurysms seen in the setting of MALS can be treated using endovascular techniques with a high success rate. MALS is likely underdiagnosed and asymptomatic relative to true prevalence, as demonstrated by high relative incidence in orthotopic hepatic transplant surveillance imaging.

P-655

Efficiency of percutaneous angioplasty for renal artery stenosis (RAS): a 15-year single-center experience in a large tertiary care center

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Purpose

To retrospectively analyse data of 107 patients treated by percutaneous angioplasty (PTA) for renal artery stenosis (RAS) at a university medical centre and to assess further into the therapeutic efficiency of percutaneous renal artery revascularisation for RAS as well as the role of other factors such as patient selection and degree of stenosis in the clinical outcome.

Material and methods

A total of 115 PTAs were analysed. In total, 107 patients with a haemodynamically relevant RAS underwent PTA via the femoral approach. Eight patients underwent bilateral PTA. Short- and long-term clinical data were retrospectively analysed. Creatinine and blood pressure levels at different time points were collected and statistically analysed. Clinical outcomes, complication rates, and long-term oral therapy adaptations were taken into consideration.

Results

The procedure was technically successful in 100% cases. Four patients presented with periprocedural renal artery dissection. Among the 50 patients presenting with an increased creatinine level before the procedure, 19 showed a successful long-term reduction. Thirty-eight patients presented with long-term stable creatinine levels and only 7 patients had a deterioration in the renal function despite the intervention. Forty-three patients showed a reduction in blood pressure after the procedure and 53 maintained stable levels during the follow-up.

Conclusion

Percutaneous renal artery revascularisation is a safe and effective therapeutic technique and should be considered in patients with haemodynamically relevant RAS to reduce the clinical deterioration associated with renal artery obstruction.

P-656

Pancreaticoduodenal artery aneurysm associated with median arcuate ligament compression: our experience with endovascular treatment and review of the literature

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Purpose

Pancreaticoduodenal artery (PDA) aneurysms require prompt treatment due to high risk of rupture. Overall, 3%–18% of PDA aneurysms are associated with extrinsic compression of the celiac artery by the median arcuate ligament (MALC). We review the clinical presentation, endovascular treatment, and outcomes of patients treated with this constellation at our institution and review the English literature.

Material and methods

Nine patients with 10 PDA aneurysms associated with celiac axis stenosis due to MALC who underwent endovascular treatment were included. The English literature from 1978 on was reviewed for PDA aneurysms exclusively associated with MALC.

Results

Five of the nine patients presented with rupture. Initial embolization was successful in 7/9 patients. Two patients had to undergo successful repeat embolization because vasospasm did not allow aneurysm exclusion initially. Both were treated successfully. Celiac stenosis was treated in none of the patients. Follow-up imaging was available for 5 patients. Median follow-up was 39 months (1 month to 8 years) without recurrent or new symptoms, including those suggestive of mesenteric ischemia and without recurring aneurysms on imaging. All but two aneurysms were located in the immediate vicinity of bifurcations. Analysis of 70 case reports from the literature was in agreement with the findings of this cohort. Only 21.4% (15/70) of the reported aneurysms underwent concomitant celiac axis stenosis treatment.

Conclusion

Our cases and the review of literature suggest that both ruptured and incidentally found PDA aneurysms are successfully treated with endovascular embolization without concurrent celiac axis treatment regardless of the size.

P-657

Endovascular treatment of true visceral arterial aneurysms: a single-center experience

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Purpose

To review the initial and mid-term follow-up outcomes of the endovascular management of true visceral artery aneurysms (VAA) and share our technical strategies.

Material and methods

Between 2003 and 2015, we performed endovascular treatment in 47 patients with a diagnosis of 52 true VAAs. Any case of the visceral artery pseudoaneurysm (VAPA) was excluded. This study was performed retrospectively with IRB approval.

Results

Aneurysms were noted in multiple locations: splenic artery (n=19), pancreaticoduodenal arcade (n=10), renal artery (n=8), hepatic artery (n=7), celiac artery (n=5), superior mesenteric artery (n=1), inferior mesenteric artery (n=1), and left gastric artery (n=1). Twelve VAAs (23.0%) were symptomatic at initial presentation: rupture (n=5), abdominal pain (n=5), back pain (n=1), and flank pain (n=1). Various embolic materials were used, including coils, glue, covered stents, glue, and Onyx. The endovascular treatment of VAAs was technically successful in 94.2% (49/52). There was no periprocedural mortality related to endovascular treatment. Post-procedural complications occurred in 11 VAAs: Society of Interventional Radiology grade A minor (n=3), grade B minor (n=3), grade C major (n=2), and grade D major (n=3). Mean follow-up duration was 4.7 years (1 month to 13 years). Postprocedural CTA was obtained in 92.3% (48/52) of patients within 30 days.

Conclusion

VAAs can be successfully treated with endovascular interventions with high clinical success rates, low periprocedural morbidity, and favorable results at the mid-term follow-up.

P-658

Combination of the double-microcatheter technique and triple-coaxial system in coil packing for visceral artery aneurysms

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Purpose

When performing coil packing for visceral artery aneurysms (VAAs), it is sometimes difficult to preserve patency of the parent artery, especially in wide-necked aneurysms. On the other hand, the double-microcatheter technique has been reported to be effective in preventing coil migration, and the triple-coaxial system has been shown to be useful in preventing the kicking back of a microcatheter. The purpose of this study was to assess the feasibility of combining these two techniques in coil packing for VAAs.

Material and methods

Fourteen VAAs (8 splenic, 4 renal, 1 common hepatic, and 1 anterior superior pancreaticoduodenal aneurysms) in 13 patients were evaluated. They were treated with coil packing using both the double-microcatheter technique and triple-coaxial system. The median size of VAAs was 15 mm (range, 8–29). Eleven of them were diagnosed as wide-necked aneurysms based on the calculation of the dome/neck ratio. Technical success rates, complications, and clinical outcomes were evaluated. Technical success was defined as completion of the coil packing. Occlusion of VAAs was evaluated using time-resolved magnetic resonance angiography (TR-MRA).

Results

Coil packing for VAAs was performed successfully in all lesions (technical success rate: 100%). The median packing density was 23% (range, 16–40). There was no major complication related to coil packing. Follow-up TR-MRA could be performed in 12 VAAs of 11 patients with a mean follow-up period of 8 months (range, 3–12), and complete occlusion was observed in 10 VAAs (83%).

Conclusion

Combination of the double-microcatheter technique and triple-coaxial system appears to be a feasible method in coil packing for VAAs.

P-659

Endosaccular packing for visceral artery aneurysms with adjunctive techniques: long-term outcomes

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Purpose

To evaluate immediate and long-term outcomes of endosaccular packing with adjunctive techniques for visceral artery aneurysms (VAAs).

Material and methods

We reviewed 28 patients with unruptured VAAs, including 15 splenic, 11 renal, 1 gastroduodenal and 1 pancreaticoduodenal artery aneurysm (AN), who underwent endosaccular packing in the previous 9 years. In all patients, adjunctive techniques, including balloon-assist, stent-assist and multiple-catheter techniques, were applied to preserve parent arteries and/or major branches. The mean maximum diameter of ANs was 15.8mm. All cases were followed up by digital subtraction angiography and/or MR angiography. The geometric factors of ANs, immediate occlusion rates, complications and long-term outcomes were evaluated. The relationships between geometric factors of ANs, packing density and outcomes were also statistically analysed.

Results

All patients were successfully embolised without any complications. Angiography immediately after embolisation revealed complete occlusion (CO) in 13, neck remnants (NRs) in 11 and dome filling (DF) in 4 patients. During follow-up (mean 36 months), all patients with CO showed no recurrence. Patients with NRs included stable or decreased residual NRs in 8 and became DF because of coil compaction in 3 patients. Patients with DF included stable or decreased DF in 3 and had enlarged DF in 1. Two patients showing coil compaction were re-treated by endosaccular embolisation. There was no statistical relationship of the stable occlusion status with any geometric factors of ANs or packing density.

Conclusion

Endosaccular packing with adjunctive techniques is effective for VAAs. Immediate complete occlusion promises long-term efficacy. Although 86% of patients were stable after embolisation, careful imaging follow-up is required for patients with NR and DF.

P-660

Coronary stentgraft implantation for the management of acute visceral arterial bleeding

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Purpose

To evaluate the immediate and long-term efficacy of coronary stentgraft for emergent treatment of acute arterial visceral bleeding.

Material and methods

Over a 5-year period, 20 shock patients (median age 66 years) because of acute arterial hemorrhage following surgery (n=10: hepatic 7, renal 2, and GDA 1) or ruptured false aneurysms (n=10: splenic 4, pulmonary 3, and hepatic 3) were treated with emergent Graftmaster stent implantation. All patients were contraindicated for arterial sacrifice because of the major risk of end-organ ischemia. The Graftmaster stent (Abbott, Santa Clara, CA, USA), a flexible balloon-expandable coronary stentgraft ranging from 3 to 5 mm in

diameter, is primarily recommended for PTA-related coronary arteries rupture or aneurysm. All procedures were performed using a 6-Fr sheath to introduce the 0.014 monorail stent system.

Results

The procedure succeeded technically in 19 of 20 patients (95%). Major bleeding ceased immediately after stentgraft implantation in 16/19 patients (84%). In the 3 remaining patients, stent overdilation by 1 mm allowed completion of the arterial repair. No procedure-related complication occurred and the 30-d mortality was 0%. During the follow-up (median 3 year), no recurrent bleeding or sepsis occurred. The survival rate was 89% and 2 patients died from unrelated causes. Among the 17 patients followed by CT angiography or DSA (median 30 month), stent patency with preserved distal perfusion was present in 14 (82%) patients. Asymptomatic occlusion of hepatic or mesenteric stents occurred in 3 patients.

Conclusion

Implantation of coronary Graftmaster stent is highly efficacious for managing acute hemorrhage of small/medium-sized visceral arteries with an acceptable long-term patency.

P-661

Embolization of renal angiomyolipoma using a n-butyl-cyanoacrylate adhesive

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Purpose

To evaluate the safety of transarterial embolization (TAE) of angiomyolipoma (AML) using n-butyl-cyanoacrylate.

Material and methods

Seven patients with AML (all female) and a median age of 40 years (range 27–60) underwent TAE using an n-butyl-cyanoacrylate adhesive between January 2014 and January 2016.

Two of the 7 patients presented with acute hemorrhage. In all procedures, a 4- or 5-Fr catheter was introduced in the renal artery, and we performed supraseductive catheterization with a 2.4-Fr microcatheter into the tumor-feeding artery.

We described the clinical scenario, radiological images, technical success rate (devascularization rate of $\geq 90\%$), radiological success rate (any reduction tumor size and abnormal blood vessels), and complications.

Results

Technical success was achieved in all patients. At the mean follow-up of 12 months, the mean size reduction was from 6 cm to 3.5 cm (large diameter) after embolization. Decreased tumor size was achieved in all patients (100%) during the mid-term follow-up.

Cortical infarctions of about one-third of the circumference of the embolized kidneys could be detected on follow-up examinations, but all patients had a normal total kidney function. The bleeding was primarily stopped in all patients.

Unplanned repeated embolization or surgery was not required during this period. None had recurrence of tumor bleeding or rupture during follow-up.

Self-limiting postembolization syndrome (including abdominal pain, cramping, fever, nausea, and vomiting) developed following 100% of embolizations. No procedural mortality was reported.

Conclusion

Transarterial embolization of angiomyolipoma using a n-butyl-cyanoacrylate is a safe, relatively fast, and effective technique that demonstrates low rates of serious complications.

P-662

Prognostic factors of transarterial embolization for hemostasis after pancreaticoduodenectomy

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Purpose

To retrospectively evaluate prognostic factors and complications related to transarterial embolization (TAE) for hemostasis after pancreaticoduodenectomy (PD).

Material and methods

Twenty-two patients (20 men and 2 women; mean age, 67 years) with post-PD hemorrhage underwent TAE. Mortality and major complications following TAE were evaluated according to age, sex, primary disease, bleeding artery, hemorrhagic shock, and decrease in hemoglobin from before surgery to onset of TAE.

Results

Technical and clinical success rates were 96% (21/22) and 73% (16/22), respectively. Bleeding was controlled in 21 patients, although 3 patients required repeat embolization. Major hepatic complications occurred in four patients: hepatic failure in one (5%) and hepatic abscess in three (14%). The mortality rate was 14% (3/22). Bile duct cancer cases had hepatic abscesses without death (n=3), hepatic failure result in death (n=1, Fisher test, $P=0.032$), respectively. Decrease in serum hemoglobin levels in nonsurvivors (mean, 8.3 mg/dL) were significantly greater than those in survivors (mean, 3.5 mg/dL) ($P<0.05$). The rate of complications was higher in patients with bile duct cancer (56%, 5/9) than in those with other cancers (8%, 1/13) ($P<0.05$). Bleeding artery was associated with hemorrhagic shock. Among patients with hemorrhagic shock at onset of TAE, fewer had bleeding from the gastroduodenal artery (GDA) stump (1/7) than those from other arteries (8/15). We could save all the patients who had bleeding from the GDA stump.

Conclusion

Various patient conditions defined their prognosis and complications. In addition, in patients with bile duct cancer, postoperative follow-up is essential.

P-663

Selective arterial embolization of renal tumor in a hybrid operating room simultaneously with laparoscopic partial nephrectomy: a new approach in renal surgery

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Purpose

Laparoscopic nephron-sparing surgery (LNSS) is the standard of care for tumors confined to the kidney. Supraselective tumoral embolization (STE) allows limiting operative bleeding without renal ischemia. However, surgical excision can be difficult because of adherent perirenal fat or in case of delayed surgery due to the occurrence of post-embolization perilesional edema.

Here we describe a new concept for treating kidney tumors using a hybrid operating room to perform STE simultaneously with LNSS.

Material and methods

We treated 40 patients with localized renal tumors with a moderate-to-high complexity RENAL score. STE was performed in the hybrid operating room simultaneously with LNSS without dissection and clamping of the renal pedicle. A 3D renal arteriography was performed to precisely identify the tumor vascularization, and an endovascular guidance software was used in order to limit radiation and iodine injection.

Results

Mean size of the tumor was 3.2 (range, 1.5–8) cm. Mean operative time was 80 minutes, and mean blood loss was 141 ± 155 mL. Post-embolization control 3D arteriography confirmed healthy renal parenchyma in all patients. No postoperative complications occurred. Mean hospital stay after the procedure was 4 ± 1 days.

Conclusion

Combined approach, including STE and LNSS, in a hybrid operating room is a new zero ischemia method, which reduces the complexity of the surgery, limits injury to the kidney, and increases patient safety.

P-664

Complications of ultrasound-guided renal core biopsy

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Purpose

Accurate histopathology of kidney disease is crucial in modern treatment strategies. This is obtained by image-guided core biopsy, which is considered as a safe procedure. The purpose of this study was to define the complication rate of ultrasound (US)-guided renal biopsy and identify possible risk factors for complications.

Material and methods

This retrospective study was approved by the local ethics committee. Altogether 275 consecutive percutaneous renal parenchymal biopsies (n=235, age 4–84 years) were performed at a tertiary care center (Kuopio university hospital) between Jan 2013 and Mar 2016. Biopsies were performed with 14–18 G biopsy needles by general radiologists. Postprocedural complications were divided based on severity as follows: minor (pain, hematuria, and wound bleeding), moderate (aforementioned reasons + extended hospital care), or major (blood transfusion/embolization).

Results

Average of 4.3 (1–12) samples were obtained per kidney. Altogether 1.8% (5/275) biopsies resulted in major complications: one pseudoaneurysm and two active bleedings were treated by endovascular embolization. Moderate complications occurred in 2.2% (n=6) and minor in 18.2% (n=50) cases. Risk factors for any complications were as follows: young age ($p=0.018$) and decreased renal cortical thickness ($p=0.042$). Only statistically risk factor for major and moderate complications in our data was decreased hemoglobin ($p=0.047$). The number of samples or blood pressure did not affect the complication rate.

Conclusion

US-guided renal biopsy is a minimally invasive procedure with a low rate of major complications. Nevertheless, severe complications such as active bleeding are possible and careful monitoring during and after the procedure is mandatory. In addition, the availability of endovascular embolization is important.

P-665

Endovascular management of iatrogenic renal vascular injuries

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Background

Percutaneous nephrolithotomy (PCNL) is the preferred approach for managing large and/or complex kidney stones. Bleeding is the most common significant complication with a potential of causing major morbidities.

Clinical Findings/Procedure

From 2010 to 2015, 28 patients were treated with superselective renal artery embolization for iatrogenic arterial kidney bleeding, including diagnostic angiography, in our hospital. PCNL (n = 26), nephron-sparing surgery (NSS, n = 2). Embolization materials included a mixture of cyanoacrylate and lipiodol, coils, and Spongostan. We analyzed the angiographic appearances of the vascular lesions that caused hemorrhages and treatment outcomes for endovascular embolization.

Three patients (10.7%) had no angiographic findings to account for the hemorrhage; their condition improved after conservative treatment. Twelve patients (42.9%) had pseudoaneurysms, four (13.8%) had an arteriovenous fistula (AVF), five (17.9%) had a pseudoaneurysm and an AVF, three (10.7%) had a pseudoaneurysm and an arteriofistula (ACF), and one (3.6%) had a pseudoaneurysm, an AVF, and an ACF. Seven cases involved more than one vessel. Technical success was achieved in all the cases. Clinical success was achieved in 24 cases. One patient with pseudoaneurysms after PCNL involving the accessory renal artery needed a second treatment to stop bleeding. No major complications requiring intensive care treatment were encountered during the procedures. No patient required emergency surgery or subsequent surgical treatment. The renal function--creatinine before and after treatment has no statistical difference.

Conclusion

Superselective renal artery embolization is a safe and effective procedure for the treatment of iatrogenic renal vascular injuries and can be proposed as a first-line treatment.

P-666

Review of prophylactic embolization of renal artery pseudoaneurysms detected by early postoperative CT after partial nephrectomy

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WITHDRAWN

P-667

Endovascular methods for treating renal artery aneurysms (RAA)

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Learning Objectives

To delineate different endovascular methods for treating renal artery aneurysms (RAAs), including covered stent use, aneurysm coiling, balloon-assisted coiling, stent-assisted coiling, and flow diverter use.

Background

RAAs account for 15%–22% of visceral artery aneurysms. Routine use of CT and MR imaging has led to an increased diagnosis of RAAs. Based on the location and morphology, RAAs can be classified as saccular, fusiform, aneurysmal, and intrarenal microaneurysms. These aneurysms have a female predilection and demonstrate a higher incidence in patients with fibromuscular dysplasia and hypertension. Less than 50% of patients are symptomatic, but symptoms such as rupture, arterial thrombosis, abdominal pain, and hematuria may develop. RAA rupture is rare, with a reported incidence of 0%–10%. Rupture incidence appears to be high in large aneurysms (>2 cm) and in pregnant women. Rupture mortality is approximately 50% for the mother and 90% for the fetus.

Clinical Findings/Procedure

RAAs can be treated with surgical or endovascular approaches with the common endpoint of preventing aneurysmal expansion and

rupture by excluding the aneurysm from the arterial circulation and pressure. Management depends, in part, on the location of the aneurysm but is also determined by factors, including patient age and sex, severity of hypertension, anticipated pregnancy, and anatomic features of the aneurysm, including size.

Conclusion

Based on our experience of treating over 20 RAAs, we will depict different endovascular methods for treating RAAs, including covered stent use, aneurysm coiling, balloon-assisted coiling, stent-assisted coiling, and flow diverter use.

P-668

Embolisation of gastrointestinal bleeding after open surgery

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Learning Objectives

We want to share our successful experience in embolisation of acute bleeding and compare our experiences with those of other leading experts.

Background

From 2012 to 2016, we performed 47 interventions on GI bleeding after pancreatic resection. In 2 cases, we did not find any extravasation.

Clinical Findings/Procedure

We performed angiography twice to determine the bleeding area in 2 patients; we completed repeated interventions with embolisation of the bleeding vessel. We had 2 cases of serious complications when using histoacryl: anastomotic leakage and distal embolism of histoacryl in arteria ileocolica with cecum necrosis. In all the cases, after embolisation, we obtained an immediate result; recurrent bleeding in the early post-embolisation period was successfully stopped twice. We used PVA, coils, histoacryl + lipiodol, plugs, stent grafts and their combination. When possible, we performed CTA before angiography. Three patients showed another origin of bleeding after successful embolisation of bleeding; this was associated with acute pancreatitis.

Conclusion

Emergency embolisation of acute bleeding after pancreatic surgery may be a method of choice, excluding relaparotomy and reducing mortality in patients with GI bleeding.

P-669

Adding value to preoperative superselective transarterial embolization using 3D-rotational angiography and cone-beam CT before laparoscopic partial nephrectomy

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Learning Objectives

1. To understand the role of preoperative superselective transarterial embolization of renal tumors in laparoscopic partial nephrectomy.
2. To become familiar with the usage of 3D-rotational angiography for preoperative transarterial embolization of renal tumors.
3. To understand when and how to use cone-beam CT for avoiding non-target embolization.

Background

Superselective transarterial embolization (STAE) of renal tumors has been pointed out to have benefits before laparoscopic partial nephrectomy (LPN). The aim of this study is to present the usage of combined 3D-rotational angiography (3DRANG), cone-beam CT (CBCT), and STAE as a preoperative adjunct before LPN.

Clinical Findings/Procedure

From April 2015 to September 2015, 28 cases of LPN had been undertaken with preoperative STAE using 3DRANG and CBCT. These comprised 18 male and 10 female patients with a mean age of 57 ± 11 (min: 36; max: 73) years. Technical success was 100% using the 2.6 Fr microcatheter. The mean greatest diameter of tumor was 3.35 ± 2.4 (min: 0.6; max: 14.7) cm. No immediate or short-term complication was observed.

Conclusion

STAE is a feasible and safe minimally invasive interventional procedure. By the combined usage of 3DRANG and CBCT, more precise excision and lesser complications in LPN have been achieved.

P-670

Endovascular management of iliac artery dissection during renal transplantation

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We present a renal failure patient who received a donor kidney complicated with flow-limiting external iliac dissection.

We demonstrate through our case that this rare complication can be successfully managed with endovascular techniques that salvage a failing donor kidney.

P-671

Treatment of a hepatic artery aneurysm in a patient with segmental arterial mediolysis using the pipeline embolization device

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A 62-year-old male with segmental arterial mediolysis involving the celiac and hepatic arteries developed a proper hepatic artery aneurysm that was treated with a flow diverter (pipeline embolization device). The hepatic artery remained patent and the aneurysm thrombosed on follow-up.

P-672

Endovascular management of acute SMA occlusion occurred during the transcatheter aortic valve implantation (TAVI) procedure

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Acute occlusion of the SMA trunk with "movable" calcified plaque occurred during the TAVI procedure. Percutaneous balloon angioplasty and stenting of the SMA trunk were successfully performed through the retrograde approach via the mesenteric arterial arcade.

P-673

Can segmental arterial mediolysis (SAM) and cystic medial necrosis (CMN) coexist?

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A 53-year-old female with a history of aortic valve replacement for CMN presented with acute anemia from intrabdominal hemorrhage. CT angiography revealed a bleeding pseudoaneurysm in the gastroduodenal artery along with multiple fusiform aneurysms/irregularities in the jejunal arcade consistent with SAM. Embolization was successfully performed.

P-674

Ruptured pancreaticoduodenal arcade aneurysms with segmental arterial mediolysis treated by transcatheter coil embolization

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Ruptured pancreaticoduodenal arcade aneurysms without celiac artery stenosis underwent transcatheter coil embolization in patients with segmental arterial mediolysis. The changed morphology of another aneurysm and the string of beads sign from the surrounding arteries could be checked readily.

P-675

Endovascular treatment of spontaneous gastroduodenal artery rupture after arterial chemoport insertion

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A 68-year-old man who had inserted an arterial chemoport for HCC treatment was admitted to our hospital with hematemesis. CT showed that the coil protruded into the duodenum with gastroduodenal artery rupture, and successful treatment was achieved with a stentgraft.

P-676

Exclusion of a highly angulated post-pancreatitis pseudoaneurysm of the superior mesenteric artery via the brachial artery

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We present the successful endovascular management of a post-pancreatitis pseudoaneurysm of SMA. Due to angulation, a 360 degree loop of a microcatheter was deliberately formed in the 'sac' to allow passage to the SMA beyond the neck of the pseudoaneurysm.

P-677**Aneurysm at the left renal arterial bifurcation: successful treatment with a flow-diverting stent**

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A 59-year-old woman presented with a 26 mm left renal arterial aneurysm. She was treated with a 6/30 mm flow-diverting stent. At the 1-year follow-up CT control, the aneurysm was markedly thrombosed and a major side branch was freely perfused from the aneurysm base.

P-678**Tubular aneurysm of the hepatic artery: successful treatment with a flow-diverting stent**

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In a 69-year-old patient, a 2cm wide tubular aneurysm extended along the common hepatic artery. A 10/80mm flow-diverting stent was implanted successfully. At the 1-year follow-up, the aneurysm was completely thrombosed and the gastroduodenal and left hepatic arteries remained patent.

P-679**Flow-diverter stent in the management of splenic artery aneurysm: a case report**

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A splenic aneurysm of 2.8 cm was incidentally detected in a CT scan. A flow-diverter stent was placed in the splenic artery, after which the intra-aneurysmal eclipse phenomena was achieved. Successful thrombosis was seen on the follow-up CT scan.

P-680**NBCA embolization of a true splenic artery aneurysm: simulation with a 3D-printed model and treatment**

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We successfully embolized a splenic artery aneurysm with a short proximal neck by filling the entire aneurysm with NBCA under balloon-assisted flow control after distal coil embolization. Preoperative simulation with a 3D-printed model was useful for establishing the treatment plan.

P-681**Through-and-through wire technique for endovascular treatment with AVP in high-flow renal AVF: a case report**

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We describe a case of high-flow renal AVF successfully isolated with AVP and coils. The through-and-through wire technique was useful for the stabilization of a guide catheter and made it possible to deploy AVP from a draining vein.

P-682**Spontaneous gastroduodenal artery pseudoaneurysm hemorrhage embolized from the backdoor with coils**

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A 61-year-old male presented a spontaneous gastroduodenal artery pseudoaneurysm hemorrhage. CT scan revealed proximal occlusion of the celiac trunk and stenosis of the origin of the superior mesenteric artery. The pseudoaneurysm was successfully embolized from the backdoor with coils.

P-683**Percutaneous, trans-needle coil embolisation in endovascular inaccessible aneurysm of the splenic artery**

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A false aneurysm of the splenic artery was treated via the percutaneous access. Using a G18 needle, 3 fibred vascular coils were implanted. Due to residual perfusion, 500IU thrombin was injected. Subsequently, complete occlusion was evident. The aneurysm remained occluded. Minor splenic perfusion deficits were seen.

P-684**Embolization of a giant post-traumatic arteriovenous renal fistula with the new Penumbra POD system**

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We treated a post-traumatic giant arteriovenous renal fistula complicated with an aneurysm. The embolization was performed with the Penumbra POD system and two packing coils released in the arterial afference. Complete exclusion of the fistula and aneurysm was obtained.

P-685

A rare case of spontaneous extrahepatic arterioportal fistula: treatment with transarterial embolization using the Amplatzer vascular plug II

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A 46-year-old woman presented with variceal bleeding. CT study showed spontaneous direct arterioportal fistula between right gastric artery and gastric vein causing portal hypertension. Transarterial embolization of the fistula was successfully and safely done using a 12-mm Amplatzer vascular plug II.

P-686

Successful parenchymal sparing embolization of large renal artery aneurysm in a patient with Marfan syndrome and aortic dissection

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This is the first reported case of successful renal-sparing embolization of a large renal artery aneurysm in a patient with aortic dissection (Marfan syndrome) using detachable hydrogel microcoils. The patient was previously treated with a composite graft, an elephant trunk, and a thoracic stentgraft.

P-687

Balloon-assisted coil embolisation (B.A.C.E.) of a wide-necked renal artery aneurysm in a single kidney using the Scepter CTM dual-lumen neurovascular microcatheter

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A 64-year-old patient presented with fibromuscular dysplasia and a single left kidney with worsening renal function and a progressively enlarging 2cm, wide-necked renal artery aneurysm. Transarterial coil embolization of the aneurysm with assistance of a dual-lumen neurovascular balloon microcatheter was successfully performed.

P-688

Management of postoperative pseudoaneurysm after pancreaticobiliary surgery: case reports on parent artery embolization, stent-assisted coiling, and hybrid procedure

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We introduce 7 cases of the treatment of postoperative pseudoaneurysm with TAE. We selected parent artery embolization using coiling isolation, injection of n-butyl-2-cyanoacrylate, and stent-assisted coiling. In life-threatening situations, a hybrid procedure combining abdominal surgery and TAE was effective.

TIPS and portal vein intervention

P-689

Early volumetric and functional imaging assessment of portal vein embolisation

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Purpose

Portal vein embolisation (PVE) is an established method to increase future liver remnant (FLR) volume, increasing resectability of liver tumours. Volumetry and global liver function tests are usually performed to assess the response but do not evaluate segmental liver function. Furthermore, functional changes may precede volumetric growth. Uptake of an hepatospecific MR contrast, gadoxetic acid, has recently been shown to provide both functional and morphological segmental information. The aim of this study is to determine the contribution of MR with gadoxetic acid in an early imaging assessment after PVE.

Material and methods

This is a prospective study of 10 patients subjected to liver MR with gadoxetic acid before and 11 days after PVE prior to liver resection. In all exams, ROI measurements of both liver lobes were performed precontrast and in the hepatobiliary phase. Liver volume, hepatic enhancement relative to the spleen and hepatic uptake index were calculated.

Results

All patients (6 cases of HCC and 4 cases of colorectal metastases) had an embolisation procedure determined as successful, performed with polyvinyl alcohol particles and proximal embolisation coils. Left branch (n=2) or right branch (n=8) embolisation was performed. After PVE, there were significant increases in FLR volume (p=0.008) and FLR hepatic uptake index (p=0.038) and decrease in the relative enhancement of the embolised liver (p=0.008). There was also significant increase in the differential enhancement between the FLR and the embolised liver (p=0.008) but not in relative enhancement of FLR (p=0.314).

Conclusion

Liver uptake of gadoxetic acid may provide a multitude of additional data for early post-PVE assessment, allowing segmental functional analysis.

P-690

Management of spontaneous splenorenal shunt during TIPS implantation in patients with cirrhosis and variceal bleeding: a single-center experience

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Purpose

Transjugular intrahepatic portosystemic shunt (TIPS) is a well-established treatment for complications arising from portal hypertension. However, hepatic encephalopathy (HE) is a common complication after TIPS insertion. The incidence rate of HE after TIPS insertion is 15%–48%. Splenorenal shunt (SRS) is a spontaneous portosystemic shunt that persists in 14%–21% of patients with cirrhosis. When TIPS

is used in patients with SRS, the risk of stent dysfunction and HE is increased. The aim of this study is to evaluate the safety and efficacy of occlusion of splenorenal shunt during TIPS implantation.

Material and methods

From September 2013, at our institution, 37 TIPSs have been implanted as a prevention of rebleeding or acute treatment (early TIPS) for variceal bleeding. In 5 of 37 patients, we observed the presence of SRS (nine). All SRSs were occluded during TIPS implantation with different tools (coil, plug, and Onyx).

Results

The mean follow up was 15.4 months. In two cases, the treatment was performed in emergency settings as a early TIPS. Technical success was 100%. Totally, we embolized nine SRSs. The mortality and rate of reintervention was 0%. All TIPSs were performed using a polytetrafluoroethylene-covered stent 10 mm in diameter. The mean portosystemic gradient before TIPS was 16.0 ± 3.7 mmHg and after TIPS was 6.5 ± 2.3 mmHg.

Conclusion

In our limited and retrospective experience, the results obtained show that TIPS implantation decreases the portal pressure for the prophylaxis of rebleeding and that SRS embolization improves liver function and maintains stent patency.

P-691

Effect of portal vein embolization on extrahepatic metastases growth rates: a retrospective analysis

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Purpose

Portal vein embolization (PVE) is associated with an increased growth rate of liver metastases. This effect is believed to be partly due to the release of growth factors, which could have potential systemic effects. This study's aim is to determine if this association exists with extrahepatic metastases.

Material and methods

Retrospective study (2006–2015) of PVE cases with extrahepatic metastases. Extrahepatic metastases and lymphadenopathy were measured on serial pre- and post-PVE computed tomography scans. Pre- and post-PVE lesion growth rates were compared.

Results

Of 29 PVE patients who had extrahepatic metastatic disease (total of 39 extrahepatic lesions or lymphadenopathy), 64% had an increased growth rate after PVE. However, the change in growth rate was not statistically significant [0.0094 ± 0.0825 mm/day before vs 0.0348 ± 0.1265 mm/day after PVE ($p=0.20$)]. In the colorectal cancer liver metastasis subset (27 lesions), there was no significant difference in growth rate after PVE [0.0129 ± 0.0988 mm/day before vs 0.0375 ± 0.1497 mm/day after PVE ($p=0.39$)]. The difference in growth rate of lung metastases ($n=13$) was also not significant [0.0187 ± 0.0455 mm/day before vs 0.0288 ± 0.0431 mm/day after PVE ($p=0.63$)]. The difference in growth rate of lymphadenopathy ($n=17$) was also not significant [0.0158 ± 0.0653 mm/day before vs 0.0122 ± 0.0497 mm/day after PVE ($p=0.89$)].

Conclusion

Our study did not demonstrate a statistically significant difference in the growth rate of extrahepatic metastatic disease after PVE. We postulate that either the difference in growth rate is too small to be confirmed with this sample size or there is no systemic effect of PVE.

P-692

Feasible and technical aspects of a new technique for ipsilateral percutaneous transhepatic portal vein embolization

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Purpose

We devised a new, simple technique in which absolute ethanol was injected via a sheath under the proximal balloon occlusion of the right portal vein using a single balloon catheter and examined the feasibility and safety of this new technique for ipsilateral percutaneous transhepatic portal vein embolization (PVE).

Material and methods

Between 2010 and 2016, PVE was performed using this new technique in 19 patients (14 men and 5 women) before hepatic major resection. PVE was performed via an ipsilateral percutaneous transhepatic approach, and the right portal branch was embolized. We entered the right portal vein branch for embolization under ultrasonic guidance and placed the balloon catheter in the proximal site of the main right portal branch. Absolute ethanol was injected via a sheath under the proximal balloon occlusion of the right portal vein. Technical success and complications following PVE were evaluated. Changes in future liver remnant (FLR) and FLR/total functional liver volume ratio (TFLV) were calculated. Total X-ray exposure times of this method were compared with those of the conventional method using "a conventional loop" technique.

Results

PVE was successfully performed in all patients. The mean preoperative FLR was 566 ml. FLR/TFLV was 40.2%–59.4%. One patient (5.2%) developed complications following PVE (perihepatic hematoma). The mean total exposure times of this method and the conventional method were 8.64 and 15.8 min, respectively.

Conclusion

This new technique for ipsilateral percutaneous transhepatic PVE in which absolute ethanol was injected via a sheath under the proximal balloon occlusion of the right portal vein using a single balloon catheter before extended liver resection was safe and convenient.

P-693

Portal vein embolization: an updated analysis of the effect of porto-portal collaterals and segment IV obliteration on hypertrophy of the future liver remnant in 70 patients

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Purpose

Portal vein embolization (PVE) is a standard procedure for inducing hepatic hypertrophy before extended right hepatectomy (ERH). High variability in outcome is frequently observed. Previous findings based on a small collective from our group indicated a negative effect of porto-portal collaterals (PPC) to the embolized liver volume on hypertrophy of the future liver remnant (FLR). Therefore, an updated retrospective analysis was performed at our institution with an almost three-fold patient collective to confirm this hypothesis.

Material and methods

Seventy patients with primary or secondary hepatic malignancies who underwent PVE with microparticles and coils were retrospectively analyzed. Volumetric parameters were assessed. Most notably,

the effects of additional embolization of segment IV portal branches as well as the development of PPCs after PVE were investigated.

Results

The mean absolute increase in FLR (segments II and III) was 173 ± 91 ml and the mean relative increase was $68.5\% \pm 71.3\%$. Of 70 patients, 33 underwent additional obliteration of segment IV portal branches in addition to those of segments V–VIII but showed no significant volume increase compared with those who did not undergo additional obliteration ($p < 0.107$). In contrast, the development of PPC in 24/70 patients on post-PVE computed tomography (CT) proved to be a highly significant inhibitor of hypertrophy of FLR ($p < 0.0001$).

Conclusion

Embolization of portal segment IV branches has no significant effect on hypertrophy, whereas formation of PPCs in post-PVE CT showed a negative effect on hypertrophy of FLR.

P-694

C-arm cone-beam CT for intraprocedural image fusion and 3-D guidance in portal vein embolization (PVE)

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Purpose

Portal vein embolization (PVE) is used in patients with extended oncologic liver disease to induce hyperplasia of non-embolized liver segments and make surgery feasible. Sonographic guidance is the gold standard for percutaneous PV access. This study evaluated the feasibility and safety of C-arm cone-beam computed tomography (CBCT) for needle guidance.

Material and methods

Ten patients with an indication for PVE and limited sonographic visualizability of the intrahepatic PV or unsuccessful previous attempts at PVE procedure were enrolled. Puncture was performed under 3-D needle guidance in a volumetric data set. Contrast-enhanced CT or MR baseline scans were registered to a native CBCT (image fusion, $n=3$) or a contrast-enhanced CBCT was generated ($n=7$). Technical success; number of punctures; puncture time, defined as the time between CBCT acquisition and successful portal vein access, as well as dose parameters were evaluated. Ten PVE interventions with conventional ultrasound-guidance were retrospectively analyzed as the control group.

Results

All interventions were technically successful. The mean number of puncture attempts were 3.1 ± 2.5 . The puncture time was 12 ± 10 minutes. The mean total dose area product (DAP) was 288 ± 154 Gy*cm². The relative share of CBCT-related radiation exposure was $6\% \pm 3\%$. Intervention times and DAP were slightly higher than those in the control group without reaching significance.

Conclusion

CBCT-guided PVE is feasible and safe and the relative dose share of CBCT is low compared with the overall dose of the intervention. This technique may be a promising approach for difficult anatomic situations that limit the use of sonography for needle guidance.

P-695

Cost analysis using Viatorr stent vs. Fluency/Wallstent for TIPS at a community hospital

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Purpose

To perform cost analysis of stocking Viatorr stent vs. Fluency/Wallstent combination for potential TIPS procedures at community hospitals accompanied with a case illustration.

Material and methods

Cost analysis was performed on using Viatorr stent vs. Fluency/Wallstent combination for TIPS placement. In addition, the analysis includes time value of money, cost of complication, variability of TIPS patient volume, and sunk cost of expired equipment. Two scenarios were reviewed: emergent TIPS for bleeding and elective TIPS for ascites/effusion. A mathematical algorithm is generated based on literature data to predict the potential volume of TIPS at a community hospital based on demographics, community size, and disease prevalence. A case of Fluency/Wallstent combination performed at a community hospital was presented, and potential TIPS volume was generated for this community hospital based on the algorithm.

Results

Viatorr stent TIPS cost on an average \$2500 more than Fluency/Wallstent combination. However, when we included time value of money and cost of complication/re-intervention, Viatorr TIPS costed \$5345 less than combination TIPS. One variable that alters the comparison is TIPS volume due to sunk cost of expired stentgrafts. It is more cost effective to stock Viatorr stents when a hospital performs more than one TIPS per year. For our hospital in New Jersey, the maximum TIPS volume is 14 per year based on our model.

Conclusion

Viatorr stent is more cost effective than Fluency/Wallstent combination when there is more than 1 TIPS procedure per year at a community hospital. The newly devised algorithm to predict potential TIPS volume at a community hospital is much higher than reality.

P-696

Transjugular intrahepatic portosystemic shunt (TIPS) in the treatment of patients with symptomatic Budd–Chiari syndrome: patency assessment, overall survival, and long-term results

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Purpose

Budd–Chiari syndrome (BCS) is a rare and life-threatening disorder secondary to hepatic venous outflow obstruction. Transjugular intrahepatic portosystemic shunt (TIPS) plays an increasing role in the management of patients with symptomatic BCS. The aim of this study was to assess stent patency, overall survival, and long-term results in patients with symptomatic BCS who underwent TIPS.

Material and methods

Between January 2001 and December 2016, out of 348 TIPS performed, 27 (7.76%) were performed in patients with symptomatic BCS. All patients with BCS who underwent TIPS were retrospectively reviewed until death, orthotopic liver transplantation (OLT), or last

clinical evaluation. The mean age was 34 years (range: 6–62 years) and 20 of the patients were female. The average follow-up was 49.45 months (range: 3–218 months).

Results

BCS was mainly caused by myeloproliferative disorders (33.3%), and ascites was as the most prevalent finding (81%). The success rate for TIPS was 97%. In 5 patients (at the beginning of our experience), bare stents were used and in the other 22 patients, polytetrafluoroethylene (PTFE)-covered stents were used. TIPS revision was performed in all 5 patients with bare stents and in 14/22 (63%) patients with covered stents. TIPS complications were present in 8/27 (30%) patients: hepatic hematoma (1), sepsis (2), encephalopathy (2), ischemic hepatitis (1), hepatic artery pseudoaneurysm (1), and TIPS dysfunction in the first 30 days of procedure (3). No deaths were observed. One patient developed cirrhosis and hepatocarcinoma and underwent OLT.

Conclusion

TIPS in patients with symptomatic BCS is technically feasible and safe if performed by an expert. PTFE-covered stents should always be used. TIPS seems to be an effective treatment for the long-term management of this disease.

P-697

Transjugular intrahepatic portosystemic shunt through the strut of a previously placed stent: long-term follow-up results

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Purpose

To evaluate technical feasibility and clinical outcome of TIPS through the strut of previously placed stents in 7 consecutive patients who have already undergone interventions in the form of stenting of the hepatic vein or IVC or TIPS.

Material and methods

Retrospective evaluation of 7 consecutive patients (3 male and 4 female; age range 13–65 years) who underwent TIPS through the strut of the previously placed stents in the hepatic vein or IVC or TIPS between April 2008 and May 2016. Kaplan–Meier test was used to calculate 2- and 5-year primary patency rates of TIPS stent.

Results

TIPS through the strut of a previously placed stent with strut plasty was technically successful in all the patients (100%). The mean portosystemic pressure gradient reduced from 24 ± 5.9 mmHg [pre-TIPS portosystemic pressure gradient (PPG): range, 15–31 mmHg] to 8.57 ± 4.4 mmHg (post-TIPS PPG: range, 3–14 mmHg). One patient required 3 sessions of TIPS revisions. Another patient needed TIPS revision after 5 years of TIPS creation. All patients showed improvement in clinical symptoms, lab parameters, Child–Pugh score, and MELD score during mean follow-up of 40.57 ± 34.9 months (range, 3–100 months). Primary patency rates of TIPS stent measured with Kaplan–Meier estimate at 2- and 5-year follow-up were 100% and 71%, respectively (95% CI, 0.36–0.92).

Conclusion

TIPS through the strut of previously placed stents is technically feasible with a good long-term primary patency and clinical outcome.

P-698

Evaluation of 3D overlay during transjugular intrahepatic portosystemic shunt (TIPS) procedure

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Purpose

Transjugular portosystemic shunt (TIPS) is performed under fluoroscopy guidance using 2D carbon dioxide (CO₂) venography imaging. This does not demonstrate the 3D relationship between the hepatic vein and portal vein. The purpose of this study is to evaluate the feasibility of using 3D overlay images created using cone-beam computed tomography (CBCT) for guiding portal vein (PV) puncture during TIPS creation.

Material and methods

This is a single-center IRB approved prospective evaluation of patients undergoing TIPS. Access was gained into the hepatic vein, wedged hepatic CBCT CO₂ venogram was performed, and digital overlays of the intrahepatic portal vein were displayed for real-time guidance. Evaluation of overlay benefit, number of punctures, procedure and fluoroscopy time, dose, procedural success rate, and periprocedural complications were recorded.

Results

Twenty-eight patients were enrolled in the study, and 20 patients completed the study. Of the 20 who completed the study, overlay was utilized and considered to be of “high” benefit in 14/20 (70%) cases. The mean number of punctures required to access the PV was 6.6 ± 6 (range 1–24). Mean time and DAP from CBCT to PV access was 50.2 ± 36 min (range 12–129 min) and 165 ± 169 mGy cm² (range 46–660 mGy cm²). Mean fluoroscopy time from CBCT to successful PV entry was 15.3 ± 14.5 min (range 2.3–51.3 min). Procedural success was obtained in all cases without periprocedural complications.

Conclusion

Utilizing 3D overlay is feasible and may reduce the number of needle passes, radiation exposure, and risk of complications.

P-699

Clinical experience with real-time 3D guidance based on C-arm-acquired cone-beam CT (CBCT) in transjugular intrahepatic stent shunt (TIPSS) placement

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Purpose

Transjugular intrahepatic stent shunt (TIPSS) placement is a treatment option for patients who suffer from symptoms of portal hypertension, frequently caused by liver cirrhosis. Its placement is a standard and technically challenging procedure in interventional radiology. The aim of this study was to evaluate the feasibility of cone-beam CT (CBCT)-based real-time 3D guidance in TIPSS placement and the relative dose of CBCT.

Material and methods

We prospectively included 19 patients with indication for TIPSS placement. One patient suffered from acute bleeding and 18 from therapy-refractory ascites. We evaluated technical success of TIPSS placement, puncture time to assess the portal venous system,

number of punctures needed, applied radiation dose of the intervention, and relative dose of C-arm-acquired CBCT (Allura Xper FD20 and XperCT, Philips Healthcare, Andover, MA, USA) using real-time 3D guidance.

Results

CBCT-based guidance for portal vein puncture could be applied to all patients. Further US guidance was necessary in 6 cases due to difficult anatomical situations; in 2 of these cases, TIPSS could not be implanted despite using additional US guidance. In the 13 CBCT-guided cases, the puncture time was 12 ± 13 minutes, with 3 ± 3 punctures needed. Total applied dose (dose area product, DAP) was $587 \pm 290 \text{ Gy} \cdot \text{cm}^2$ during intervention and relative dose of CBCT was $5\% \pm 3\%$.

Conclusion

CBCT-based real-time 3D guidance for portal vein puncture in TIPSS placement is feasible, and the relative dose of CBCT is low compared to the total dose of intervention.

P-700

Flow model to replan TIPS revision in patients suffering from post-TIPS hepatoenkephalopathy due to excessive shunting

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Purpose

To design a flow dynamic model to preplan TIPS revision in patients suffering from post-TIPS hepatoenkephalopathy due to excessive shunting. The model is validated by TIPS reduction in 7 patients using a unique in-TIPS flow reduction method at our institution.

Material and methods

Between May 2011 to June 2015, eight patients underwent TIPS reduction for encephalopathy refractory to medical management. We have devised and validated a mathematical model to pre-plan the specification of a unique stentgraft deployment method for achieving the desired portal gradient with a single adjustment using 8 patients' flow dynamic data.

Results

Six out of eight patients had significant immediate improvement of hepatic encephalopathy. Four patients were alive at the last follow-up. One expired due to spontaneous bacterial peritonitis, and 2 were lost to follow-up. The reduction procedure increased portosystemic gradient by 4.88 mm Hg on average; Welch's t-test was applied to compare ten sets of data between the true stentgraft waist radii and those calculated in the model, giving a statistically significant two-tailed p-value of 0.026.

Conclusion

Therefore, the model can now be clinically used to design the stentgraft configuration and waist diameter for obtaining the desired portosystemic pressure gradient prior to the TIPS reduction procedure.

P-701

Transjugular intrahepatic portosystemic shunt (TIPS) dysfunction: quantitative assessment of perfusion changes using 2D-perfusion angiography (2D-PA) following shunt revision

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Purpose

To analyze the feasibility of 2D-PA in quantifying perfusion changes pre- and post-TIPS revision.

Material and methods

Twelve patients (54 ± 14 years, 5 men) undergoing TIPS revision were included in this study. To quantify perfusion changes caused by TIPS revision using 2D-PA, acquired DSA series were post-processed using a dedicated software. A reference region-of-interest (ROI) in main portal vein (input function) and two distal target ROIs (1. intraluminal in TIPS and 2. in the liver parenchyma of the right liver lobe) were placed in corresponding areas on DSA pre- and post-TIPS revision. Time to peak (TTP), peak density (PD), and area under the curve (AUC) were assessed. The ratios of reference ROI to target ROIs ($\text{TTP}_{\text{TIPS}/\text{parenchyma}}/\text{TTP}_{\text{inflow}}$, $\text{PD}_{\text{TIPS}/\text{parenchyma}}/\text{PD}_{\text{inflow}}$, and $\text{AUC}_{\text{TIPS}/\text{parenchyma}}/\text{AUC}_{\text{inflow}}$) pre- and post-TIPS revision were calculated. Pressure measurements pre- and post-TIPS revision were performed and correlated to 2D-PA.

Results

The pressure gradient was significantly reduced following TIPS revision (17 vs. 10 mmHg; $p < 0.002$). Regarding the intraluminal TIPS perfusion, the ratios $\text{PD}_{\text{TIPS}}/\text{PD}_{\text{inflow}}$ (0.33 vs. 0.58 ; $p < 0.001$) and $\text{AUC}_{\text{TIPS}}/\text{AUC}_{\text{inflow}}$ (0.39 vs. 0.69 ; $p < 0.005$) increased significantly, whereas the ratio $\text{TTP}_{\text{TIPS}}/\text{TTP}_{\text{inflow}}$ missed significance ($p = 0.15$). Compared with the TIPS lumen, the perfusion of the liver parenchyma showed opposing changes. The ratios $\text{PD}_{\text{parenchyma}}/\text{PD}_{\text{inflow}}$ (0.26 vs. 0.13 ; $p < 0.003$) and $\text{AUC}_{\text{parenchyma}}/\text{AUC}_{\text{inflow}}$ (0.26 vs. 0.13 ; $p < 0.002$) decreased significantly. Interestingly, the ratio $\text{TTP}_{\text{parenchyma}}/\text{TTP}_{\text{inflow}}$ shortened but missed significance ($p = 0.054$). Surprisingly, no correlation was found when comparing changes in the pressure gradient and changes in the 2D-PA parameters ($p > 0.05$).

Conclusion

Quantification of perfusion changes following TIPS revision using 2D-PA is feasible and has the potential to optimize TIPS revision and to quantify technical success for scientific purposes.

P-702

Therapeutic efficacy and patency of primary stenting in patients with chronic portal vein thrombosis

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Purpose

To retrospectively investigate the therapeutic efficacy and stent patency of primary transhepatic stent placement in the management of chronic portal vein (PV) thrombosis.

Material and methods

Between May 2010 and December 2016, six patients (mean age, 65.3 years; range, 58–73) underwent primary stent placement via the percutaneous transhepatic route for chronic PV thrombosis. Five patients (83.3%) were subjected to treatment due to chronic thrombosis after hepatobiliary or pancreatic surgery, and one patient (16.7%) was subjected due to an unknown cause. The clinical manifestations were gastrointestinal hemorrhage, ascites, and/or abnormal liver function. After cannulation with guidewire, the stent was

placed in the occluded segment of PV. Technical and clinical success, stent patency, and complications were investigated.

Results

In all patients, complete thrombotic obliteration of PV was demonstrated on venography. Four patients (66.7%) showed cavernous transformation with extensive varix, and two patients (33.3%) showed cavernous transformation alone. The extent of thrombosis was confined to the main PV in four patients (66.7%) and from the main PV to the intrahepatic PV in two patients (33.3%). Technical success was achieved in five patients (83.3%). One patient (16.7%) who failed to pass the guidewire into thrombus was considered to have experienced a technical failure. All patients in whom stenting was successful (n=5) showed improvement of clinical manifestation (clinical success rate: 100%). There was no procedure-related major complication. During the median follow-up period of 298.5 days, all stents were patent.

Conclusion

Primary stenting appears effective as the treatment with high technical and clinical success rates in the management of chronic PV thrombosis.

P-703

Combined tissue and portal venous sampling informs biomarkers of dynamic immune aberrancy and hepatic fibrosis in chronic hepatitis C (HCV)

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Purpose

Understanding the microbial translocation and immune aberrancies in chronic HCC infection will inform cirrhosis and hepatocellular carcinoma (HCC) development and provide therapeutic targets. Differences in portal versus systemic venous blood in HCV patients were correlated with fibrosis in liver biopsy specimens.

Material and methods

Overall, 29 consecutive hepatitis C patients (18 males, 11 females, mean age 57.8 years) underwent combined ultrasound-guided percutaneous liver biopsy and portal venous sampling using a single 17G needle transcapsular puncture in 26/29 patients. Safety was assessed with immediate post-procedure ultrasound imaging and serial blood counts.

Results

There were no hemorrhagic complications. Portal venous samples correlated with the Ishak fibrosis score in terms of CD4+ central memory T_{subset} cells (p=0.001, r=0.56) but not CD8+ T_{subset} cells. Neither CD4+ nor CD8+ subset cells from peripheral blood correlated with the increase in fibrosis. Peripheral CD8 effector memory T cells negatively correlated with direct portal pressure (p=0.048, r=-0.38). Direct portal pressure also positively correlated with the Ishak fibrosis score (p=0.0001, r=0.71).

Conclusion

Tissue and portal venous sampling can be safely performed with a single liver puncture in HCV patients. T cell subset distribution in portal vs. peripheral venous blood shows dynamic changes between compartments across the severity of HCV-related liver disease. Changes in the portal compartment may not be reflected in peripheral blood, making portal blood sampling crucial for the complete understanding of HCV progression and immune dysregulation related to development of cirrhosis and HCC.

P-704

BRTO vs PARTO for gastric variceal bleeding using sodium tetradecyl sulfate (STS) in a single US medical center

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Purpose

To compare the safety and efficacy of balloon-occluded retrograde transvenous obliteration of gastric varices (BRTO) vs plug-assisted retrograde transvenous obliteration (PARTO) using sodium tetradecyl sulfate (STS) in patients with active or prior gastric variceal (GV) bleeding.

Material and methods

A retrospective cohort study of all BRTO and PARTO procedures from 9/1/2009 to 8/31/2016 for active or prior GV bleeding at our single US academic medical center was performed. Both BRTO and PARTO procedures were performed with STS. Preprocedural data, procedure details, and postprocedural outcomes were assessed.

Results

Twenty-nine patients underwent BRTO and 15 patients underwent PARTO for GV bleeding with technical success. Both groups had comparable preprocedural demographics and MELD scores (BRTO, 56 years, MELD score 11.4 vs PARTO, 61 years, MELD score 10.0). In the BRTO group, there was one balloon rupture. In the PARTO group, the mean size of the Amplatzer plug was 15.9 mm. Postprocedure, the GV rebleeding rate was 13.8% (4/29) and 6.7% (1/15) in the BRTO and PARTO groups, with a need for reintervention in 10.3% (3/29) and 6.7% (1/15) over an average follow-up time of 577 days and 149 days, respectively. The 30-day mortality rate was 13.8% [4/29: underlying cancer (n=2), liver failure (n=2)] and 6.7% (1/15: hepatorenal failure) in the BRTO and PARTO groups, respectively. There was no statistically significant difference in outcomes between the BRTO and PARTO groups.

Conclusion

PARTO and BRTO with STS offer similar safety and long-term efficacy results for GV bleeding. However, PARTO may be more cost effective than BRTO considering no post-procedure dwell time of the occlusion balloon under ICU level care.

P-705

The influence of puncture sites on the portal vein during TIPS with ePTFE-covered stents on postoperative clinical efficacy: 3-year follow-up results

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Purpose

To evaluate the influence of puncture sites on the portal vein during TIPS with ePTFE-covered stents on long-term clinical efficacy, including primary patency, incidence of hepatic encephalopathy (HE), and survival.

Material and methods

A retrospective review was performed, including 171 patients who underwent TIPS with ePTFE-covered stents from January 2008 to October 2014. All patients were divided into 3 groups according to the puncture site of TIPS: intrahepatic bifurcation of the portal vein (group A, n=88), right branch of the portal vein (group B, n=48), and left branch of the portal vein (group C, n=35). The Kaplan-Meier analysis was performed to assess the effect of different puncture sites on primary patency, incidence of HE, and survival.

Results

Intrahepatic shunts were successfully established in all patients. The median follow-up time was 22 months, ranging from 3 to 94 months with a mean of 35.23 ± 18.91 months. The primary restenosis rate was 29.8% (51/171). The total HE rate was 31.6% (54/171). The cumulative death rate was 19.3% (33/171). The Kaplan–Meier analysis showed that the primary restenosis rate was significantly different in group C versus group A, group C versus group B, and group A versus group B ($\chi^2=11.49$, $P=0.001$; $\chi^2=4.54$, $P=0.033$; and $\chi^2=4.12$, $P=0.046$, respectively). In addition, the incidence of HE was significantly different in group C versus group A and group C versus group B ($\chi^2=8.07$, $P=0.004$ and $\chi^2=9.44$, $P=0.002$, respectively). There was no significant difference in survival ($\chi^2=0.364$, $P=0.834$).

Conclusion

Choosing the left branch of the portal vein as the puncture site to create the shunt in TIPS can significantly decrease the incidence of primary restenosis and HE.

P-706

Long-term outcomes of percutaneous transhepatic stent placement for portal vein stenosis or thrombosis after liver transplantation

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Purpose

We retrospectively evaluated long-term outcomes of percutaneous transhepatic stent placement for portal vein stenosis or thrombosis after liver transplantation (LT).

Material and methods

Between January 2004 and December 2014, 1294 patients underwent LT (living donor: 889 and deceased donor: 405); 39 patients (34 men, 5 women; mean age, 56.8 years) were confirmed to have portal vein stenosis or thrombosis on follow-up doppler ultrasonography or computed tomography. All patients with portal vein stenosis underwent percutaneous transhepatic interventions, including direct portography with manometry and balloon angioplasty with or without stent placement. Technical and clinical success, laboratory and manometry findings, patency, and major complications were evaluated. Follow-up after the initial balloon angioplasty ranged from 13 days to 132.5 months (mean, 47.2 months).

Results

The technical success rate was 100%, and clinical success was achieved in 89.7% cases. At 1 and 2 years, primary stent patency was 96.9% and 96.6%, respectively, and at 3, 5, and 10 years, primary stent patency was 93.6%. One major complication following balloon angioplasty and stent placement, namely abrupt removal of the vascular sheath with tract bleeding, was noted.

Conclusion

Percutaneous transhepatic stent placement is a safe and effective treatment with long-term patency for portal vein stenosis or thrombosis after LT.

P-707

Long-term outcome of portal vein angioplasty or stent placement in pediatric liver transplant recipients

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Purpose

To compare the long-term efficacy of balloon angioplasty and stent placement for treating portal vein (PV) stenosis in pediatric liver transplant recipients.

Material and methods

Fifty patients (<18 years, median age: 1.2 years) who had undergone balloon angioplasty ($n=12$) or stent placement ($n=38$) via the percutaneous transhepatic or intraoperative mesenteric vein route were retrospectively analyzed. Balloons of 6–15mm diameter and self-expandable stents of 6–14mm diameter were used.

Results

Median follow-up for balloon angioplasty and stent placement groups were 6.0 (0.3–14.4) years and 8.7 (3.9–14.4) years, respectively ($p=0.002$). Mean number of endovascular procedures to maintain patent PV were 1.5 ± 1.0 (range, 1–4) and 1.1 ± 0.4 (range, 1–3), respectively ($p=0.031$). The 1-, 5-, and 10-year primary patency rates of balloon angioplasty were the same ($73.3\% \pm 13.2\%$), and secondary patency rates were $90.9\% \pm 8.7\%$, $81.8\% \pm 11.6\%$, and $81.8\% \pm 11.6\%$, respectively. The 1-, 5-, and 10-year primary patency rates of stent placement were $94.7\% \pm 3.6\%$, $94.7\% \pm 3.6\%$, and $90.4\% \pm 5.4\%$, respectively, and secondary patency rates were the same ($97.4\% \pm 2.6\%$). However, patency rates were insignificant between the two groups ($p=0.065$ and $p=0.050$, respectively). Post-stent segment PV dilation >2-folds of placed stents was observed in 10 (26.3%) patients; however, no patient had portal hypertension symptoms. Stent fracture was observed in 2 patients. Three patients in the stent group underwent retransplantation successfully with end-to-end PV reanastomosis with a stent in-situ ($n=2$) or a jump cadaveric vein interposition ($n=1$).

Conclusion

Patency rates of PV were similar between balloon angioplasty and stent placement groups. However, repeat procedures were common following balloon angioplasty to maintain PV patency. Stent placement had low rates of recurrence and repeat procedures. Functional stent stenosis was rare and retransplantation was also feasible in pediatric patients with PV stent placement.

P-708

Study of interventional treatments for chronic portal vein occlusion and cavernous transformation with symptomatic portal hypertension

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Purpose

To investigate the efficacy and safety of percutaneous transhepatic intrahepatic portosystemic shunt (PTIPS) placement for chronic portal vein occlusion and cavernous transformation with symptomatic portal hypertension.

Material and methods

Clinical and imaging data of 38 patients with chronic portal vein occlusion and cavernous transformation with symptomatic portal hypertension who underwent PTIPS placement at our hospital from November 2009 to June 2016 were retrospectively analysed. The significance of differences in the portosystemic pressure gradient (PPG) measured before and after PTIPS placement was assessed by paired sample t-test. All patients were followed up. The curative effect and operation-correlated complications were observed.

Results

PTIPS placement was successful in 36 patients and failed in 2 patients. The technical success rate was 94.7% (36/38). The mean PPG decreased from 25.2 ± 2.9 mmHg to 13.2 ± 1.3 mmHg after successful PTIPS placement ($P<0.05$). During the procedure, arterial hemorrhage occurred in 2 patients who underwent embolization and biliary injury occurred in 1 patient who underwent PTBD. The mean follow-up was 26.7 ± 10.4 (range: 3–74) months. Hepatic

encephalopathy occurred in 4 (11.1%) patients, among whom 3 patients recovered after receiving medical treatment, while 1 patient experienced grade 3 hepatic encephalopathy and recovered after a smaller cover stent implantation. Shunt dysfunction appeared in 10 patients (27.8%); 8 of whom recovered after shunt revision with stent implantation or balloon angioplasty, whereas 2 underwent anticoagulation by warfarin only. There were 7 patients who died from liver failure (n=5), recurrent varicose vein bleeding (n=1), or stroke (n=1).

Conclusion

PTIPS is both safe and effective for the treatment of chronic portal vein occlusion and cavernous transformation with symptomatic portal hypertension.

P-709

Transjugular liver biopsy after TIPS/DIPS: Is it feasible, effective, and safe

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Purpose

To evaluate our experience with transjugular liver biopsies (TJLB) in patients with previously placed transjugular intrahepatic portosystemic shunt (TIPS) or direct intrahepatic portocaval shunt (DIPS).

Material and methods

A single-institution retrospective review was performed looking at all cases of TJLBs in patients with previously placed TIPS or DIPS over the past 7 years. Patient demographics, indications, procedural details, labs, complications, and pathology were recorded. Patients with known occluded TIPS were excluded from this study.

Results

Seven TJLBs were performed in 7 patients, 5 of whom had TIPS and 2 who had DIPS. All procedures were technically successful with adequate samples obtained. There were no immediate or delayed complications. Of the patients with TIPS, biopsies were performed from the same hepatic vein as TIPS in 3 cases and from a different hepatic vein in 2 cases. The reasons for the transjugular rather than the percutaneous approach to liver biopsy included ascites, coagulopathy, or need for concurrent TIPS/DIPS evaluation and/or revision.

Conclusion

Currently, there exists no published literature on performing TJLBs in patients with TIPS or DIPS. These patients often have indications for liver biopsy with concurrent contraindications to percutaneous liver biopsy, such as ascites or coagulopathy. We found a 100% technical success rate and no instances of complications. This suggests that TJLBs can safely and effectively be performed in patients with previously placed TIPS or DIPS.

P-710

Prospective assessment of ultrasound-guided method for hepatic vein cannulation (JASH method), portal pressure measurement, and transjugular liver biopsy: a back-to-back non-inferiority study

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Purpose

To prospectively compare the US-guided method with the conventional (real-time fluoroscopy) method for hepatic vein (HV) cannulation. Secondary goals were whether HV-portal gradient (HVP) measurement and transjugular biopsy (TJB) were comparable to real-time fluoroscopy-guided methods.

Material and methods

Hundred patients (between 01/2015 and 12/2016) with liver disease were included in the study. Informed consent and ethics committee approval were obtained. Seventy patients needed TJB. Patients acted as their own control, with one or the other method randomly being performed first and the alternative method performed later (TJB with the second procedure). The US-guided method for HV cannulation was termed as the "JASH method" in recognition of the mentor who helped this small study move forward (Prof. JA Solís-Herruzo). SPSS v.14 was used for statistical analysis.

Results

HV cannulation was achieved 99 times using the fluoroscopy-guided method and 97 times using the US-guided method (NS). The average time was 13.2 minutes using the fluoroscopy-guided method and 15.5 minutes using NS. As long as the balloon was observed on US and the HV Doppler wave obliterated with the balloon, HVP measurements were similar, with no significant differences. TJB was performed 70 times (39 times with the JASH method). No major complications were detected. Only 5 small liver (2 by the US-guided method) hematomas were detected during a 6-hour US.

Conclusion

The "JASH method" is safe and feasible, with a short learning curve and HVP and TJB results were similar to those of the conventional methods. It does not use radiation or contrast and can even be performed at the bedside of the patient (generally in an ICU environment). Other, more complex procedures cannot be recommended based on the results of this study.

P-711

Ten-year outcome of transjugular intrahepatic portosystemic shunt treatment for Budd-Chiari syndrome

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Purpose

To investigate long-term outcomes of transjugular intrahepatic portosystemic shunt (TIPS) creation in patients with symptomatic Budd-Chiari syndrome (BCS) refractory to drug therapy.

Material and methods

This was a retrospective, single-centre study of 27 consecutive patients (17 female; mean age: 50.8 ± 15.0 years) who underwent TIPS in the interventional radiology department between July 2003 and June 2016 due to symptomatic BCS not responding to anticoagulation therapy. Model for end-stage liver disease (MELD) score, BCS-TIPS prognostic index (BSC-TIPS PI) scores, and procedural details were recorded. Primary outcome measure was orthotopic liver transplant (OLT)-free survival. Secondary outcome measures included primary patency (PP) and reintervention-free interval as well as the identification of factors influencing outcomes.

Results

Mean time follow-up was 46.5 ± 38.7 months (range 1–139). Mean MELD and BSC-TIPS PI scores were 13.8 ± 4.9 (range 6–25) and 4.9 ± 1.3 (range 3.25–8.48); respectively. According to Kaplan-Meier survival analysis, estimated OLT-free survival rates were 96.3%, 96.3%, and 82.5% at 2-, 5-, and 10-year follow-ups, respectively. PP was 77.4%, 55.3%, and 26.3% and reintervention-free interval was 80.4%, 57.4%, and 30.8% at 1-, 2-, and 8-year follow-ups, respectively. Univariate subgroup analysis demonstrated that stent grafts were correlated with increased survival (HR 0.0045; 95%CI 0.00003–0.701; p=0.035) and PP (HR 0.36; 95%CI 2.503–3.053; p=0.03).

Conclusion

TIPS resulted in high 10-year OLT-free survival and satisfactory reintervention rates in patients with symptomatic BCS refractory to anticoagulation. Stentgrafts were correlated with increased survival and primary patency.

P-712

One-step minilaparotomy-assisted transmesenteric antero-grade portal vein recanalization and transjugular intrahepatic portosystemic shunt for portal cavernoma-induced variceal bleeding in 3 patients

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Purpose

To present the transmesenteric route as an alternative approach for one-step portal vein antegrade recanalization (PVR) followed by transjugular portal stenting and TIPS in patients with portal cavernoma (PC) and recurrent bleeding varices.

Material and methods

From 2012 to 2016, 3 patients (2 without cirrhosis and 1 with HCV-related cirrhosis) with PC underwent transmesenteric PVR-TIPS and variceal embolization. All presented with patent superior mesenteric and splenic veins, chronic PC, and extensive variceal bleeding initially treated by endoscopic ligation and β -blockers. Double approach was performed: minilaparotomy for ileocolic vein cannulation, antegrade portal vein recanalization, direct variceal embolization and use of the jugular vein for portal stentgraft and TIPS placement. Patients were followed up for adverse events. The portal vein and TIPS patencies were evaluated by ultrasonography and CT.

Results

The transmesenteric approach allowed portal vein recanalization in all patients. Six 10-mm Viatorr stentgrafts were used. Variceal embolization and TIPS allowed variceal decompression and maintained patency of the portal stentgraft. Extrahepatic portal vein puncture occurred during TIPS placement in a young girl treated by planned stentgraft release without blood transfusion. The baseline Child-Pugh score was B7 for the first patient and A for the others. Reintervention by residual variceal embolization and TIPS hourglass reduction was performed in 1 patient for shunt-related encephalopathy. All stentgrafts were patent in the follow-up (median 30 months) without endoscopic signs of further bleeding or encephalopathy episodes.

Conclusion

Transmesenteric antegrade PVR and variceal embolization associated with transjugular portal stenting and TIPS seem to be safe and effective for treating PC and relieving portal hypertension and its complications.

P-713

How useful it is to use combined approaches to get successful insertion of TIPS into portal thrombosis and cavernomatosis?

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Purpose

Portal vein thrombosis (PVT) is common in patients with cirrhosis. Transjugular intrahepatic portosystemic shunt (TIPS) is a treatment option reported in several studies. TIPS followed by portal vein recanalization (TIPS-PVR) or PVR followed by TIPS (PVR-TIPS) have

been described as therapeutic strategies. The aim is to report the usefulness of these techniques as well as the patency rate and survival of patients.

Material and methods

Twenty-three patients with PVT (acute 7, chronic 4, chronic with cavernomatosis 12) undergoing TIPS-PVR (N=15) or PVR-TIPS (N=8; transhepatic approach n=5, transsplenic n=3) between January 2006 and May 2016 were enrolled in this retrospective study. Procedure considerations, distance of PTFE-covered endoprosthesis from the atrium, and the confluents spleno-porto-mesenteric, technical success, and pre- and post-procedure portosystemic gradients (P-SG) were evaluated; also, we analyzed their relationship with the patency rate.

Results

Balloon (n= 5), colateral vein (n=3), goose snare (n=1), and biliary duct (n=1) were used as the targets for recanalization of PVT. In 19 patients, an additional stent was used proximal to the atrium (atrium=3, 0.5–2cm=9, and >2cm=6) and proximal to the venous confluence (splenic vein=7, mesenteric vein=2, confluence=3, <2cm confluence=3, and >2cm=3). Mean P-SG post-TIPS was 8.3 (2–16). Gastroesophageal varices were embolized in 3 patients (P-SG>12). TIPS was successfully placed in 100%. Mean follow-up was 30 months (7–64). Primary patency was 69.56% (n=16) and secondary patency was 95.65% (n=22); number of retreatment was 10. There were no significant differences (p>0.05) between the approach and type of PVT in TIPS patency. There were significant differences (p<0.05) between stent localization in TIPS patency.

Conclusion

TIPS followed by PVR or PVR followed by TIPS are safe and useful in cirrhosis with PVT.

P-714

Endovascular treatment of refractory hepatic encephalopathy

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Learning Objectives

To learn about the endovascular treatment options available for selected patients with refractory hepatic encephalopathy due to large portosystemic shunt vessels, which is an underdiagnosed condition.

Background

Cirrhosis and portal hypertension remain a significant cause of morbidity and mortality worldwide. Currently, the treatment of refractory hepatic encephalopathy (HE) remains a challenge for both patients and physicians. Failure of conventional medical therapy for HE or encephalopathy occurring in the context of well-preserved liver function may indicate the presence of a large portosystemic shunt, which could be amenable to percutaneous occlusion. This has the potential of decreasing or completely ceasing the frequency of HE episodes with a minimally invasive approach. However, many patients who could benefit from these procedures are never considered for them.

Clinical Findings/Procedure

The purpose of this poster is to understand and review the following topics:

- Pathophysiology of HE
- Clinical presentation of HE and indicators that warrant investigation for portosystemic shunts
- Relevant vascular anatomy
- Range of endovascular techniques and treatments available
- Appropriate patient selection based on clinical, anatomic, and biochemical parameters
- Procedural details of treating large portosystemic shunts
- Advantages and disadvantages of each procedural technique
- A discussion of the relevant risks and required post-procedure follow-up

Conclusion

If a patient with refractory HE demonstrates well-preserved synthetic function, this should prompt an immediate search for large portosystemic shunts. Sadly, many such patients go unrecognized. This educational poster will not only increase the awareness of the condition but also give the reader the required knowledge to plan and undertake shunt occlusion procedures with safety and confidence.

P-715

Advanced portal vein access using IVUS/ICE for portal vein decompression, variceal embolization, and portal vein recanalization

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Learning Objectives

1. To understand the basics of using an intracardiac echo catheter for portal vein access.
2. To review patient cases with the use of PV access for portal vein decompression (TIPS and DIPS), variceal embolization (esophageal, gastric, antegrade, and retrograde venous obliteration), and portal/mesenteric vein thrombolysis.

Background

In the past year, there has been a growing trend in the use of intracardiac echo for guidance of PV access, demonstrating reduced procedure metrics (procedure time, radiation, and contrast). The authors will illustrate the advantages of ICE catheters for PV access, including cases where no shunt was placed. Sample cases will demonstrate the ease of use of ICE catheters, variceal embolization, antegrade/retrograde obliteration of varices, and portal vein thrombolysis.

Clinical Findings/Procedure

Intracardiac echo guidance was used for portal vein access in 20 different patients (from October 2015 to October 2016) with portal hypertension and comorbid conditions, including recurrent ascites, gastroesophageal variceal hemorrhage, rectal variceal hemorrhage, recurrent hepatic encephalopathy, and portal vein thrombosis.

Conclusion

Intracardiac echo catheters reduce the time and complexity of portal vein access, facilitating a wide range of procedures for the treatment of portal hypertension and related comorbidities. The ease of access into the portal vein reduces difficulties often faced when combining portal vein access with additional procedures such as antegrade/retrograde venous obliteration, portal vein thrombolysis, and even variceal embolization. The authors advocate the use of ICE catheters for majority of PV access cases given the advantages it provides. Further testing is needed to prove the cost effectiveness of using ICE catheters.

P-716

Balloon-occluded retrograde transvenous obliteration for duodenal varices

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Learning Objectives

1. To describe anatomical characteristic of duodenal varices (DVs).
2. To learn the method of balloon-occluded retrograde transvenous obliteration (B-RTO) with adjunctive techniques.
3. To learn an additional antegrade approach in case of failed B-RTO.

Background

DVs are rare, and no standard treatment has been established. Several studies reported the validity of B-RTO as a treatment for DVs, but no large-scale studies have been reported.

Clinical Findings/Procedure

We retrospectively evaluated 13 patients (8 women; mean age, 68.2 ± 9.3 years) who underwent B-RTO for DVs in our institute between March 2000 and December 2015. All DVs were located at the second/third junction of the duodenum. The afferent veins were pancreaticoduodenal varices in all cases (100%). The efferent veins were the right gonadal ($n=6$, 46%), right renal capsular ($n=3$, 23%), left gonadal ($n=2$, 15%), left renal capsular ($n=1$, 8%), and unnamed retroperitoneal veins ($n=1$, 8%). B-RTO was successfully performed in 10 cases (77%). Among the cases successfully treated with B-RTO, 9 (90%) required adjunctive techniques, including coil embolization of multiple efferent veins, advancing occlusion balloon catheter beyond a minor efferent vein, or simultaneous double balloon occlusion for two efferent veins. Embolic materials included ethanolamine oleate ($n=10$, 100%) and n-butyl cyanoacrylate ($n=1$, 10%). Three cases with failed B-RTO underwent percutaneous transhepatic obliteration ($n=1$), transileocecal obliteration ($n=1$), or dual balloon-occluded embolotherapy ($n=1$).

Conclusion

B-RTO is an effective treatment for DVs, although adjunctive techniques are required in most cases. An antegrade approach can be considered when B-RTO alone fails.

P-717

Splanchnic venous thrombosis and Janus kinase 2 (JAK2) mutation

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Learning Objectives

1. To educate interventional radiologists about the association between non-cirrhotic, non-malignant splanchnic venous thrombosis (SVT) and Janus kinase 2 (JAK2) V617F mutation-associated hypercoagulability.
2. To present a case series outlining the clinical and imaging characteristics of the JAK2 mutation and percutaneous interventions.
3. To discuss management and surveillance strategies.

Background

It is well established that myeloproliferative neoplasms (MPNs) are a major risk factor for the development of SVT. Recent studies have noted that 33% patients with SVT will have the JAK2 mutation. MPNs most commonly associated with JAK2 mutations are polycythemia vera, primary myelofibrosis, and essential thrombocythemia.

Clinical Findings/Procedure

A 51-year-old female presented with severe abdominal pain and emesis. Abdominal CT showed extensive SVT. Two weeks of therapeutic heparin failed to ameliorate symptoms. Patency was achieved with catheter-directed thrombolysis and TIPS. Hypercoagulable workup confirmed the JAK2 mutation. Despite therapeutic anticoagulation, she required 4 thrombolytic interventions in the ensuing 18 months. Between 2014 and 2016, two additional patients presenting with acute SVT were subsequently diagnosed with the JAK2 mutation. Both responded to percutaneous thrombolytic therapy. One required a second intervention within 6 months.

Conclusion

Because 40% patients with MPN will develop SVT before the diagnosis of MPN, it is critical that interventionalists are attuned to this association. A presentation of SVT warrants evaluation for the presence of the JAK2 mutation. We must be aware so that hematology-oncology referral and appropriate testing are performed. Discovery of MPN will alter treatment in a significant proportion of patients.

P-718

Endovascular intervention through liver tissue in the treatment of portal hypertension

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Background

To assess the feasibility and effectiveness of endovascular intervention through the liver tissue in the prevention of varicose vein bleeding of the esophagus and stomach in patients with portal hypertension.

Clinical Findings/Procedure

We analyzed the treatment results of 54 patients who were diagnosed with portal hypertension and were at a risk of varicose vein bleeding of the esophagus and stomach. Their age ranged from 19 to 86 (mean 59.2) years. Indications for endovascular intervention through the liver tissue were determined by the presence of recurrent bleeding or inefficiency of endoscopic procedures and a high risk necessitating surgical intervention. After selective catheterization, endovascular occlusion of the superselective splenic, left gastric, and right gastro-omental arteries was performed. Endovascular occlusion of the veins was performed by percutaneous transhepatic catheterization of the left gastric and short gastric veins by the sequential administration of sclerosing agents, coils, and hemostatic sponge using "sandwich" technology. In case of the presence of refractory ascites, transjugular shunting was combined with simultaneous occlusion of varicose veins of the esophagus and stomach with splenic artery embolization. Patients were remotely monitored for 2 years.

Conclusion

Complex endovascular interventions, including the occlusion of the splenic artery and other arterial supplies to the spleen and intervention endovascular embolization of the varicose veins of the esophagus and stomach through the liver tissue, are less invasive and more effective alternative methods when other methods of hemostasis cannot be applied.

P-719

Modified balloon-occluded retrograde transvenous obliteration (BRTO) techniques for the treatment of gastric varices: balloon-occluded antegrade transvenous obliteration (BATO)/vascular plug-assisted retrograde transvenous obliteration (PARTO)/coil-assisted retrograde transvenous obliteration (CARTO)

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Learning Objectives

1. To know the basic balloon-assisted retrograde transvenous obliteration (BRTO).
2. To know the modified BRTO techniques: balloon-occluded antegrade transvenous obliteration (BATO), vascular plug-assisted retrograde transvenous obliteration (PARTO), and coil-assisted retrograde transvenous obliteration (CARTO).
3. To present interesting cases of BRTO and modified BRTO techniques.

Background

Although BRTO has been used for two decades in Asia for the management of gastric variceal bleeding, it is an emerging management option in USA. Modified versions of BRTO have been developed, including BATO, PARTO, where a vascular plug is deployed within a portosystemic shunt, and CARTO, where multiple coils are deployed within a portosystemic shunt.

Clinical Findings/Procedure

- Pathophysiology of gastric varices
- Basic BRTO techniques
- BATO
- PARTO
- CARTO
- Interesting cases

Conclusion

To know the basic and modified BRTO techniques, including BATO, PARTO, and CARTO.

P-720

How do I TIPS this: tricks to accomplish the difficult TIPS placement

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Learning Objectives

To demonstrate techniques for the placement of a transjugular intrahepatic portosystemic shunt (TIPS) in challenging circumstances. Technical problems and complications are discussed with interventions to overcome them.

Background

TIPS is an effective treatment for portal hypertension sequela. Placement and revision of TIPS may be challenging in conditions such as an underlying liver disease, history of liver transplant, or a prior liver intervention. This exhibit describes techniques for TIPS placement in complicated scenarios with emphasis on the management strategy.

Clinical Findings/Procedure

Challenging TIPS procedures discussed include hepatocellular carcinoma, superior vena cava (SVC) occlusion, hepatic vein occlusion/Budd-Chiari syndrome, portal venous thrombosis, hepatic artery occlusion/injury, history of hepatic arterial chemoembolization (HACE), inadequacy of previous TIPS, and hemobilia. 1) In

case of a massive right liver lobe hepatocellular carcinoma, the left hepatic vein was used with wire guidance in the left portal vein. 2) SVC occlusion was bypassed via SVC or the femoral approach. 3) TIPS placement in a case with hepatic vein occlusion is discussed. 4) A thrombosed portal vein can be recanalized by thrombolysis. 5) TIPS placement in case of a thrombosed hepatic artery is possible when the development of sufficient collaterals is documented. 6) Similarly, TIPS placement is possible after HACE by virtue of collateral circulation. 7) Direct puncture of the hepatic artery during shunt placement can be treated with stent grafting. 8) A parallel second TIPS can be placed if the primary TIPS (occluded or patent) gives inadequate pressure reduction. 9) For uncontrolled hemobilia after TIPS, the culprit hepatic artery can be embolized.

Conclusion

TIPS placement and subsequent complications can be challenging. Scrupulous preprocedural planning and correct interventions are indispensable for favorable outcomes.

P-721

TIPSS AND TRICKS: the use of the TIPSS procedure in acute and chronic portal vein thrombosis

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Learning Objectives

This educational report documents the innovative use of the transjugular intrahepatic portosystemic shunt (TIPSS) procedure in the management of five patients with acute and chronic portal vein thrombosis. It outlines the varied clinical presentations of patients, the imaging findings, and the interventional techniques and challenges experienced during TIPSS insertion.

Background

This year marks the 29th anniversary of the first successful TIPSS procedure completed with a metallic Palmaz stent in Freiburg in 1988. The last three decades have seen both the techniques and indications for TIPSS stenting evolve. The advantages of TIPSS insertion in portal vein thrombosis include access to treat underlying portal hypertension and varices and early restoration of flow in the mesenteric and portal veins. While portal vein thrombus does pose a greater technical challenge for TIPSS insertion, one center reported a 98% success rate in achieving stent patency in a sample group of 60 patients¹.

Clinical Findings/Procedure

Techniques combining the use of ultrasound-guided percutaneous portal vein access with balloon placement for TIPSS target and wedge portography were used. Utilizing the skills of two experienced operators allowed for a 100% success rate in ultrasound-guided TIPSS detection.

Conclusion

The five patients involved in this case series underwent successful stent insertions with resolution of their presenting symptoms. The different approaches adopted in each case highlight the resourceful techniques required when dealing with portal venous thrombosis and the importance of careful case-by-case consideration.

Reference:

1. Thornburg et al., Portal vein Recanalisation and TIPSS Creation for Chronic Portal Vein Thrombosis: Technical Considerations, TVIR. Vol19(2016):52- 60.

P-722

Trans-splenic approach: an option when conventional TIPS goes wrong

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Learning Objectives

The trans-splenic approach may be an option when conventional TIPS fails. In this review, we talk about the technique of the trans-splenic approach, with examples based on our experience.

1. To know the most common indications and contraindications.
2. To demonstrate the efficacy and safety of this method.
3. To identify the main complications and how to resolve them.

Background

The trans-splenic approach is another way to access the PV. However, because of the high vascularity of the spleen, there is a risk of bleeding, which is a complication associated with this technique. This technique is rarely applied by clinicians. It is less frequently used in patients with decompensated cirrhosis and coagulation deficiencies. We are going to present cases when conventional TIPS becomes difficult or fails based on our experience.

Clinical Findings/Procedure

Under ultrasonographic guidance, the branch of the splenic vein is located and punctured with a Shiba 22-G needle, venous return is checked, and COPE guide is introduced, afterward to perform NEFF trimodular exchange and to advance hydrophilic guidewire 0.35 inches and on this forward multipurpose catheter 5 FR and inject water-soluble contrast agent and opacify the portal vein and its branches, under stereotaxic perform the suprahepatic portal connection with previous transjugular approach.

Conclusion

The trans-splenic approach is an option when conventional TIPS is difficult or fails depending on the skill and experience of the interventionalist.

P-723

Different approaches for portal recanalization with cavernomatous degeneration

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Learning Objectives

1. To review current indications for portal recanalization.
2. To discuss the standard therapeutic approach for portal cavernomas.
3. To discuss the issue of hepatic transplantation when portal cavernomatous degeneration coexists.
4. To describe different techniques for portal recanalization and their possible indications in patients with cavernomatous degeneration.

Background

Current guidelines for portal recanalization often dismiss endovascular treatment when cavernomatous degeneration exists; however, new studies have shown successful outcomes with a transjugular, transhepatic, or trans-splenic approach for portal recanalization.

Clinical Findings/Procedure

Successful portal recanalization with the transjugular approach as well as the hybrid transjugular/transhepatic and transjugular/trans-splenic approaches will be accurately described.

Conclusion

- Whenever conventional treatment lacks adequate control for portal hypertension complications in the presence of portal cavernomatous degeneration, endovascular treatment should be considered.
- Portal recanalization before liver transplantation in cavernomatous degeneration can aid/enable the procedure by lowering the difficulty of porto-portal anastomosis.

P-724

Preoperative portal vein embolization through splenic vein access

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We report successful portal vein embolization using gelatin particles and Amplatzer vascular plug through splenic vein access before planned extended right hepatectomy owing to a huge neuroendocrine tumor in the right hepatic lobe. During the final procedure, we occluded the splenic access tract using a coil and Histoacryl.

P-725

A rare congenital non-cirrhotic extrahepatic portosystemic shunt causing adult-onset encephalopathy treated with an endovascular procedure

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A 47-year-old female presented with a 7-month history of episodic confusion and progressive ataxia (serum ammonia 434 ug/dl). CT scan showed a portosystemic shunt between the inferior mesenteric vein, inferior vena cava, and left ovarian vein. Endovascular shunt closure was performed.

P-726

Percutaneous transhepatic coronary vein and posterior gastric vein embolization to restore the reduced portal flow after living donor liver transplantation

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A 43-year-old man who had undergone living donor liver transplantation a day before showed no main portal vein flow on Doppler ultrasound and underwent an immediate embolization of the collateral vein through the transhepatic approach; the portal flow was successfully restored.

P-727

Percutaneous embolization treatment of parastomal ectopic variceal bleeding

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We present two cases of parastomal ectopic variceal bleeding, one of them due to portal hypertension and the other due to inferior vena cava (IVC) and superior vena cava (SVC) occlusions that were treated successfully by percutaneous parastomal variceal embolization.

P-728

Modified coil-assisted retrograde transvenous obliteration (CARTO) for gastric varices: a report of two cases

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CARTO is a modified technique for balloon-occluded retrograde transvenous obliteration that occludes the efferent shunt by microcoils instead of a balloon catheter. We report a modified CARTO technique by placing microcoils deep in the gastrosplenic shunt to reduce the amount of sclerosant.

P-729

A case of hepatocellular carcinoma (HCC) rupture after B-RTO for gastric varices

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The patient was an approximately 70-year-old woman with hepatocellular carcinoma (HCC) and gastric varices. We performed preoperative B-RTO for gastric varices; the next day, the complication of HCC rupture occurred. There are few reports on the complication of HCC rupture after B-RTO; thus, we will report based on literature consideration.

P-730

Percutaneous embolization of a congenital portocaval shunt improved encephalopathy

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We report the case of a 66-year-old man with hepatic encephalopathy and cardiac insufficiency due to the congenital intrahepatic portocaval shunt. We embolized it with the Amplatzer vascular plug through the transhepatic access. Clinical and laboratory findings improved after embolization.

P-731

Duodenal variceal bleeding embolization through dual venous access

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A patient with a 3-year non-dysfunctional TIPS presented with duodenal variceal bleeding involving a mesocaval shunt. Microcoils were placed by the antegrade approach with hemorrhage control. Meanwhile, shunt occlusion was being performed by the retrograde approach using the Amplatzer vascular plug II.

P-732

Hepatofugal flow in the portal vein secondary to a large splenorenal shunt in a pediatric liver transplant recipient: diagnosis and minimally invasive endovascular treatment

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US and CT diagnosis of hepatofugal flow in the portal vein and a large splenorenal shunt. Hepatopetal flow in the portal vein was restored during the endovascular temporary balloon occlusion of the shunt, which was subsequently successfully closed with the Amplatzer vascular plug II.

P-733

Three-dimensional printing facilitates successful endovascular closure of a type II Abernethy malformation using the Amplatzer atrial septal occluder device

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Three-dimensional printing has been used to develop patient-specific representations of surgical and endovascular planning and intervention. This report describes the use of three-dimensional printing to successfully close a type II Abernethy malformation using the Amplatzer atrial septal occluder device.

P-734

Combined percutaneous transhepatic transjugular intrahepatic portosystemic shunt in an adult patient with cavernous transformation of the portal vein (PV) and a completely calcified PV remnant

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Severe bleeding from ectopic duodenal varices. CT diagnosis of the cavernous transformation of PV and a completely calcified PV remnant. A combined percutaneous transhepatic transjugular approach was used to recanalize the PV remnant and successfully deploy a e-PTFE covered stent.

P-735

BRTD for rectal varices with liver cirrhosis

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The patient was a 74-year-old male with rectal varices. After rectal bleeding, BRTD was performed on the percutaneous hepatic portal vein. Varices were embolized using 50%TZ, 5%EOI, and detachable coils. The percutaneous hepatic route was embolized using NBCA.

P-736

Portal vein stent placement in ectopic variceal bleeding with extrahepatic portal vein obstruction after pylorus-preserving pancreatoduodenectomy

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A 47-year-old woman underwent pylorus-preserving pancreatoduodenectomy 2 years ago and presented with recurrent hematochezia. On direct portography, the main portal vein was obliterated and jejunal varix had developed. After stent placement through the obliterated portal vein, the jejunal varix had disappeared with no bleeding.

P-737

Coil-assisted retrograde transvenous obliteration of a duodenal varix with the superior mesenteric vein to right ovarian vein shunt

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We present a patient with hematochezia diagnosed as bleeding from duodenal varices. CT revealed a duodenal varix with mesenterogonadal shunt. We successfully treated the duodenal varix with coil-assisted retrograde transvenous obliteration using gelfoam.

P-738

Rare case of hepatic encephalopathy secondary to a non-cirrhotic extrahepatic portosystemic shunt treated with endovascular closure

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A 76-year-old man presented with a 3-month history of progressive episodic delirium and ataxia. Laboratory workup revealed only hyperammonemia. Imaging showed a portosystemic shunt connecting the inferior mesenteric vein and internal iliac veins. Endovascular closure using the Amplatzer II vascular plug and multiple coils was curative.

P-739

TIPS reduction³

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Case of cirrhosis with bleeding in parastomal varices wherein TIPS was performed. Persistent bleeding led to coil embolization. Then, hepatic encephalopathy required TIPS reduction with a modified

stent combination. No improvement necessitated a second TIPS reduction with another modified stent combination different from the existing one.

P-740

Successful balloon-occluded retrograde transvenous obliteration (BRTO) for large gastric varices using selective coil embolization of multiple hepatofugal collateral vessels

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A 56-year-old female presented with hematemesis. Contrast-enhanced CT revealed gastric varices with a large gastroduodenal shunt and multiple hepatofugal collateral vessels. We managed BRTO successfully using coil embolization of collateral veins. Particularly, selective microcoil embolization via the left inferior phrenic vein was useful.

P-741

Successful coil-assisted transvenous obliteration (CARTO) of isolated gastric varices in a patient with pancreas tail neuroendocrine tumor and chronic portal and splenic vein thrombosis

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A 63-year-old female with pancreas tail neuroendocrine tumor and chronic portal and splenic vein thrombosis presented with bleeding from isolated gastric varices. These isolated gastric varices were successfully treated with coil-assisted transvenous obliteration (CARTO) via percutaneous transhepatic portal venous access.

P-742

Transjugular intrahepatic portosystemic shunt in an alpha-1 antitrypsin deficient child

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The creation of a transjugular intrahepatic portosystemic shunt successfully arrested acute variceal hemorrhage in a pediatric patient with early cirrhosis secondary to α -1 antitrypsin deficiency. The use of TIPS in this patient population is previously undescribed in literature.

P-743

An uncommon case of a post-traumatic portal vein pseudoaneurysm treated with percutaneous transhepatic stent grafting

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A man who presented with a traumatic portal vein pseudoaneurysm was managed with percutaneous transhepatic stent grafting. This

case demonstrates a rarely seen condition in the traumatic population and a novel management strategy, which should be considered in the management of this challenging injury.

P-744

Percutaneous trans-splenic and trans-hepatic combined approach for portal vein stenting and TPA infusion in chronically occluded portal venous segments in status post-right extended hepatectomy for Klatskin tumour

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Use of access from both hepatic and splenic routes may be a better approach in patients in whom only trans-hepatic or trans-splenic access has failed for better guidance of aggressive recanalisation manoeuvres followed by TPA infusion in chronically occluded portal venous segments.

P-745

Simultaneous treatment of ruptured rectal varices and duodenal varices: a case report

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A 77-year-old female with hepatitis C cirrhosis developed rectal and duodenal varices. She was hospitalized with massive rectal bleeding. We simultaneously performed balloon-occluded antegrade transvenous sclerotherapy, followed by coil embolization for rectal varices and coil embolization for duodenal varices.

P-746

Portal vein bleeding due to pancreatitis and biliary fistula after liver transplant: treatment with an iliac limb stentgraft extension placement

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We report a case of extrahepatic portal vein bleeding on day 14 after liver transplant. A stentgraft iliac limb extension 18 mm in diameter was deployed in the main portal vein using a transhepatic approach that successfully treated the hemorrhage.

P-747

3D printing facilitates endovascular closure of a large type 2 Abernethy malformation using the Amplatzer septal occluder

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Endovascular closure of a large type 2 Abernethy malformation in a 9-year-old boy using the Amplatzer ASD septal occluder following 3D printing of the malformation using CT data to facilitate procedural planning and closure device selection and sizing.

P-748

Percutaneous transhepatic treatment of portal stenosis by placement of a balloon-expandable covered stent in a 2-years-old liver transplanted patient

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Portal vein stricture stenting after pediatric liver transplantation is controversial because of anatomical changes during growth. We present the percutaneous transhepatic placement of a balloon-expandable covered stent in a 2-years-old female. If required, this device allows further dilatation during growth.

P-749

Successful stentangioplasty of the left renal vein for the treatment of nutcracker syndrome and portal hypertension

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Nutcracker syndrome was diagnosed (pressure gradient 12 mmHg) in a patient with portal vein thrombosis, mesorenal shunt to the left renal vein, and recurrent variceal bleeding. Following stentangioplasty of the left renal vein, bleeding stopped and varices disappeared.

Urinary tract intervention

P-750

Clinical results after prostatic artery embolization (PAE) for bothersome lower urinary tract symptoms (LUTS) due to BPH: a single-center study of 109 patients

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Purpose

To report the clinical results of 109 consecutive patients treated by PAE for bothersome LUTS due to BPH using a single technique (PERFECTED technique, Embosphere 300–500).

Material and methods

Single-center experience of 109 consecutive patients (mean age 65 years) with bothersome lower urinary tract symptoms (LUTS) due to BPH treated by PAE between Dec 2013 and Oct 2016. Inclusion criteria: IPSS > 8 and/or QoL < 3, referred for PAE because of refusal or contraindication to surgery. Exclusion criteria: prostate volume < 40 mL, LUTS not related to BPH, urinary infection, complicated BPH, prostate cancer. We used the PERFECTED technique with hyperselective embolization of diluted 300–500µm Embosphere® (Merit medical) into the prostatic artery. Technical success was defined as unilateral or bilateral embolization. Clinical success was defined according to IPSS (≥ 25% or 8-point decrease), to QoL (< 4 or ≥ 1-point reduction), and/or to Qmax (> 7.5 mL/sec or –25%) or to Foley retrieval.

Results

Technical success: 100% (109/109). Unilateral embolization: n=9/109 (8%). No case of vesical or rectal necrosis and no retrograde ejaculation or erectile dysfunction were observed. Clinical Success (mean follow-up: 11.3 months): 85% (93/109), 16 patients showing no clinical benefit at 3 months. IPSS (pre vs. post), QoL and prostatic volume were 16±8.3 vs. 6±7 (p=0.001), 5.4±1.3 vs. 2.3±1.6 (p<0.001), and

101±48 vs. 69±21 mL (p=0.01), respectively. Mean Q max was 8.8±5.1 (pre) vs. 15.1±7.5 (post) mL/sec (p=0.01).

Conclusion

PAE is a safe and efficient treatment for bothersome LUTS due to BPH.

P-751

Retrograde transvesical ureteral stent exchange by interventional radiology at a tertiary oncology centre: techniques and experience in 134 procedures

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Purpose

The aim of this study was to assess the efficacy and safety of fluoroscopy-guided retrograde double-J stent exchange in an IR setting in a tertiary oncology referral centre over a 2-year period.

Material and methods

A review of our hospitals informatics system was performed to collect data on procedures performed between July 2014 and July 2016. The procedure was routinely performed using sedation. The patient was catheterised, and a wire was inserted into the bladder. A snare device was passed into the bladder and used to snare the distal portion of the stent. The stent was withdrawn beyond the urethral meatus and then a guidewire was inserted through the partially retracted stent and advanced into the intrarenal collecting system. A new stent was then advanced over this wire and deployed. The procedure may be performed as a day case.

Results

Between July 2014 and July 2016, 134 retrograde ureteral stent exchange procedures were performed under fluoroscopic guidance in 56 patients. All patients were females. The technical success rate was 96% (128/134). The indication for majority patients was related to underlying gynaecological malignancy [cervical, 48% (27/56), ovarian 25% (14/56) and endometrial 9% (5/56)].

Conclusion

Fluoroscopy-guided retrograde double-J stent exchange is a safe and effective procedure and can easily be performed with a high degree of success with equipment and techniques used in daily interventional practice. This approach frees up time in operating theatres, allows for faster patient recovery and discharge, contributes to overall well-being in a largely palliative group of patients and spares the patient the risks associated with a general anaesthesia.

P-752

Safety and effectiveness of different types of embolic materials in the treatment of testicular varicoceles

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Purpose

The purpose of this study was to assess the current evidence for the safety and effectiveness of different types of embolic materials used in the endovascular management of testicular varicoceles.

Material and methods

A systematic review of the available clinical studies was performed according to PRISMA guidelines.

Results

Twenty-three retrospective and seven prospective clinical studies were identified with a total of 3588 patients. Coils were used in

majority studies, which were followed by the use of coils in combination with sclerosants. Technical success rates were > 92% for all embolic materials without any significant difference. In terms of recurrence rates, glue (N= 188) had the lowest and sclerosants alone (N=728) had the highest rates of recurrence, which were 0.8% (1.6%–0%, SD: 0.8) and 11.03% (18.8%–5.15%, SD: 6.06) within an average follow-up of 12 and 25.48 months, respectively. Coils alone (N=845) had an average recurrence rate of 8.6% (17.8%–1.4%, SD: 6.3) and a mean follow-up of 24.66 months. After an average of 12 months of follow-up, the addition of sclerosants (N=1562) as an adjunct to coils did not improve recurrence rates (8.75%, 16.5%–5.1%, SD: 3.5). No significant differences were reported regarding the safety profile of the different types of embolic materials.

Conclusion

Given the heterogeneity of the included studies, at 1 year, glue was the most effective and coils were the second most effective in preventing recurrence. The addition of sclerosants to coil embolization did not impact the recurrence rates. Further research is required to evaluate the cost effectiveness.

P-753

Unilateral left-sided transcatheter varicocele coil embolization for the management of symptomatic bilateral varicoceles

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Purpose

Bilateral varicoceles are a common complaint in men. Their management with transcatheter embolization (TE) can be technically challenging because of the right spermatic vein anatomy. Our aim was to assess the effectiveness of unilateral left varicocele TE for the management of the symptoms bilaterally.

Material and methods

A prospective case-series study was designed. Twelve consecutive symptomatic patients with bilateral testicular varicoceles confirmed on scrotal ultrasound underwent unilateral left-sided TE with pushable coils. Pre- and post-procedure pain symptoms recorded using a 10-point visual analogue scale (VAS) at 3 and 6 months. Scrotal ultrasound scans were also performed during follow-up.

Results

Average pain score prior to embolization was 6 (R: 5–7). At 3 months, 75% (9/12) patients were asymptomatic with VAS of 1/10 (R: 0–2). This improved even further at 6 months with 83% (10/12) patients being symptom free (VAS: 1/10). The average screening time, radiation skin dose, and procedure costs were also significantly reduced compared with average values from patients who had previously undergone traditional bilateral embolization in our department. No complications were associated with this procedure. Two patients had to undergo further right-sided embolization for resolution of symptoms.

Conclusion

The preliminary results of this case-series study suggest that unilateral left-sided TE of the testicular vein for the management of bilateral symptomatic varicoceles can be an acceptable option with decreased cost and radiation burden. Further research is warranted to assess cost-effectiveness in the long-run compared with traditional bilateral embolization.

P-754

Retrograde access on VUJ is a useful vantage for urological interventions

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Learning Objectives

1. The flexible cystoscope is a valuable facility for the interventional radiologist.
2. Retrograde access to the bladder and VUJ allows hybrid IR techniques that fuse the advantages of minimally invasive procedures that obviate the need for GA and OR and can be performed as day procedures.
3. Retrograde access to VUJ and the ureter is an optimal vantage for higher profile metal stenting.
4. Rendezvous procedures optimize vantage and improve outcomes in cases of difficult fistulas and strictures.

Background

Cystoscopy-assisted stent-exchange (CASE) procedures were introduced to IR in 2013 and allow quick and easy double J stent exchange under sedative analgesia using a flexible cystoscope in the interventional radiology suite. This obviates the need for OR, GA, and rigid cystoscopy and offers the patient a minimally invasive alternative for a conventional urologic procedure.

Clinical Findings/Procedure

Eighty flexible CASE procedures were performed between 2013 and 2017: 82% females and 18% males; mean age 68 years; malignant stricturing 70%; and benign diseases, including PUJ obstruction, calculous stricturing, iatrogenic injury, fistulas, and AAA comprised the rest. Primary success of in situ stent retrieval, ureteric recannulation, and stent reinsertion was 96%. Secondary success was 100%. Retrograde access to VUJ allowed salvage, including the rendezvous completion of otherwise technically difficult scenarios such as proximal stent migration and unfavorable fistulas. It also allowed retrograde 14-Fr metal ureteric stenting in 13 cases.

Conclusion

Fusing flexible endoscopic and IR techniques results in a hybrid IR lead procedure that combines the advantages of both. Retrograde access on VUJ is a very useful vantage in urological interventions.

P-755

Left varicocele sclerotherapy: tips and tricks to reduce patient radiation exposure

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Background

Treatment of left varicocele by percutaneous sclerotherapy has been shown to be effective in improving sperm parameters and consequently increasing pregnancy rates. Compared with surgical techniques, percutaneous sclerotherapy of left varicocele has the advantage of minimizing complications rates and the time of return to normal activities. The disadvantages of the percutaneous technique include a small percentage of vascular anatomical variations, the use of contrast media, and the exposure to ionizing radiation. Given that the procedure is performed on otherwise healthy young patients, it is mandatory to reduce radiation exposure to the minimum level possible.

Clinical Findings/Procedure

The aim of this poster is to illustrate the techniques for minimizing fluoroscopy doses to patients when using the "left varicocele sclerotherapy protocol." These include the following: 1) low-dose fluoroscopy, 2) two-to-four-pulse rate fluoroscopy, 3) collimation, 4) pelvic radiation external protection, 5) no direct radiation exposure of testicles, and 6) no use of fluorography. These technical precautions may lead to a change in the total area under radiation exposure from 60 microGym² to 100 microGym², for a mean fluoroscopy time of 3.5 minutes.

Conclusion

The use of low radiation exposure techniques for left varicocele sclerotherapy should be mandatory, given that the procedure is performed on healthy young patients.

P-756

Ureteroarterial fistula presenting as perirenal hematoma after percutaneous nephrostomy

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A 50-year-old female with a chronic ureteral stent after hysterectomy for uterine cervical cancer showed perirenal hematoma after percutaneous nephrostomy. After resolving the hematoma, ureterography performed during ureteral stent reinsertion revealed a ureteroarterial fistula. Embolization of the ureter, followed by stentgraft placement in the external iliac artery was successfully performed.

P-757

Iatrogenic fistula between the right bulbourethral artery and bulbar urethra

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Superselective embolization with coils of an iatrogenic fistula between the right bulbourethral artery and bulbar urethra in a patient surgically treated for the evacuation of a huge post-traumatic perineal-penile-scrotal hematoma.

P-758

Interventional primary urethral realignment as a radical treatment for two hemodynamically unstable pelvic trauma patients

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Two patients with severe pelvic trauma showed complete posterior urethral disruption on a urethrogram. An antegrade guidewire was passed through the suprapubic cystostomy and navigated to pass through the urethral injury site. Foley catheter was inserted for interventional primary urethral realignment.

Venous intervention and IVC filters

P-759

Lost inferior vena cava filters

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Purpose

An investigation into effective removal of inferior vena cava (IVC) filters once no longer required was performed. Complications of remaining IVC filters and non-retrieved filters and the reason for non-removal were noted. Retaining IVC filters longer than required increases the risks of complications: IVC thrombosis, stent fracture, embedded hooks or migration.

Material and methods

All patients across University Hospitals of Leicester who underwent IVC filter insertion over the last 5 years were retrospectively investigated using uniquely identifiable CRIS search codes. The indication for filter insertion, type of filter inserted, whether filters were present for more than 3 months and if any complications occurred was documented. The reason for a filter not being removed was also documented.

Results

Ninety-eight patients (52 females; 46 males) who had IVC filters inserted over the past 5 years were included in the study. Overall, 74/98 (75.5%) filters inserted were retrievable. Of the retrievable filters, 61% (45/74) were retrieved; of these, 88.9% (40/45) were retrieved within 3 months. Ten filters (10.2%) were non-retrievable and none were removed. In total, 39.1% (29/74) of the IVC filters were not retrieved because of bleeding (10/29), recurrent emboli (4/29), no documentation (2/29) or had died (13/29). Complications included hooks being incorporated, stent thrombosis and compression of the vein.

Conclusion

There are still a substantial number of retrievable filters that are not removed and given the risks of IVC filters lost to follow-up and increased litigation, more robust guidelines for follow up of these IVC filters are needed.

P-760

Opt out scheme for attempted retrieval of temporary inferior vena cava filters

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Purpose

Retrievable inferior vena cava (IVC) filters should be removed to reduce the potential of delayed complications. At the time of insertion, a retrieval date was booked and a referral team was informed to notify us of any change in circumstances. We evaluated the impact of an opt out scheme on IVC filter retrieval rates.

Material and methods

Data were collected for all patients who had a retrievable IVC filter inserted over a 1-year period. Audit standards were as follows: (1) justification of insertion, (2) retrieval should have been attempted for 100% temporary IVC filters, (3) documentation of the retrieval plan, and (4) retrieval success rate of $\geq 80\%$.

Results

A total of 51 filters were inserted, of which 34/51 (66%) were for pre-operative management of DVT/PE, 9/51 (18%) were for contraindications to anticoagulation, and 8/51 (16%) were for prophylaxis. Seventeen of 51 patients were excluded from the analysis (11 whose clinical circumstances changed such that removal was contraindicated, 5 who died before retrieval, and 1 with a permanent filter). Of the remaining, retrieval was attempted in 32/34 (94%) patients. Retrieval was successful in 24/32 (75%) patients. Technical failure was not associated with dwell time ($p=0.743$). Reasons for abandonment included occluded internal jugular vein access, large clot burden, and tilt orientation with hook abutting the caval wall. The remaining 2/34 (6%) patients were lost to follow-up.

Conclusion

Implementation of an opt out scheme in which the clinical team has to opt out of filter retrieval has been successful. Reduction of filter tilting at deployment may further improve retrieval success rates.

P-761

Value of follow-up angiography and factors predictive of further intervention in patients undergoing catheter-directed thrombolysis for massive and sub-massive pulmonary embolisms

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Purpose

To assess the utility of next-day pulmonary angiography for catheter-directed thrombolysis (CDT) in patients with acute massive and sub-massive PEs undergoing continuous pulmonary arterial pressure monitoring, and secondarily, to determine factors predictive of further intervention.

Material and methods

Patients undergoing CDT from 2006 to 2016 for massive ($n=14$) and sub-massive ($n=18$) PEs were reviewed. Patient demographics, comorbidities, pre-procedural labs, non-invasive hemodynamic studies, and technical variables were recorded. Among patients receiving next-day angiography, those requiring further intervention, defined as continued CDT and/or mechanical thrombectomy ($n=10$), were compared with those not requiring an additional intervention ($n=17$) to assess for any predictive factors and the role of angiography.

Results

Twenty-seven (84.4%) of 32 patients (56.3% male, 43.7% Caucasian, mean age 66.2 years) underwent next-day pulmonary angiography; of which, 10 (37%) were identified to require additional interventions: catheter repositioning/exchange ($n=3$), mechanical thrombectomy ($n=5$), and both catheter and mechanical exchange ($n=2$). Factors predicting additional interventions included obesity (9 vs 1, $p=0.02$) and younger age (48.4 vs 62.5, $p=0.02$). Between patients requiring further intervention and not, initial (41.4 vs 35.9, $p=0.29$), next-day (31.2 vs 26.8, $p=0.34$), and interval change (5.0 vs 8.6, $p=0.65$) in pulmonary artery pressures (mmHg) were not statistically significant or predictive. Pre-procedural RV/LV size also did not differ significantly ($p=0.96$). The 30-day mortality was comparable (2 vs 1, $p=0.56$) between patient subsets.

Conclusion

Measurements of pulmonary arterial pressures and pre-procedural RV/LV ratios in patients undergoing CDT were not predictive of additional intervention. Next-day pulmonary angiography, however, effectively identified patients requiring prolonged CDT and/or adjunct interventions in acute PE management.

P-762

Treatment of varicose veins with EVLA (1470 nm) using low linear endovenous energy density

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Purpose

Chronic venous insufficiency is a common disease causing significant morbidity. Endovenous laser ablation with high linear energy density (LEED) >90 J/cm is an effective mode of treatment of varicose veins but is associated with a higher number of complications. The purpose of our study was to assess the efficacy of EVLA with 1470 nm laser using low linear energy density (LEED) less than 80 J/cm.

Material and methods

A prospective study was conducted comprising a total of 58 limbs with GSV incompetence using low LEED less than 80 J/cm. The occlusion rate, improvement in CEAP and VCSS, and ulcer healing rate were assessed. The complication rate and recurrence of disease were also assessed.

Results

The occlusion rate was 96.1%; there was upgradation of CEAP score by a period of 1 month in around 75% cases and rest by a maximum period of 3 months. Ulcer healing was seen in more than 91% patients. Over 95% confirmed improvement of symptoms. The post-procedure pain was minimal. DVT was encountered in 2% patients. No major complications such as pulmonary embolism were encountered. Two patients had segmental recanalization of GSV on follow-up. One patient had recurrence of symptoms.

Conclusion

EVLA with 1470 nm using low LEED is an effective mode of treatment for varicose veins with lesser complications and similar venous occlusion rate compared with those using higher LEED more than 90 J/cm. No significant recanalization of GSV was encountered; however, a longer period of follow-up will be required to determine incidence of recanalization and recurrence of disease.

P-763

Success rate of secondary IVC filter retrieval at a tertiary care center in patients referred for failed primary retrieval

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Purpose

To evaluate success rates, complications, and need for advanced retrieval techniques in secondary IVC filter retrievals.

Material and methods

Retrospective, IRB-approved study was conducted on all IVC filters referred to a single radiology department from outside institutions or departments following unsuccessful primary filter retrieval. From 2009 to 2016, 39 patients presented for secondary retrieval, with an average age of 46.0 ± 14.8 years (74.4% female). Primary indication for placement was venous thromboembolic disease ($n=32$, 82.1%). Patient and procedural variables, including indwelling time, indwelling and procedural complications, and retrieval data were obtained.

Results

Thirty-seven of 38 filters were retrieved successfully (97.4%). Single retrieval deferred due to existing IVC thrombus. Of retrieved filters, 36 were placed in the infrarenal IVC (97.3%). Average indwelling time of retrievals was 565 days (range: 25–3,743 days). All retrievals were via a right jugular vein approach. Multiple indwelling effects resulted in difficult filter removal, including hook incorporation into

the IVC wall (n=23, 62.2%), filter tilt (n=21, 56.8%), and strut penetration (n=24, 64.9%). Advanced techniques beyond conventional snaring were required in 89.2% (n=33) of retrievals. Conventional (n=4), modified snare (n=2), loop snare (n=9), endobronchial forceps (n=8), loop snare and forceps (n=12), balloon dilation and forceps (n=1), and loop snare, balloon dilation, and forceps (n=1) techniques were used. Excimer laser technique was not employed. Average fluoroscopy time was 24.9 minutes (range: 1.0–121.2 minutes). Procedural complications included filter fracture (n=2) and focal extravasation (n=2). Filter fragments were successfully snared without incident. Focal extravasations were asymptomatic.

Conclusion

Current study suggests that multiple techniques can optimize filter retrieval despite primary retrieval failure.

P-764

Prevention of pulmonary embolism in patients with severe trauma: role of IVC filters

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Purpose

Prophylactic use of inferior vena cava filters (IVC filters) in patients with severe trauma is a common practice in certain countries. However, it remains uncertain whether IVC filters are beneficial.

Material and methods

Analysis of data collected retrospectively between January 2008 and December 2013 from two participating hospitals, H1 and H2, both university clinic-accredited level 1 trauma centers. In H1, IVC filters were commonly used in patients with severe trauma, whereas in H2, prophylactic placement of IVC filters was not considered. The inclusion criteria were age > 15 years, injury severity score (ISS) > 15, abbreviated injury score (AIS) > 2, and survival for more than 24 hours after admission, and for H1, the criterion was placement of IVC filters. After applying these criteria, 973 patients were included in the study. The primary outcome measure was incidence of in-hospital computed tomography-verified pulmonary embolism (PE). Secondary outcomes included in-hospital mortality and incidence of lower-extremity deep-vein thrombosis (LE-DVT).

Results

Use of IVC filters was not associated with a lower incidence of PE [OR=1.22, 95% CI (0.39, 3.82), p=0.74] but with a significantly lower mortality [HR=0.59, 95% CI (0.36, 0.98), p=0.04]. The incidence of LE-DVT was much higher in patients in whom a filter was placed (OR>10, p<0.001).

Conclusion

Placement of IVC filters was not associated with a lower incidence of PE but a higher incidence of LE-DVT in patients with IVC filters. Patients in H1 had lower mortality rate. This contradictory constellation of findings further underscores the urgent need for a prospective trial of IVC filters in the context of severe trauma.

P-765

A comparison of retrievability: Celect vs. ALN IVC filters

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Purpose

Data comparing retrievability characteristics of various retrievable inferior vena cava filters is lacking. We aim to elucidate differences in retrievability between Celect (Cook Medical, Bloomington, IN) and ALN (ALN Implants Chirurgicaux, Ghisonaccia, France) filters. We hypothesized that there are no significant differences in retrievability characteristics between the two devices.

Material and methods

All Celect and ALN filters placed with a subsequent retrieval attempt were acquired from a prospectively acquired, single-institution database. We assessed the filter dwell time, technical success, fluoroscopy time, advanced retrieval technique usage, and device-related retrieval procedural complications. Fisher's exact test and Welch t-test were used for analysis; significance was determined at p<0.05.

Results

In total, 414 Celect (2/2009–6/2016) and 244 ALN retrievals (12/2012–12/2016) were performed. After an average of 2.3 and 2.5 months, 68% (n= 414/608) of patients with Celect and 68% (n=244/360) of patients with ALN filters, respectively, presented for retrieval (p=0.87). Average fluoroscopy times were 10.5 minutes for Celect retrieval vs. 6.0 minutes for ALN retrieval (p<0.01). Retrieval failure rates were 1.3% (n=5) for Celect vs. 0% for ALN filters (p=0.08). Advanced techniques were used in 16% (n=65) of Celect vs. 19% (n=47) of ALN cases (p=0.25). The incidence of filter-related retrieval complications was 2.1% for Celect (n=9, SIR Standards: all minor) vs. 0% for ALN filters (p=0.02).

Conclusion

Retrieval of Celect filters required significantly more fluoroscopy time and was subject to higher rates of device-related retrieval procedure complications. Overall complication rates remained low. There was no significant difference in retrieval rates, technical success, necessity of advanced retrieval techniques, or dwell times.

P-767

Angioplasty and stenting for superior vena cava syndrome (SVCS) caused by cardiac resynchronization therapy (CRT) or implantable cardioverter defibrillator (ICD) placement: preliminary results after 6 months

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Purpose

Cardiac resynchronization therapy (CRT) or implantable cardioverter defibrillator (ICD) placement through upper limbs veins leads to narrowing or occlusion of the superior vena cava (SVC) in 30% patients. Although it is mostly asymptomatic, in some patients, SVC syndrome (SVCS) impairs the quality of life (QoL). Previous reports on central vein treatment with stent placement resulted in a high rate

of restenosis. The aim of this study was to assess the effectiveness and safety of angioplasty and stenting in patients with SVCS caused by pacemaker leads using new venous stents.

Material and methods

Six patients (1 female, median age 54 years) after pacemaker implantation (1–16 years since implantation; median 6 years) had symptomatic SVCS. The SF-36 questionnaire was used to assess patients' QoL and Sandford-Doty classification was used to assess the grade of stenosis and collaterals. Pacemaker leads were transvenously removed using the telescope technique and then angioplasty with VENOVO stent (Bard) placement in SVC and/or innominate vein was performed. One, 2, or 3 stents were implanted in every 2 patients. Anticoagulation therapy was continued for 6 months after the treatment. Clinical evaluation, QoL assessment, venography, and stent's X-ray were performed 6 months after the treatment.

Results

All patients were asymptomatic after 6 months with significant improvement of QoL. Vein narrowing <70% was found in two patients (33%). One stent (8.3%) was compressed without significant destruction of struts. No complications were observed during the treatment nor during the follow-up.

Conclusion

Angioplasty with stent placement seems to be a promising strategy for SVCS caused by pacemaker leads. Clinical assessment and QoL showed significant improvement, while no complications were observed.

P-768

Venacavogram for renal vein anatomy is not essential during insertion of the IVC filter in patients who had undergone preprocedural contrast-enhanced CT: a prospective study

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Purpose

To investigate the need of performing venacavogram for renal vein anatomy before insertion of the inferior vena cava (IVC) filter in patients who had undergone preprocedural contrast-enhanced CT (CECT).

Material and methods

Eighty-one consecutive patients underwent insertion of the IVC filter from November 2013 to November 2016 where an intra-procedural venacavogram was not performed. All these patients had undergone preprocedural CECT for various clinical indications where IVC and origin of renal veins were identified in relation to the lumbar vertebrae. Out of these 81 patients, 54 patients underwent subsequent follow-up CECT for various clinical indications. The position of the IVC filter was assessed on follow-up scans.

Results

No anatomical vena cava anomaly or vena cava thrombus was detected in preprocedural CT. All 54 patients (100%) who underwent follow-up CT following insertion of the IVC filter had their filters correctly placed in relation to the origin of renal veins ($p < 0.05$). The disc space between L2 and L3 was the commonest location for the deployment of the filter ($p < 0.05$). No patient had tilting or migration of the filter. The mean in dwelling time of the filters was 74.3 days. None of the procedures had any complications because of the insertion.

Conclusion

Venacavogram to identify renal vein anatomy during the insertion of the filter may be omitted in patients who had undergone preprocedural CT. Anatomic landmarks provide a reliable position for the deployment of the filter.

P-769

Evaluation of the timing of contrast-enhanced CT for adrenal venous sampling

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Purpose

Adrenal venous sampling (AVS) of the right adrenal vein (RAV) remains difficult because of its small size and anatomy. RAV visualization is important as a pre-procedural mapping for AVS.

To evaluate the proper phase of visualization of RAV on contrast-enhanced CT.

Material and methods

Eighteen patients (male 9, female 9; Mean age, 54 years; range 33–74 years) with primary aldosteronism underwent contrast-enhanced CT for pre-procedural mapping for AVS between July 2013 and November 2015. CT imaging setting were as follows: using a 128-row detector CT (iCT256; Philips), breath hold in the shallow expiratory phase, axial scan; at the right adrenal level, reconstruction thickness/interval; 1.0 mm/1.0 mm, 100 or 120 kVp, 100–150 mA, contrast medium; 350 mgI/ml, iodine dose; 600 mg/kg (max 35 mg), flow rate; 0.07 ml/kg/sec, imaging phase; 7 phases (30, 33, 36, 39, 42, 45, and 48 sec after injection) and delay (90 sec). Visual analysis: RAV visualization rates were estimated. The most clearly visualized RAV phase was evaluated and the density of RAV was compared with that of the aorta peak.

Results

RAV was visually evident in 17 patients (94%). In all cases, CT identified the correct position of RAV. RAV formed a common trunk with the accessory hepatic vein in 1 patient. The most clear phase was at 45.9 ± 2.1 sec (42 sec: 2, 12%; 45 sec: 8, 47%; and 48 sec: 7, 41%). Comparison with the aorta peak was $+11.8 \pm 2.9$ sec.

Conclusion

Contrast-enhanced CT is a reliable way to map RAV prior to AVS. In this study, the most proper timing for mapping RAV was approximately 46 sec after iodine injection on CT.

P-770

Feasibility of a single-session endovascular treatment for aged lower extremity deep vein thrombosis

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WITHDRAWN

P-771

Radiation exposure during segmental adrenal venous sampling using dynamic trace digital angiography and spot fluoroscopy

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Purpose

Segmental adrenal venous sampling (AVS) of effluent tributaries was recently introduced to detect and localize intra-adrenal aldosterone secretion, although it could increase radiation exposure. The purpose of this study was to evaluate radiation exposure in patients undergoing segmental AVS using dynamic trace digital angiography (DTDA), which enhances background compression and image contrast of vessels and devices, and spot fluoroscopy, which allows

focused fluoroscopy within an adjustable region of interest under a similar peak dose condition.

Material and methods

Segmental AVS was performed in 32 patients using DTDA and spot fluoroscopy with a single plane system (Infinix Celeve-i; Toshiba Medical Systems, Tokyo, Japan). In 5 patients, cone beam CT images were obtained. In 2 patients, digital subtraction angiography (DSA) images were also obtained. The dose-area product (DAP) and peak skin dose were measured and compared with those of previous studies.

Results

Segmental AVS of at least 2 effluent tributaries in the right and left adrenal veins were obtained in 28 (87.5%) and 32 (100%) patients, respectively. The total DAP was 69.4 ± 37.8 Gy-cm². The acquisition and fluoro DAP were 15.8 ± 17.0 and 53.7 ± 31.0 Gy-cm², respectively. The peak skin dose for patients was 634.7 ± 264.4 μ Sv. The operator radiation exposure was 36.7 ± 56.5 μ Sv. These results were lower than those of previous studies with conventional methods.

Conclusion

Radiation exposure during segmental AVS was acceptable using DTDA and spot fluoroscopy in comparison with that using conventional methods.

P-772

Laser-assisted complex IVC filter retrieval

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Purpose

Retrievable IVC filters must be removed to prevent thrombosis and/or vein stenosis (MHRA 2013). Standard filter retrieval techniques fail in up to 26% patients because of endothelialisation and perforation of filter components. Complex techniques are then required. We present our experience of our escalatory approach for IVC filter retrieval. Standard technique: a single-day procedure under local anaesthesia using a 8-Fr sheath and a loop snare. Failing this, patients were rebooked for a complex retrieval, under general anaesthesia, which included the following:

- using a 16-Fr $\times$ 45-cm sheath via the right internal jugular vein (RIJV) enabling the "wire-loop snare" method (Rubenstein, 2007) $\pm$
- microdissection with a laser via RIJV or using an endoscopic forcep via the common femoral vein (CFV).

Material and methods

A 5-year review of the IVC filter removal experience.

Results

There were 167/179 (93%) successful retrievals. Of these, 130 (78%) were standard retrievals. Thirty-seven patients were subsequently rebooked for a complex retrieval: 14/37 (38%) were successful using a 16-Fr sheath + the wire-loop snare methods and the remaining patients required microdissection. In total, 20/37 (54%) patients underwent complex retrieval using a 16-Fr sheath + laser-aided extraction and 3/37 (8%) patients underwent complex retrieval using a 16-Fr sheath + disimpaction with an endoscopic forcep via CFV. No reported complications or incomplete retrievals were observed. Filters in the standard technique group were in situ for a shorter time (mean 134 days) than those in the complex retrieval group (mean 203 days) ($p < 0.001$). If preoperative imaging (venogram/CT) demonstrated filter-feet endothelialisation, this was predictive of requiring laser/endoscopic forcep microdissection [14/17 patients ($p < 0.05$)].

Conclusion

Standard techniques failed in 22% (as per the reported literature). The escalatory approach for IVC filter retrieval was both safe and effective, with no complications or incomplete retrievals. Preoperative imaging demonstrating filter-feet embedding/perforation predictive of requiring microdissection techniques (62%).

P-773

Thromboaspiration with Indigo system reduces the time and dose of fibrinolysis and improves the outcomes of massive and submassive PE compared with catheter fragmentation

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Purpose

To determine whether thromboaspiration with Indigo system for PE improves short- and medium-term outcomes compared with the interventional treatment of choice (mechanical thrombolysis + catheter-directed thrombolytic therapy).

Material and methods

From May 2016 to January 2017, 22 patients were diagnosed with PE: 18 with massive and 4 with submassive PE. Thirteen patients were conventionally treated according to our protocol: thrombolysis + catheter fragmentation (MFT), and 9 were treated with thromboaspiration + catheter-directed thrombolytic therapy (TAs). No significant difference was observed in age, sex, and the angiographic pulmonary index (Miller index). Pulmonary pressures after fibrinolysis and 1 month later were compared between the groups. The total dose and total time of fibrinolysis were also compared between the groups.

Results

Postoperative mean pulmonary arterial pressure (PAP) was 37.84 ± 7.01 mmHg after MFT and 36.66 ± 4.27 mmHg after TAs, with no significant difference in the angiographic control after 24 h and 1 month between the groups. Significant differences were observed in the total dose of urokinase (UK) administered as a bolus ($119,230.76 \pm 153,756.38$ IU of UK for MFT vs $51,122.22 \pm 50,098.24$ IU of UK for TAs), the total time of UK perfusion (44.30 ± 11.36 h for MFT vs 10.00 ± 4.24 h for TAs), and the mean length of stay (9.54 ± 1.75 days for MFT vs 7.00 ± 0.86 days for TAs) ($P < 0.05$).

Conclusion

Thromboaspiration improved the results of conventional mechanical fragmentation and catheter-directed thrombolytic therapy by decreasing the time and total dose of fibrinolysis and also by rapidly decreasing PAP.

P-774

Graduated complexity technique for inferior vena cava filter retrieval at a multi-hospital institution

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Purpose

To assess a predictive modeling strategy using the graduate complexity technique (GCT) for inferior vena cava (IVC) filter retrieval.

Material and methods

A retrospective analysis of 110 IVC filter retrievals in 101 patients by 14 operators at 4 hospitals in a single institution over a single year was performed. Records were reviewed for demographics, operators, use of sedation, technique, type of filter, and complications. GCT was assessed using the following criteria:

Level 0: conventional retrieval

Level 1: use of multi-loop snares

Level 2: use of a sheath larger than 14 French, loop snare technique

Level 3: use of endobronchial forceps or sheath laser

Results

Median age was 58 years, and 60% patients were females. Seven types of filters were retrieved. Median filter dwell time (MFD) was 160 days. Median fluoroscopy time (MFT) was 8.0 minutes. Technical success (TS) was 90.9%. Each GCT level was performed in 0: 80 procedures (TS: 96.3%; MFD: 177 days; MFT: 5.7 minutes), 1: 6 procedures (TS: 83.3%; MFD: 188 days; MFT: 15.1 minutes), 2: 11 procedures (TS: 54.5%; MFD: 181 days; MFT: 40.5 minutes), and 3: 13 procedures (TS: 92.3%; MFD: 188 days; MFT: 30.4 minutes). One level 3 procedure resulted in unretrievable filter fragments.

Conclusion

Advanced filter retrieval without classification has previously been described. GCT classification may allow for predictive modeling and quality assessment. Need for a high GCT level was not impacted by dwell time. Level 2 retrievals demonstrated low technical success and high fluoroscopy time, suggesting that earlier progression is warranted. Levels were not associated with high complication rates.

P-775

Evaluation of fibrinogen levels during catheter-directed thrombolysis with and without ultrasound acceleration for acute pulmonary embolism

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Purpose

To evaluate the effect of catheter-directed thrombolysis (CDT) with and without ultrasound acceleration (USAT) on systemic fibrinogen levels during the treatment of acute massive or submassive pulmonary embolism (PE).

Material and methods

A retrospective review of medical records in a single health system between 1/2010 and 12/2016 was performed in order to locate patients who underwent CDT utilizing tPA for acute massive or submassive PE. CDT was performed with either pigtail catheters (PCDT) or USAT. Endpoints included systemic fibrinogen levels taken approximately every 6 hours during treatment, infusion duration, tPA dose, and bleeding complications.

Results

Sixty cases of CDT for acute PE were reviewed (age: 56.8±14.6 years, 31 males, 8 massive PE), including 24 cases in which USAT was utilized. The mean initial fibrinogen level was 376.8±122.7 mg/dl (range: 157–884), while the mean final fibrinogen level was 358.4±124.4 mg/dl (115–723). The mean reduction from the initial to the final fibrinogen level obtained was 18.4±63 mg/dl (4.9%), which was not a statistically significant change ($p=0.06$). Mean infusion duration was 24.6±10.9 hours (7.8–60.1), while the mean tPA dose infused was 27.7±13.9 mg (9.1–78.7). A single major bleeding complication occurred (1.7%) in a patient whose initial fibrinogen level was 157 mg/dl that was reduced by 26.8% to 115 mg/dl. No minor bleeding complications were noted. When comparing USAT and PCDT, there was no significant difference in initial fibrinogen levels ($p=.21$) or fibrinogen reduction ($p=.39$) between the two groups.

Conclusion

CDT with or without USAT for acute PE does not significantly reduce the systemic levels of fibrinogen.

P-776

Late clinical outcome of hybrid catheter intervention for acute massive pulmonary thromboembolism

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Purpose

Interventional radiology is now available for treating most severe cases of acute massive pulmonary thromboembolism with a high mortality rate. It includes catheter-directed thrombolysis and catheter-tip embolectomy, and early clinical outcomes have been reported concerning this type of catheter intervention. However, the late clinical outcome associated with this kind of therapy have not yet been reported. The objective of the study was to retrospectively analyze the late outcome of hybrid catheter intervention.

Material and methods

Twenty-five patients with hemodynamic impairment (8 men and 17 women; age range 35–77 years) were treated with mechanical thrombus fragmentation using a modified rotating catheter between August 1999 and June 2002. After embolus fragmentation, all patients received an intrapulmonary injection of recombinant human-tissue plasminogen activator and then underwent manual clot aspiration with a large lumen-guiding catheter. All patients were discharged after the procedure. The patient's status was checked using medical records and telephone interview. The median follow-up was 141 months (115–168 months).

Results

The 1-, 5-, and 10-year survival rates were 87.5%±6.8%, 83.3%±7.6%, and 74.5%±9.0%, respectively. Ten patients died during follow-up: 5 because of malignancy, 3 because of septic shock, 1 because of cerebral infarction, and 1 because of heart failure. There was recurrence of pulmonary thromboembolism because of drug withdrawal by self-judgement in 1 patient, but no chronic pulmonary thromboembolism was observed.

Conclusion

Patients who underwent hybrid catheter intervention for acute massive pulmonary thromboembolism have an acceptable late outcome.

P-777

Pharmacomechanical management of acute deep vein thrombosis

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Purpose

To assess the efficacy and safety of pharmacomechanical (PMT) thrombectomy in deep vein thrombosis (DVT).

Material and methods

From January 2014 to January 2017, 29 patients underwent PMT for symptomatic acute DVT (<21 days). The mean patient age was 44 yr (range, 19–91 yr) (14 ♂ and 15 ♀). Seventeen patients had proximal lower limb DVT (LDVT) and 12 had upper limb DVT (UDVT). PMT

was performed with intraclot urokinase bolus of 300.000 IU and different devices: Trellis®, Angiojet Sole-Omni®, and Angiojet Zelante®. Vena cava filters were placed in patients with LDVT. Clinical, laboratory, and imaging follow-up data was obtained. Technical success was defined as clot removal $\geq 75\%$. Clinical success was defined as absence of post-thrombotic syndrome (PTS) or DVT during follow-up.

Results

Risks factors for LDVT were neoplasms (35%) and May–Thurner syndrome (24%). Effort-related thrombosis was the main risk factor for UDVT (66%). Unknown thrombophilia was observed in 10.3%. Technical success was achieved in 65% (19 patients). Clinical success was achieved in 100% patients with UDVT and 70% patients with LDVT. The mean follow-up was 17.2 months (range 1–36 months). Two patients had re-thrombosis in 30 days and another 2 had significant PTS during follow-up. Of the 16 vena cava filters, 15 could be retrieved after the procedure. A major complication occurred in 3.4% patients (acute renal failure recovered after 6 weeks, 1 patient) and minor complication occurred in 3.4% patients (asymptomatic increase in serum creatinine level).

Conclusion

PMT is effective for acute proximal DVT treatment. No bleeding or thrombotic complications were related to the PMT procedure. Adequate hydration is recommended before hydrodynamic thrombectomy.

P-778

Outcomes of Angel® catheter (AC) use for pulmonary embolism prophylaxis in a level 1 UK trauma centre

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Purpose

To evaluate outcomes of AC use for thromboembolic prophylaxis in a level 1 UK trauma centre.

Material and methods

A retrospective review of all cases of AC insertion at the Royal London Hospital was conducted from Sept 2013 to Jan 2017.

Results

A total of 51 ACs were placed in polytrauma and perioperative patients (36 male, mean age 40 ± 16.2 years). Mean time from admission to insertion was 3 ± 3 days. The final filter position on check radiographs varied from T12 to L5/S1, with majority placed over L3 ($n=12$). Fourteen filters were unsatisfactorily placed, either centred over the origin of the renal veins ($n=12$) or straddling the iliac vein confluence ($n=1$). There was one case of intra-arterial deployment at the aortic bifurcation retrieved without complications. ACs remained in situ for an average of 7 ± 4 days. Two patients died with catheter in situ from sequelae of traumatic injury sustained. Of all retrieval cavograms, five demonstrated significant thrombus, two of which required proximal conventional IVC filter insertion, with clot retrieval by re-sheathing the filter in the other case.

No significant complications as a direct result of AC insertion was seen. One filter was fractured in situ prior to retrieval. Attempted retrieval was unsuccessful; however, manipulation of the filter to the right common femoral vein was achieved with subsequent successful removal by surgical cut down.

Conclusion

ACs are safe for thromboprophylaxis in both polytrauma and perioperative patients. Although no insertion complications were seen, one should be aware about the potential of filter fracture and possible complicated retrieval techniques considering the filter is still tethered to the catheter.

P-779

Great saphenous vein access facilitates endovascular venous interventions

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Purpose

To report the technique, success, and complications associated with great saphenous vein access for endovascular venous interventions.

Material and methods

In total, 425 consecutive patients, with a mean age of 39 years (range: 14–90 years), underwent great saphenous vein access during venous interventions at a single institution from January 1990 to November 2016 (322-month period). Great saphenous vein access was preferred over common femoral vein or popliteal vein access to avoid entry to the deep venous system and to maintain post-procedure hemostasis in fully anticoagulated patients. Moreover, such access avoided the groin crease where applying pressure-assisted devices may be difficult. Number of interventions, access location, technical success, sheath size, hemostasis method, anticoagulation, and complications were reported.

Results

In total, 368 (87%) patients underwent one intervention with saphenous vein access and 57 (13%) underwent multiple interventions with repeated saphenous vein access. Right, left, and bilateral saphenous vein access was used in 200 (47%), 136 (32%), and 89 (21%) patients, respectively. Technical success was achieved in 416 (98%) patients. Failure occurred in 9 (2%) patients. Mean sheath size was 8-French (range: 3–16 French). Hemostasis was obtained using the Safeguard pressure-assisted device, manual pressure, or purse string sutures in 231 (54%), 146 (34%), and 26 (6%), respectively. Overall, 395 (93%) patients were placed on post-procedure anticoagulation. Fourteen (3%) complications occurred.

Conclusion

Great saphenous vein access is a technically feasible venous access with good patency for repeated interventions and few complications.

P-780

Accelerated thrombolysis for post-thrombotic syndrome using the acoustic pulse thrombolysis EkoSonic® Endovascular system (ACCESS PTS) study: initial results of a multi-centeric study

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Purpose

Post-thrombotic syndrome (PTS) occurs in up to 50% of patients (pts) with DVT. Chronic DVT and PTS is debilitating, reduces the quality of life, and treatment options are limited. A multi-centeric, prospective, single-arm study evaluated the efficacy/safety of endovascular recanalization, including ultrasound-accelerated, catheter-directed thrombolysis (USCDT) in pts suffering from chronic DVT and PTS.

Material and methods

Inclusion criteria were as follows: femoral DVT diagnosed ≥ 6 months earlier, Villalta Score (VS) ≥ 8 , and failure of 3 months conservative therapy. Exclusion criteria were as follows: isolated iliofemoral DVT, high bleeding risk, popliteal vein occlusion, and filling defect ≥ 3 cm into IVC. Pts underwent initial PTA of the occlusive DVT segments followed by >12 h USCDT and adjunctive therapy as needed. The primary efficacy endpoint was a reduction in VS of ≥ 4 at the 30-d post-USCDT in $\geq 50\%$ pts. The primary safety endpoints were major bleeding events within 72h of starting the procedure and pulmonary embolism (PE) within 30d post-USCDT.

Results

Overall, 81 pts enrolled with 3 failures to cross. Seventy-eight pts (mean age 55 years, male 68%) underwent treatment with USCDT for 23 ± 5.4 h and at a tPA dose of 18.5 ± 7.6 mg. Of 77 evaluable limbs in 73 pts, VS improved from 15.97 to 9.64 at 30d ($p < 0.0001$), 8.53 @ 90d (72 limbs) and 8.15 @ 180d (60 limbs), with an overall improvement in VS of 7.82 from baseline. 67% ($p = 0.001$) met the primary endpoint. One major bleed occurred within 72h post-USCDT. One PE occurred within 30d post-USCDT.

Conclusion

In chronic DVT pts suffering from PTS, endovascular intervention using USCDT with PTA was safe and effective in recanalizing chronic venous occlusions while improving the Villalta score and thereby improving the signs and symptoms of PTS.

P-781

Nutcracker syndrome: have we cracked it yet

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Learning Objectives

To facilitate a better understanding for decoding the conundrum of nutcracker syndrome, with its ultrasound imaging findings, CT angiography and correlation with catheter angiography, and endovascular management as well as to discuss the surgical options.

Background

Nutcracker syndrome is characterized by the compression of the left renal vein between the abdominal aorta and the superior mesenteric artery; it is a complex of symptoms that results from this phenomenon. The varied clinical manifestations include hematuria, proteinuria, pelvic congestion syndrome in female patients, and varicocele in male patients. Although the terms nutcracker phenomenon and nutcracker syndrome are used interchangeably in many manuscripts, the term syndrome usually refers to the clinical symptoms related to the phenomenon.

Clinical Findings/Procedure

Ultrasound imaging findings, including the velocities and the caliber of the left renal vein at various levels, will be discussed along with its implications for management. CT scan and CT angiography findings will be reviewed. Catheter angiography with pressure measurements will be discussed in detail, and endovascular management with angioplasty and stenting will be discussed with illustrative examples. Surgical management will also be discussed, especially in the setting of posterior nutcracker syndrome. A discussion into possible complications of endovascular procedures will be added. An algorithm to manage these patients will be presented.

Conclusion

Nutcracker syndrome is a relatively rare and easily overlooked condition. Although it could remain asymptomatic, it may catch attention

in patients with hematuria/proteinuria or more often in an indirect manner such as varicocele in males or pelvic congestion in females. Our exhibit provides an opportunity to learn about this syndrome.

P-782

Acute and chronic leg swellings: radiological manifestation and interventional management

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WITHDRAWN

P-783

A comparison between vein sealing and laser ablation for the treatment of venous insufficiency

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Learning Objectives

Vein sealing is the newest nonthermal ablation technique. The two-year results of a prospective comparative study of vein sealing versus endovenous laser ablation for the treatment of venous insufficiency are presented.

Background

A total of 360 adult subjects were treated with vein sealing or endovenous laser ablation. The primary endpoint of this study was complete occlusion of the great saphenous vein. Secondary endpoints were procedure time, procedural pain, ecchymosis on day 3, adverse events, changes in the venous clinical severity score compared with baseline, and the Aberdeen Varicose Vein Questionnaire.

Clinical Findings/Procedure

Operative time was shorter (12 ± 2.5 versus 28 ± 5.2 , < 0.001) and peri-procedural pain was lesser (3.4 ± 1.8 versus 6.3 ± 2.5 , < 0.001) in the vein sealing ablation group compared with those in the endovenous laser ablation group. Ecchymosis on day 3 was also significantly less in the vein sealing group (0.001). Temporary or permanent paresthesia developed in 9 patients in the endovenous laser ablation group and in none in the vein sealing group (0.015). One-, three-, and twelve- and twenty-four-month closure rates were 85.2, 89.6, and 91.7, respectively, for the endovenous laser ablation group and 97.6, 96.7, and 96.2, respectively, for the vein sealing ablation group. Both groups had significant improvement in the venous clinical severity score and Aberdeen Varicose Vein Questionnaire postoperatively (0.001).

Conclusion

The efficacy and safety analysis shows that vein sealing is a safe and simple method that can be recommended as an effective endovenous ablation technique. The follow-up data of more than two years will clarify the future role of vein sealing in the treatment of incompetent great saphenous veins.

P-784

Superior vena cava and bilateral brachiocephalic veins endovascular reconstruction to preserve implanted central venous catheter while treating superior vena cava syndrome

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We report the case of a patient with tumoral superior vena cava syndrome with venous port-catheter in right brachycephalic vein and a preferential head and neck venous drainage through left internal jugular vein. We describe a complex procedure with kissing stents implantation and repositioning port-catheter.

P-785**Retrieval of accidental ureteral DJ stent catheter away from the heart during nephrolithotomy****M.-C.P. Shih***Medical Imaging, Kaohsiung Medical University Hospital, Kaohsiung City, Taiwan*

Nephrolithotomy using ultrasound decreases fluoroscopic radiation. The following ureteral stenting catheter sending under nephroscope was smooth and not until final fluoroscopy did urologist found out the mystery venous entry tract connection with the collecting system.

P-786**Percutaneous embolization of a recurrent varicocele****R. De Robertis¹, F. Furlan¹, N. Sulpasso²***¹Radiology, P. Pederzoli Hospital, Peschiera Del Garda, Italy, ²Pediatric Surgery, P. Pederzoli Hospital, Peschiera Del Garda, Italy*

Among our series of 87 percutaneous varicocele embolizations since 2014, we identified 9 patients with a recurrent varicocele after surgery (6/9) or previous percutaneous embolization (3/9). Successful embolization using sclerosant foam (6/9) alone or associated with coils (3/9) was obtained in 7/9 cases.

P-787**Spinal canal stent placement as a complication of endovascular treatment for May-Thurner syndrome: a report of two cases****R.H. do Amaral¹, A. Basso Dias¹, V. Martins¹, P. Amorim da Silveira¹, J.-F. De Wispelaere², F.C. Deprez², R. Lenhardt¹***¹Departamento de Radiologia, Santa Casa de Misericórdia de Porto Alegre, Porto Alegre, Brazil, ²Radiology Department, CHU Mont-Godinne, Namur, Belgium*

We report two cases of May-Thurner syndrome treated endovascularly. Both cases presented stent misplacement at vicariant collateral lumbar veins through vertebrae spinous foramen and eventually inside the vertebral canal. One of the patients developed tetraplegia, with MRI demonstrating severe spinal cord damage.

P-788**IVC stenting post-endobronchial forcep- and laser-assisted removal of a 16-year-old embedded Bard Simon Nitinol permanent IVC filter causing chronic back pain related to an extruded leg into an intervertebral disk****A.Z. Vance, C. Fedele, A. Graif, G. Kimbiris, K. Lie, D.A. Leung**
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A 56-year-old female with a 16-year indwelling Bard Simon Nitinol permanent IVC filter complained of chronic back pain post-lumbar fusion without relief. We present a successful endobronchial forcep- and laser-assisted removal of the filter complicated by IVC rupture treated with IVC stenting.

P-789**Percutaneous femoral to femoral vein bypass creation to manage severe lower extremity swelling****B. Arslan¹, J.C. Tasse¹, M. Ozen², U.C. Turba¹***¹Vascular & Interventional Radiology, Rush University Medical Center, Chicago, IL, United States of America, ²Radiology, Rush University Medical Center, Chicago, IL, United States of America*

Creation of a percutaneous femoral to femoral vein bypass using covered stentgrafts between the occluded left common femoral vein and a large collateral draining into the right common femoral vein. Bypass was patent at 9 months with persistent clinical improvement.

P-790**Extravascular creation of a neo inferior vena cava in a symptomatic patient with congenital absence of the inferior vena cava****J.C. Tasse, B. Arslan, O. Ahmed, S. Madassery***Vascular & Interventional Radiology, Rush University Medical Center, Chicago, IL, United States of America*

We present a case of complete congenital absence of the infra-hepatic IVC in a symptomatic patient with severe bilateral lower extremity pain and swelling. We treated the patient with creation of a percutaneous transvenous neo IVC using an extravascular retro-peritoneal course.

P-791**Bridging stent placement in a patient with superior vena cava syndrome****V.G. Di Caro¹, J.M. Rabellino¹, P.N. Moltini¹, J.G. Chas¹, R.D. Garcia-Mónaco²***¹Angiografía, Hospital Italiano de Buenos Aires, Ciudad Autónoma de Buenos Aires, Argentina, ²Interventional Radiology, Hospital Italiano de Buenos Aires, Buenos Aires, Argentina*

Positioning is critical during the placement of an SVC stent because inaccurate positioning may cause migration and heart failure. We describe a patient who presented thrombosis of the SVC with atrial extension, which was successfully treated with bridging stent placement.

P-792**Complex retrieval of a fractured Greenfield IVC filter after a 31-year dwell time****F. Farzanegan***Radiology, Kaiser Permanente, Sacramento, CA, United States of America*

In this case report, we present the successful retrieval of a Greenfield filter with a 31-year dwell time showing four fractured filter legs and an apical cone adhered to the IVC wall through the right subclavian vein approach.

P-793**Foam sclerotherapy for arteriovenous malformation**

Y. Campos¹, **P. Saad**¹, D. Brito¹, F. de Oliveira¹, K.R. Saad², D. Ribeiro¹
¹*Cirurgia Vascular, UNIVASF, Petrolina, Brazil*, ²*Colegiado de Medicina, Universidade Federal do Vale do São Francisco, Petrolina, Brazil*

Treating vascular malformations is challenging. We report the case of a 46-year-old female with arteriovenous malformation in the upper right limb treated with 3% polidocanol foam guided for ultrasound, with good results, low cost, and few complications.

P-794**Transoral direct-puncture sclerotherapy for oral and pharyngeal venous malformations (VMs)**

A. Kuhara, N. Tanaka, M. Koganemaru, T. Kugiyama, T. Abe
Radiology, Kurume University School of Medicine, Kurume, Japan

We describe six cases of transoral sclerotherapy using polidocanol for oral and pharyngeal VMs. Polidocanol sclerotherapy is safe and effective on functional problems or pain due to VMs, while it has limited effects on large facial VMs causing cosmetic problems.

P-795**Arm access for therapeutic and diagnostic venous procedures**

N. Nicholas¹, **R. Frood**¹, O. Fowler¹, K. Lindsay²
¹*Department of Radiology, Bradford Royal Infirmary, Bradford, United Kingdom*, ²*Department of Radiology, Airedale NHS Foundation Trust, Keighley, United Kingdom*

Venous embolisation procedures are traditionally performed via transjugular or common femoral vein approaches. We provide a safe alternative method using the basilic vein, which has a similar technical efficacy with the potential to improve patient experience and reduce post-procedure recovery time.

P-796**In a spin: a novel method for IVC filter detachment following snare entanglement**

A. Ngo, N. Kibriya, A. Antonietti, R.G. McWilliams
Interventional Radiology, Royal Liverpool University Hospital, Liverpool, United Kingdom

We report a novel technique for disengaging a Cook Gunther Tulip retrieval system, which had inadvertently become entangled across the legs of a Cook Celect platinum IVC filter, which had migrated to the level of the hepatic IVC.

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PART 1

**Abstracts of
Lecture Sessions
Hot Topic Lectures
sorted by presentation
numbers**

Lecture Session

Abdominal aorta 1 – evidence and controversies

905.1

Are the new generation devices really delivering their promises?

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Learning Objectives

1. To learn about third and fourth generation stent grafts
2. To learn about the strength of new devices
3. To learn about the weaknesses of new devices

New generation devices for the endovascular repair of abdominal aortic aneurysms have been developed and marketed to improve on existing technology in several ways. Some new devices have been developed to extend the range of anatomy and geometry treatable by EVAR. Others have been developed to simplify the procedure using parallel stents rather than bifurcated devices. The parallel stents of the Nellix device (Endologix) have radically changed the concepts of treating aneurysms with polymer-filled endobags designed to remove the risk of type 2 and other endoleaks by sealing the aneurysm in the technique of endovascular aneurysm sealing (EVAS).

Devices designed to extend the range of a treatable anatomy include low-profile devices to allow treatment of patients with small access vessels and flexible devices designed to seal angulated necks, which are outside the IFU for other stentgrafts. The Gore IBE graft is a bifurcated iliac graft for the preservation of internal iliac arteries. The Nellix device was CE marked in 2013, and 2-year data from the FORWARD registry have prompted an analysis of late failures of EVAS due to migration, endoleaks, and aneurysm growth.

The IFU for the Nellix device were changed in 2016, and physicians were notified of these changes via a Field Safety Notice in October 2016.

The new IFU reduce the upper limit of the aortic neck diameter to 28 mm and have redefined the aortic neck as ending where the diameter increases by 10% rather than 20%. Another change is the introduction of an "aneurysm ratio" defined as the maximum aortic diameter divided by the maximum aortic blood lumen diameter. This must be less than 1.4. Thus, a large aneurysm with a small lumen will contain lots of mural thrombus and would not be treatable on-label with the Nellix device according to the 2016 IFU.

The Altura graft from Lombard medical is a low-profile system comprising two separate stentgrafts, which can be repositioned to optimise their position below each renal artery.

We now have 15-year data from the EVAR trials using early devices. It is hoped that latest generation devices will improve on these results, but until the promises of these devices translate into long-term data, physicians need to continue with careful surveillance and ensure that results are published through post-marketing surveillance or other studies.

905.2

EVAR 2: 15 years outcome of very unfit patients

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Learning Objectives

1. To learn if there are still patients not to intervene with
2. To learn if there is an advantage for local anaesthesia
3. To learn if there are special precautions in non-surgical patients

Objective

To compare long-term total and aneurysm-related mortalities in physically frail patients with abdominal aortic aneurysms (AAAs) randomized to either early endovascular aneurysm repair (EVAR) or no intervention.

Summary Background Data

EVAR-2 remains the sole randomised trial to identify whether EVAR reduces mortality in patients physically ineligible for open repair.

Methods

Between September 1999 and August 2004, 404 patients from 33 centres in the UK aged ≥ 60 years with AAAs > 5.5 cm in diameter were randomised in a ratio of 1:1 using computer-generated sequences of randomly permuted blocks stratified by center to receive either EVAR (197) or no intervention (207). The primary analysis compared total and aneurysm-related deaths in groups until 30 June 2015 (mean, 12.0 years; maximum, 14.1 years).

Results

Mean follow-up until death or censoring was 4.2 years. There were 187 deaths (22.6 per 100 person-years) in the EVAR group and 194 (22.1 per 100 person-years) in the no intervention group. By 12 years of follow-up, the estimated survival was 5.3% (95% CI, 2.6, 9.2) in the EVAR group and 8.5% (95% CI, 5.2, 12.9) in the no intervention group; there was no significant difference in the life expectancy between the groups (both 4.2 years; $p=0.97$). However, overall aneurysm-related mortality was significantly lower in the EVAR group [3.3 deaths per 100 person-years compared with 6.5 deaths per 100 person-years in the no intervention group, adjusted hazard ratio, 0.55 (95% CI 0.34, 0.91; $p=0.019$)]. Patients surviving beyond 8 years were younger, with a higher body mass index, eGFR, and FEV₁.

Conclusions

EVAR does not increase overall life expectancy in patients ineligible for open repair but can reduce aneurysm-related mortality.

905.3

Who to recommend for EVAR based on the long-term results of the DREAM trial

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Learning Objectives

1. To learn which patient factors increase the post-operative mortality
2. To learn which factors increase the reintervention rate after EVAR
3. To learn if new generation devices may alter the outcome

Background

Randomized trials have shown an initial survival benefit of endovascular over conventional open abdominal aortic aneurysm repair but no long-term difference for up to 6 years after repair. Longer follow-ups may be required to demonstrate the cumulative negative impact on the survival or higher reintervention and rupture rates associated with endovascular repair.

Methods

We updated the results of the DREAM trial, a multicenter, randomized controlled trial comparing open with endovascular aneurysm repair, with up to 15 years of follow-up. Survival and reinterventions were analyzed on an intention-to-treat basis. Causes of death, aneurysm rupture, and secondary interventions were compared by use of an events per person-year analysis.

Results

At the time of writing, the very long-term analysis of the DREAM trial is still in progress. Overall, 178 patients were randomized to open and 173 to endovascular repair. The cumulative overall survival and reintervention rates 12 years after randomization will be presented. Factors increasing the risk of reintervention will be detailed. Failure and its consequences due to inadequate endograft durability will be identified. This may have an impact on the vigilance required for new generation devices.

905.4

How and when to intervene on the growing aneurysm after EVAR

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Learning Objectives

1. To learn how to embolise type 1 endoleak
2. To learn about different embolisation options for type 2 endoleak
3. To learn when to observe and when to hurry

Diagnosis of type of endoleak

CTA is the standard for follow-up EVAR. However, the distinction between different types of endoleaks can be difficult. In recent years, contrast-enhanced ultrasound (CEUS) has been used more often to survey patients after EVAR, especially in patients with renal insufficiency. The advantage of CEUS is the dynamic nature of the method, which allows the distinction between an immediate detection of bubbles in the aneurysm sac typical for type 1 and 3 endoleaks and delayed visibility of bubbles within the aneurysm sac typical for type 2 endoleaks. Because of a long scan time window, CEUS is highly sensitive for delayed type 2 endoleaks (Journal of Ultrasound (2015) 18:91–99).

If an endoleak cannot be classified by CTA or CEUS, an intra-arterial angiography may be necessary for accurate diagnosis.

Treatment of type 1 and 3 endoleaks

There is a general agreement that type 1 and 3 endoleaks should be treated immediately. Type 3 endoleaks are usually fixed by realigning the leaking part of the stentgraft. Type 1 endoleaks are also often repaired by an aortic or iliac extension if anatomically feasible. Sometimes an additional chimney or fenestration is necessary to preserve flow to the kidneys while sealing the endoleak. Alternatively, the leak can be sealed by embolization. This approach is usually preferred if a chimney is already in place. Because these type 1a endoleaks are rather small, a mechanical blockage is rarely possible. Therefore, liquid agents are more promising. For better stability, a radial approach can be helpful.

Treatment of type 2 endoleaks

Type 2 endoleaks are common, and especially, early endoleaks (within 30 days) are usually observed. Despite the lack of robust evidence, most centers tend to treat type 2 endoleaks if a sac expansion of more than 10mm is observed (Vascular Health and Risk Management (2016) 12:53–63).

The concept of type 2 endoleak embolization is to occlude the nidus within the aneurysm sac ideally including the dominant vessels of the nidus. There are two different approaches: the transarterial approach, often used when the main portion of the endoleak is in the anterior portion of the sac close to the inferior mesenteric artery,

or the direct sac puncture, more commonly used when the dominant portion of the endoleak is in the posterior portion of the aneurysm sac. Alternative routes for direct sac puncture are transcaval or transabdominal. The latter approach has the disadvantage of possible carrying bacteria from the bowel to the aneurysm sac.

In either approach, the goal is to get the catheter into the nidus. When using the transarterial route, a microcatheter is nearly always required [cave: long catheters (125cm) and microcatheters (150cm) are needed when using a radial approach]. A coaxial system is also helpful for direct sac puncture to increase the stability.

Embolic agents

Endoleaks are typically blocked by either a liquid agent or mechanical blocks such as a coil or a plug or their combination. The ethylene–vinyl alcohol polymer (EVOH) has become the preferred liquid agent for most interventionists (Vascular and Endovascular Surgery (2012) 46:251–257). The advantages of EVOH are the long and controllable working time, the good visibility, and the non-adhesive property avoiding the risk of gluing the catheter into place. The long-term results also seem to be favorable compared with those of other agents. Coils and plugs can be used in combination with liquid agents for large endoleaks to slow down the flow or block a large feeding or draining artery. Coils and plugs alone seem to have a higher recurrence rate than EVOH.

Follow-up

The problem of most embolic agents is artefacts on CT afterward. Despite enhanced CT algorithms and reduced densities of embolic agents, a reliable evaluation of the residual endoleak with CTA is difficult, and in many cases, only indirect measurements such as sac enlargement are possible. A promising alternative is CEUS, which is less affected by the embolic material.

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905.5

AAA plus iliac occlusive disease – still suitable for EVAR?

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Learning Objectives

1. To learn how to get access: one procedure versus staged approach
2. To learn about advantages of low profile devices
3. To learn what to do with small femoral access

No abstract available.

Lecture Session

What's new – techniques

1005.1

New development in the treatment of TBAD

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Learning Objectives

1. To learn about the latest evidence for treatment of uncomplicated TBAD
2. To learn about the latest devices and their outcomes
3. To learn about developments in the management of complications

No abstract available.

1005.2

New development in the treatment of AAA

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Learning Objectives

1. To learn about new devices for EVAR
2. To learn about new adjuncts for EVAR
3. To learn about new procedural imaging innovations

New Concepts in AAA Repair

This overview will discuss new concepts in AAA therapy. The outline below highlights the different concepts that have led to innovative changes for improving endografts. Additionally, because devices have improved, indications have widened and now include the management of ruptures.

- Device Design
- Profile
- Fixation
- Fenestration
- Branched Devices
- Deployment Techniques
- Indications
- Rupture
- Sealing (EVAS)
- Location
- Juxtarenal
- Thoracoabdominal

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1005.3

Inner branches

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Learning Objectives

1. To learn what inner branches are
2. To learn how inner branches may be helpful
3. To learn about outcomes of devices with inner branches

The evolution of fenestrated and branched endovascular techniques is enjoying the increasing widespread. Technical feasibility and durability have been demonstrated in many presentations and publications. Our personal experience now includes over 1100 fenestrated and branched cases. The experience has grown over the years in terms of not only more complex cases but also numbers per year. This has been made possible by the technical evolution of both stentgrafts and ancillary products and further technical refinements. More complex anatomies and thereby more patients can now be offered an endovascular solution.

To address target vessels in complex abdominal (AAA) and thoracoabdominal (TAAA) aortic aneurysms, two solutions have been proposed: fenestrations (holes in the graft) and directional side branches. In general, fenestrations work well for target vessels that have a close to 90° take-off from the aorta and when the main graft at the level of the target vessel is appositioned to the wall or there is only a short gap to be bridged. Nowadays, a balloon-expandable covered stent is routinely used to seal the fenestration and to maintain perfusion to the target vessel. The Achilles' heel of fenestrations is the stability and durability of the seal between the nitinol ring of the fenestration and the covered stent, especially when there is a longer gap to bridge. Exact positioning of the graft with alignment of the fenestrations to the target vessels is mandatory, and catheterization can be tedious. Directional branches work well when target vessels have a steep take-off angle and when there is a longer gap to be bridged, which is often the case in TAAAs. Other advantages of directional branches include a better seal and fixation for the bridging stentgraft and the less critical positioning of the branch with regard to the target vessel. Disadvantages include the required "upper" approach (subclavian, axillary, or brachial) to catheterize the branches and target vessels and the stiffness of the available bridging stentgrafts. Because most side branches are directed downwards, the bridging stentgrafts have to accommodate an acute angle, especially for renal arteries. In most branched stentgrafts, the diameter of the main graft is tapering down above the level of the branches in order to create room for the branches. This means that the sealing zone needs to be achieved far above the branches.

Most complex AAAs are treated with fenestrated grafts. This is not only because of the anatomical configuration of the target vessels but also because using branched grafts would mean starting much higher in the descending thoracic aorta, leading to a TAAA repair and thereby increasing the risk of paraplegia. For TAAAs, we prefer a tailored approach by choosing the ideal configuration for each individual target vessel. This has resulted in the use of many stentgrafts incorporating both branches and fenestrations.

Recently, inner branches as a third option for visceral arteries were discussed. The Cook inner branches present with a cylindrical part inside the main graft connected to the wall via a basket-type bag. With the Cook device, the opening of the basket is diamond shaped because of the support by Z-stents. This inner-branch design gives an extra option for target vessels that are not particularly well-suited for either fenestrations or directional branches. One example is the target vessel that presents with a steep take-off in conjunction with a smaller diameter of the aorta.

With inner branches, there is no need to taper the main graft, which provides more wall contact and sealing at the level of the visceral arteries. It also reduces the need to start much higher in the aorta, as discussed above, and may therefore reduce the risk of paraplegia. A technical advantage is provided by the support of the basket that automatically directs the catheter and the wire into the direction of the target vessel and facilitates catheterization. The basket also provides support to the bridging stentgraft, which reduces the risk of not only migration and disconnection but also kinking.

A total of 24 patients (22 male, mean age, 71.3 ± 8.4 years) were treated with inner branches at our institution. Indication for treatment was a TAAA in 18 patients and a pararenal aneurysm in six patients. Technical success was achieved in all patients. A total of 38 inner branches were used (right renal artery: $n=7$, left renal artery: $n=13$, superior mesenteric artery: $n=5$, and celiac trunk: $n=13$). Catheterization of target vessels proved to be easy in all patients with a combination of fenestrations and inner branches. In two patients with inner branches only, the main graft had to be repositioned to achieve catheterization. Complications occurred in 2/38 (5.3%) inner branches, resulting in a subcapsular kidney hematoma, one of which required embolization. In-hospital mortality was zero. During follow-up (mean, 4.5 ± 3.7 months), one renal inner branch occluded 6 months after the procedure, leading to creatinine elevation to 1.5 mg/dl. One patient required a reintervention (not related to inner branch) to treat a disconnection of a bridging stentgraft from a fenestration for the superior mesenteric artery.

In conclusion, the "inner branch" technology offers another valuable option, which enables the manufacturing of a more fitting custom-made graft.

1005.4

The impact of new technologies in TAAA

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Learning Objectives

1. To learn about the new technologies available
2. To learn about the advantages of new technologies
3. To learn how to reduce the complications rate in case of TAAA

No abstract available.

1005.5

Iliac side branch devices: which is best?

M.A. Funovics

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Learning Objectives

1. To learn about the different devices
2. To learn how to select patients
3. To learn how to insert the devices

No abstract available.

Hot Topic Symposium Hot Topics Symposium – Aorta

1302.1

Do the long-term outcomes of EVAR justify its generalised use?

F. Fanelli

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In previous years, we have come a long way in improving care for our patients with aortic disease. The evolution of endovascular therapy has changed the way of treatment for abdominal aortic aneurysms (AAAs) in a way that no one could have imagined 20 years ago.

The promising initial results have been confirmed by more recent studies. Moreover, long-term follow-up supported the use of stentgraft (EVAR) for the treatment of AAAs.

What we have also observed is an increase in the inclusion criteria; initially, only those patients who were not good candidates for surgery were considered suitable for EVAR, but with each passing year, endovascular procedure has become the treatment of choice even in more complex situations such as short and angulated necks.

Recently, the 15-year follow-up of the EVAR-1 trial reported an aneurysm-related mortality rate greater for patients who underwent EVAR compared with that for those treated with open repair; however, the authors stated that during the entire follow-up, the aneurysm-related mortality was not significantly different between the two groups.

It is interesting that half the patients treated for infrarenal AAAs were still alive 10 years after aneurysm repair.

The OVER randomized trial with a follow-up of 9 years showed no differences between EVAR and open repair regarding survival, quality of life, costs, and cost effectiveness. After a mean follow-up of 5.2 years, mean life-years were 4.89 in the EVAR and 4.84 in the open repair groups.

Similar results were also reported in the DREAM trial: 12-year after initial randomization, the cumulative overall survival rates were 42.2% after open repair and 38.5% after endovascular repair.

Unlike the EVAR-1 trial, increased aneurysm-related mortality after EVAR over the long term was not found in the DREAM trial.

Both EVAR 1 and DREAM trials showed the highest rate of reintervention to be between 4 and 6 years depending on stentgraft durability.

However, we have to consider that these data are correlated with the use of "first" generation devices and that the increased mortality rate seems to be correlated with a higher incidence of post-EVAR sac rupture. Therefore, reintervention rates might be higher compared with more recent studies investigating newer generation stentgrafts.

This is also confirmed by a recent study comparing long-term outcomes with newer and older stentgrafts that demonstrated similar perioperative and long-term mortalities.

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1302.2

Is standard EVAR justified outside IFU?

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No abstract available.

1302.3

Should individualised follow-up after EVAR be the standard of care?

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The use of EVAR for the treatment of aneurysms of the abdominal aorta has become widespread over the previous decades, and this therapy is being used more and more in patients of younger age and with a longer life expectancy. The typical follow-up consists of CT angiography or Duplex ultrasound performed at regular intervals. CT-based follow-up, although highly reliable, is hampered by the significant exposure to ionizing radiation and the repetitive administration of iodinated contrast medium that may lead to radiation-induced disease and renal failure. Furthermore, these examinations cause a significant economic burden that may comprise 30%–50% of costs of EVAR follow-up.

Finally, with the development of newer generation stentgrafts, a better knowledge on the behavior of stentgrafts, the importance of endoleaks and mechanisms of stentgraft failure, and better sizing and planning (using 3D tools) the number of complications related to EVAR has been reduced significantly.

All these factors require and allow for a more tailored approach for EVAR follow-up. This presentation will discuss the rationale behind such individualized programs of follow-up and will provide algorithms that allow a reduction of the number and alter the type of follow-up examinations after EVAR.

1302.4

Is it justified to treat old and frail patients with TAAA endovascularly?

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The indication to treat an aneurysm is based on the rupture versus surgical risk. In general, abdominal aortic aneurysms (AAAs) deserve treatment when they reach a diameter of 5.5 cm.¹ Smaller aneurysms, as shown by the CAESAR trial, do not deserve treatment even with endovascular repair because there is no survival benefit overall.² For thoracoabdominal aortic aneurysms (TAAAs), the treatment indication threshold has always been 6 cm, mainly in view of the higher risk of an extensive surgery.

In TAAA repair, the impact and risk of surgery is so high that many patients are refused open repair. According to the literature, a high proportion of these TAAAs will rupture and lead to death.³ The option to treat TAAA by endovascular means has logically opened the way to treat patients who would not be offered open repair.⁴ As always, minimally invasive techniques are then "overused" before learning to respect the anatomical restrictions and other limitations. With regard to patient risk stratification, little is known because most articles on complex endovascular techniques state that they treated "high-risk" patients.

We reviewed the results of our TAAA branched cases in terms of the learning curve with regard to technical success, mortality, and outcomes. Growing experience has undoubtedly led to better planning and better execution, with lower technical failure and the possibility to treat more complex anatomies.

The main question for this presentation is whether there still are limitations with regard to the patient risk status. The risk balance analyses are based on the age and comorbidity of the patient on one side and extent of aneurysm and anatomical limitations on the other. The literature should be appraised critically because there is never a clear definition of "high risk."

Looking back at the 300 TAAA branched cases, in an attempt to divide the patients into an "old and frail" patient group versus a normal "high-risk" group, mortality was clearly higher in the "old and frail" group with 22.7% versus 6.2% in the normal "high-risk" group ($P < .001$) and survival was lower with an overall mortality of 52.9% versus 18.7% ($P = .006$) at a mean follow-up of 24.2 ± 20 months. It is therefore safe to conclude that indications to treat old and frail patients should be exerted with extra caution, especially in TAAAs with borderline diameters or with a challenging anatomy. Conclusion: "Primum non nocere" in old and frail patients.

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Lecture Session

Abdominal aorta 2 – short and adverse necks

1705.1

When to choose open surgery

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Learning Objectives

1. To learn what should be considered as a short or adverse neck
2. To learn about the limitations and results of EVAR in short or adverse necks
3. To learn about the difficulties, results and tricks in open surgery in the presence of short or adverse necks

Despite improvements in surgical expertise and anesthesia, mortality and major morbidity after open surgical repair (OSR) in the treatment of abdominal aortic aneurysms (AAAs) remain significant. The introduction of the endovascular aneurysm repair (EVAR) technique in 1991 provided a less invasive option for AAA,¹ challenging and altering the conventional OSR paradigm. Several trials comparing EVAR with OSR showing favorable differences in morbidity have endorsed the use of endovascular techniques for AAA repair, with excellent early and midterm results.²⁻³ In fact, EVAR offers a less invasive approach, thereby giving patients who are deemed unfit for OSR an option for repair. However, rupture may still occur after EVAR, and reinterventions are not infrequent. As a consequence, the long-term efficacy of EVAR, especially in patients at a low risk of open repair, is still debated. The ACE trial shows that EVAR and OSR in low-to-moderate-risk patients carry a similar risk of early and medium-term death, major adverse events, and minor complications. However, EVAR was associated with more vascular reinterventions and a trend toward a higher aneurysm-related mortality.⁴ Despite the minimally invasive nature of endovascular repair, anatomic suitability may limit the use of EVAR. Some reports suggest that >50% of patients have anatomic constraints to traditional endovascular aortic repair.⁵ The primary limitation to using standard abdominal stentgrafts in the treatment of AAA is the proximal landing zone and the inability to obtain an adequate proximal sealing.⁶ As per the instructions for use (IFU), standard abdominal stentgrafts require a minimum proximal aortic neck of at least 15 mm to achieve adequate sealing. Without an adequate sealing zone, patients are at risk for migration, endoleak, and aneurysm rupture. AbuRahma et al. reported that although endovascular repair was suitable for short-necked aneurysms, there was an association with increased type I endoleaks mostly requiring an early reintervention.⁷ In a study performed by Abruzzese et al., the authors found that deviating from IFU parameters resulted in increased mortality, reintervention, and graft-related complications.⁸ To address the exclusion of patients with aneurysm necks of <15 mm from endovascular repair, fenestrated devices (FEVAR) were introduced. FEVAR allows for an additional sealing zone above the renal arteries, thereby increasing the number of patients able to undergo an endovascular repair. Published literature about FEVAR has demonstrated

the safety and efficacy of this technique, with acceptable mortality and morbidity rates. A literature review with pooled results for 931 patients and 2465 stented target vessels showed a 30-day mortality of 2.4%.⁹ Verhoeven et al. stated in a recent paper that FEVAR, because of the high technical success, low operative mortality, significant regression of aneurysm sac diameter, high target vessel patency, and acceptable rate of reinterventions, today represents the first-line strategy for patients with short-necked, juxtarenal, or suprarenal aortic aneurysms regardless of the preoperative status of the patient.¹¹ In fact, FEVAR was initially developed to treat high-risk patients unfit for open surgery and anatomically unsuitable for standard EVAR. Gradually, FEVAR was also offered to patients at high or average risk of open repair as long as morphologically feasible. However, despite the increased feasibility of endovascular repairs with the multiple endovascular options available today, there are certain anatomic constraints that may require the use of open AAA repair. The definition of hostile proximal aortic neck implies not only characteristics such as the minimum length but also other anatomical factors such as infrarenal neck angulation >60°, neck calcification or thrombus covering >50% circumference of the aortic diameter, and a reverse taper morphology. Antoniou et al. systematically reviewed the studies comparing the outcomes of EVAR in patients with a hostile and friendly neck anatomy. They found that although patients with a hostile neck had no significant increase in the early incidence of type I endoleaks and reintervention rates, EVAR in patients with a hostile neck required more adjunctive procedures to achieve proximal sealing compared with that in those with a friendly anatomy. Furthermore, it resulted in a two-fold increased risk in the 30-day morbidity, a four-fold increased risk in type I endoleaks, and a nine-fold increase in the risk of aneurysm-related mortalities within the 1-year follow-up. They finally suggested that EVAR should be cautiously used in patients with a hostile neck.¹⁰ The IFU for FEVAR have been developed with rigorous clinical investigation to determine adequate sealing zones and an appropriate long-term suitability. However, several institutions have explored outside the limitations of fenestrated endovascular devices with increased fenestrations, scallops, and physician-modified endografts. The results of these studies are limited to institutional device exemptions, case series, and clinical trials, thus prohibiting their generalizability. Raux et al. compared FEVAR with OSR in the treatment of complicated AAAs and found a higher risk of perioperative morbidity and mortality in favor of OSR. Their results demonstrated that FEVAR had a higher rate of 30-day mortality and procedure- and graft-related complications.¹²

With this in mind, we can state that the use of FEVAR should always be based on a conservative approach for the interpretation of the manufacturer's IFU. This is much more valid for the quality of the proximal neck in terms of angulation, calcification, and thrombosis than in terms of length. In fact, in case of short but straight necks and reduced distance between the ostium of each renovisceral vessel, a custom-made device with 3 or 4 fenestrations may be planned in order to ensure proximal sealing in a non-diseased aorta. On the other hand, the use of FEVAR in thrombus or a calcified neck may result in an incomplete apposition of the stentgraft to the aortic wall or worse the deployment of a fenestrated stentgraft in a severely angulated proximal neck may lead to an unpredictable misalignment of the fenestrations with a dramatic impact on target vessel revascularization.

Although the continuous research and development of new devices and techniques implies that the applicability of endovascular therapies today is very high, there are still some anatomical constraints that may limit their use, and all vascular centers should continue to perform open AAA repair for patients with anatomy outside device protocols. The choice between OSR and EVAR in patients at a high risk of open repair is still debated and should rely on the balance of different risks: more postoperative transfusions, longer hospital stays, and incisional complications with OSR vs. the need of

follow-up with repeat CT scans, higher rate of vascular reinterventions, and small but persistent risk of rupture with EVAR.

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1705.2

Fenestrated as a first line treatment

M.S. Hamady

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Learning Objectives

1. To learn about the indications of FEVAR
2. To learn about the limitations of FEVAR
3. To learn about the results, also in the long-term of FEVAR

No abstract available.

1705.3

Are the new endograft concepts useful?

R.A. Morgan

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Learning Objectives

1. To learn what the concept of the new endografts is
2. To learn what problems they address and why they should be better than conventional endografts
3. To learn if the early results with these endografts back their claims

No abstract available.

1705.4

What is the role for adjuncts in combination with conventional endografts?

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Learning Objectives

1. To learn which adjuncts can be useful when treating short or adverse necks with conventional endografts
2. To learn how these adjuncts work and how to use them
3. To learn about the early results with these adjuncts

More and more EVAR repairs are performed in patients with challenging infrarenal aortic necks. A short neck length (<15 mm), diameter > 28 mm, conicity, and infrarenal angulation > 60° are well-known hostile neck parameters. Although newest commercially available endografts have been developed to overcome challenging neck features, the risk for acute technical failure has increased. Therefore, the interventionist must be prepared for repair of acute type IA endoleaks or to improve the suboptimal position of the endografts.

In case of a distance of >5 mm between the lowest renal artery and the top of the fabric, an extension cuff can be placed. If no extension can be achieved but an acute type IA endoleak occurs, the use of the Heli-FX Aortic Securement System (Medtronic, Santa Rosa, CA) can be of great help. Targeted treatment of EndoAnchors at the type IA endoleak gutter has been proven to be successful in >90% of patients included in the global ANCHOR trial. Use of giant stents to improve circumferential apposition of the endograft to the aortic wall may be beneficial, but it precludes eventual future endovascular options at the juxtarenal aorta.

If the seal between the endograft and aortic wall is <1 cm and a type IA endoleak persists, the best off-the-shelf option is a chimney extension. A subclavian artery or brachial artery approach is necessary with the use of 6-7-Fr braided sheaths and balloon expandable or self-expanding chimney stentgrafts.

Last but not the least, challenging access arteries may necessitate adjuncts during primary EVAR. Percutaneous angioplasty and stenting of stenotic or dissected iliac arteries must be performed in 2%-5% of patients. Moreover "paving and cracking" of narrow endograft limbs is sometimes necessary to improve outflow.

It can be concluded that the endovascular team should be prepared for adjunctive procedures during the primary EVAR procedure to overcome endoleaks and to improve longer term outcomes.

1705.5

Chimneys – do or don't

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Learning Objectives

1. To learn about the indications for using chimneys
 2. To learn about the limitations of chimneys
 3. To learn about the results with chimneys, also in the long term
- Abdominal aortic aneurysms unsuitable for conventional EVAR necessitate consideration of open surgery or in higher risk patients, endovascular techniques such as fenestrated or chimney endovascular repair¹.

Fenestrated EVAR (FEVAR) has shown good short- and long-term results but is disadvantaged by cost, manufacture time, and lack of "off-the-shelf" availability. Chimney EVAR (ChEVAR) has been developed as an alternative and is cheaper, simpler, and readily available, making it useful in the emergency setting. Issues have been raised, however, regarding the seal between the chimney stents, the main body, and the aortic wall^{2,3}. Some studies have reported good technical success rates in the short and long term, whereas others have not. Furthermore, the long-term patency of the chimney stents has been questioned.

One meta-analysis showed comparable results between ChEVAR and FEVAR with respect to technical success and mortality rate; however, the number of target vessels was significantly less in the ChEVAR group compared with that in the FEVAR group⁴. Another systematic review demonstrated advantages of FEVAR with respect to 30-day mortality, late mortality, and renal adverse events⁵. However, ChEVAR conferred advantages of a reduced procedure time, lower contrast dose, and reduced intraoperative blood loss. Although the patency rate of target vessels in ChEVAR has been a theoretical concern, in many studies, it has been found to be comparable with that in FEVAR. All agree, however, that both techniques are options for treating aneurysms with insufficient proximal seal zones for conventional EVAR^{4,5,6}.

Until recently, the use of ChEVAR has been off the IFU for all stent-grafts. The PROTAGORAS study demonstrated a good technical success, low type Ia endoleak rate, high primary patency, and acceptable freedom from intervention rate⁷. The Medtronic Endurant™ II stentgraft systems are now CE marked for use in the ChEVAR technique.

In conclusion, **do** use chimneys when there are few other options. They have a role in the management of aneurysms with short necks in high-risk patients unsuitable for open surgery. ChEVAR is particularly useful for patients with large or symptomatic aneurysms in whom the wait time for manufacture of a fenestrated stentgraft is unacceptable. It is also a bail-out option when proximal extension of an attempted standard EVAR is necessary either for type Ia endoleaks or unplanned coverage of the visceral arteries. However, the long-term durability remains uncertain, and there is a limit to the number of possible chimneys with >2 likely to compromise the seal zone. Therefore, **don't** use them when there is a suitable proven alternative.

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Lecture Session Aortic arch

2505.1

Is there a role for chimneys in the arch?

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Learning Objectives

1. To learn about the indications for chimneys in the arch
2. To learn about the acute and late complications
3. To learn about the mid- and long-term results

No abstract available.

2505.2

Open surgery with the frozen elephant trunk

M. Shrestha

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Learning Objectives

1. To learn how the procedure is performed
2. To learn what the indications for the FET are
3. To learn about the mid- and long-term results

No abstract available.

2505.3

Arch debranching: indications and techniques

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Learning Objectives

1. To learn what the various techniques are
2. To learn how they help widen the indications for endografting in the arch
3. To learn about the mid- and long-term results

Open aortic arch repair is technically demanding and associated with significant perioperative mortality and morbidity. The evolution of endovascular technology has provided alternative treatment options, particularly for older or surgical high-risk patients. These options include a purely endovascular approach (fenestrated and branched devices and parallel chimney grafts) or a "hybrid"

approach, consisting of surgical debranching of the supra-aortic vessels followed by thoracic endovascular aortic repair (TEVAR). Different landing zones for proximal landing in arch TEVAR have been classified: zone 0, ascending aorta proximal to the brachiocephalic artery; zone 1, between the brachiocephalic artery and the left common carotid artery (LCCA); and zone 2, between LCCA and the left subclavian artery (LSA).¹

When proximal landing is planned in zone 0 (e.g., isolated sacular arch aneurysm or arch and proximal descending thoracic aneurysm with no involvement of the ascending aorta), the repair comprises debranching of all supra-aortic arch vessels, followed by TEVAR simultaneously through the ascending aorta or via the femoral artery, often also staged.² Arch debranching is most often performed through a median sternotomy and partial clamping of the ascending aorta. For patients with prohibitive risk for median sternotomy, extra-anatomic debranching of supra-aortic arch vessels has been described.²

When proximal landing is planned in zone 1 (e.g., pathology of the mid and distal arch with or without involvement of the descending thoracic aorta), the treatment usually includes a left carotid–right carotid–subclavian artery bypass. TEVAR can be performed simultaneously or in a second stage.^{3,4}

Finally, when proximal landing is planned in zone 2 requiring coverage of LSA (e.g., pathology of the distal arch or proximal descending aorta), the procedure includes left carotid–subclavian artery bypass or transposition before or during TEVAR. Coverage of LSA without revascularization may also be considered. LSA revascularization seems to lower stroke rates and spinal cord ischemia, particularly during extensive thoracoabdominal repair, and is, therefore, generally advised.⁵

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2505.4

Fenestrated or branched in the arch

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Cardiology and Aortic Centre, Imperial College, The Royal Brompton & Harefield NHS Trust, London, United Kingdom

Learning Objectives

1. To learn how the technology has evolved over the past two decades
2. To learn when to choose what, and what the indications are
3. To learn about the mid- and long-term results

No abstract available.

2505.5

How to handle the lusorian artery

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Learning Objectives

1. To learn when this aberrant vessel can create problems
2. To learn about the techniques that can be employed to solve these problems
3. To learn about the possible complications

No abstract available.

Lecture Session

Complication management

3005.1

Acute complications of TEVAR for TBAD

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Learning Objectives

1. To learn about anatomical difficulties related to TEVAR in dissections
2. To learn about planning in TEVAR for dissections
3. To learn about rescue methods in case of complications

Over the past 20 years, stentgrafting (TEVAR) for proximal entry closure has become an accepted treatment in patients with type B dissections (TBADs). Although intervention in complicated TBADs is warranted, its role in uncomplicated TBADs is still controversial (1, 2, 3). Against this backdrop, procedure-related complications acquire special significance.

Acute complications that may occur as a consequence of TEVAR for TBADs include the following:

1. Access vessel injury
2. Stroke
3. Conversion to type A dissection
4. Spinal cord injury
5. Uncontrolled tearing of the intimal flap
6. Aortic rupture

Access vessel dissection or rupture resulting in bleeding and necessitating open surgical repair was reported in 3%–8% of the patients in the earlier days of TEVAR. The key to reducing these complications lies in proper patient selection and adequate preprocedural assessment of the iliac and femoral vessels with respect to vessel calcification and tortuosity (4, 5).

Stroke is one of the most dreaded complications of TEVAR for TBADs. Although it is primarily an embolic complication, injury to the arch vessels may also contribute. The incidence of stroke ranges between 3% and 6%. The risk of stroke is directly associated with atheroma burden of the aortic arch, history of stroke, coverage of the proximal descending or entire descending aorta (extent A or C coverage), type III aortic arch, zone 1 deployment, and coverage of the left subclavian artery without previous carotid–subclavian bypass (5–9).

Retrograde type A dissection as a complication occurs in 1%–3% of the patients. Such iatrogenic dissections most often require open surgical repair and are associated with a high mortality (5, 10).

Spinal ischemia complicating TEVAR is less common than stroke, with a reported incidence of 2%–3% for all aortic pathologies (9). Its incidence in TBAD patients is anecdotal (11). Aneurysm as an underlying pathology, the use of an iliac conduit, and history of open or endovascular repair are more frequently associated

with postoperative spinal cord ischemia (6, 9). Other risk factors include preoperative renal insufficiency and extent C endovascular coverage.

Uncontrolled tearing of the intimal flap may result from undue oversizing of the endograft or ballooning after endograft release, both of which hence, should be refrained from while treating TBADs.

Last but by no means the least, it is worthy of mention that acute fatal rupture despite successful endografting is also a documented complication of TBADs (4, 5).

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3005.2

Risk reduction of paraplegia in TEVAR and branched EVAR

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Learning Objectives

1. To learn about the risk of paraplegia when covering (part of) the thoracic aorta
2. To learn about techniques to reduce the risk of paraplegia
3. To learn about post-operative measures to reverse neurological symptoms

Spinal cord ischemia (SCI) is a catastrophic event that may occur in up to 10% patients after open surgical repair, in up to 5% patients after endovascular repair of thoracic aortic pathologies (TEVAR), and in up to 15% patient after branched thoraco-abdominal EVAR. Most patients may have temporary symptoms. Permanent paraparesis

or paraplegia after TEVAR are observed in <2% patients. Usually, the symptoms are observed within the first 10 hours after the procedure; however, delayed symptoms may be observed after 24–48 hours once the patient is mobilized and the blood pressure drops.

The anterior spinal artery is primarily supplied by the great anterior radiculomedullary artery, which is also known as the artery of Adamkiewicz. Most commonly it originates from a left intercostal artery between T9 and T12 and less commonly from T7-L1 or from the right side. An additional collateral supply comes from subclavian and hypogastric arteries.

Risk factors for developing SCI: patient age, renal insufficiency, extent of aortic stentgrafting including the origin of the artery of Adamkiewicz and the adjacent intercostal arteries, occlusion of the left subclavian artery, previous aortic surgery, and intraoperative and postoperative hypotension (mean arterial pressure < 80mmHg). Actions required for reducing the risk of SCI in patients with previously mentioned risk factors: imaging of the artery of Adamkiewicz: contrast-enhanced CT with multiplanar reconstructions may show the artery in approximately 80% cases, 3-T MRA with time-resolved imaging may show the artery in approximately 80% cases, and a combination of both may show the artery in 90% cases. Cerebrospinal fluid (CSF) drainage: edematous swelling of the spinal cord due to hypoperfusion increases the pressure in the spinal canal which again reduces spinal perfusion. CSF drainage with pressure recording can keep the pressure below 10mmHg. It has been shown that preoperative or early CSF drainage decreases the probability of SCI by half or more. Monitoring the blood pressure to prevent hypotension with a mean arterial pressure of <80mmHg. Staged stent-grafting for enabling the development of collateral circulation. In thoraco-abdominal aneurysms, one side branch of the prosthesis can be left open or connected by a bare stent temporarily. The second procedure that finally excludes the aneurysm and antegrade perfusion of the artery of Adamkiewicz should be performed with a delay of 4–6 months.

Post-operative measures to reverse neurological symptoms once SCI has occurred: high-dose methylprednisolone steroid therapy, CSF drainage (pressure < 7–10mmHg), and moderate blood pressure increase (mean pressure > 100mmHg) are standard therapy in the acute phase. A beneficial effect of moderate hypothermia has been discussed.

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3005.3

How to manage infected endografts

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Learning Objectives

1. To learn about the risk of infection and standards of care to reduce the risk
 2. To learn about the diagnosis of infected grafts
 3. To learn about the different treatment options
- Although rare, endograft infection is a known complication after EVAR/TEVAR. In a retrospective cohort study of patients operated for abdominal and thoracic aortic aneurysms in two large hospitals in the Netherlands, 11 cases of infection were found among 1431 endovascular procedures, indicating an incidence rate of 0.8%¹. The median time from initial TEVAR/EVAR to the diagnosis of infection was 115 days, with about half of the patients (42%) presenting within 3 months after EVAR/TEVAR. Emergency cases had a statistically greater incidence than elective cases (2.8% vs. 0.6%, $p=0.002$). The diagnosis of graft infection is based on a combination of criteria, including clinical symptoms such as fever and pain; clinical findings such as necrosis, purulent fluid, or infected graft material; elevated infection parameters such as ESR, CRP, and WBC; evidence of graft infection on computed tomography, magnetic resonance imaging, leucocyte scan, or positron emission tomography; and isolation of microorganisms from either the blood and drain material or the endograft itself².
- There are 4 principles for the management of endograft infection. First, the excision of the graft as a foreign body potentiating infection; second, a wide and complete debridement of devitalized and infected tissue to provide a clean wound in which healing can occur; third, the establishment of blood flow to the distal bed; and fourth, the institution of intensive and prolonged antibiotic coverage to reduce sepsis and prevent secondary graft infection. The gold standard for treatment of an infected prosthetic aortic endograft remains the explantation of the graft and the reperfusion of the area by placement of a new graft through an extra-anatomic uninfected route, usually an axillo-bifemoral graft. Because of persistent problems with durability and patency, many authors have advocated the use of in situ reconstructions. This can be achieved by either a new prosthetic graft or an autologous graft, usually the femoral vein (NAIS procedure)³. For TEVAR infections, in case of an aorto-esophageal fistula, a unique treatment option consists an esophagectomy followed by a tube gastric replacement together with great omentum plasty over the infected thoracic aorta⁴. In these cases, an in situ cryopreserved aortic allograft is also an option whenever this graft is available⁵. Finally, in high-risk patients, where a complex procedure

is accompanied by high morbidity and mortality, a more conservative strategy, including aggressive local wound care with preservation of the endograft, can be used. The antimicrobial treatment is critical when dealing with these cases. There is no evidence regarding the optimal duration of antibiotic administration. This may vary from 2 weeks to 1 year, although a minimum of 4–6 weeks of intravenous therapy, followed by up to 6 months of oral therapy is commonly recommended. A small number of cases in which operation was deemed to be associated with an unacceptably high risk to the patient have reported success with long-term suppressive treatment, including lifelong antibiotic administration in some cases⁶.

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3005.4

Aorto-enteric fistula: diagnosis and management

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Learning Objectives

1. To learn about the pathophysiology of the disease
2. To learn about the diagnosis of aorto-duodenal fistula
3. To learn about the different treatment options

No abstract available.

3005.5

Embolisation for type 1 endoleak

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Learning Objectives

1. To learn about indications for EVAR and causes of type I endoleak
2. To learn about the standard treatment options
3. To learn about the indications and effectiveness of embolisation in type I endoleak

Introduction:

Standard treatment for proximal type 1 endoleaks after endovascular abdominal aortic aneurysm repair (EVAR) depends on the cause

of the type 1 endoleak. Proximal type 1 endoleaks due to inferior placement of the endograft below the renal arteries are usually treated by placement of an aortic cuff. Proximal type 1 endoleaks where there is accurate placement of the aortic endograft are generally due to a poor seal, and these are usually treated initially by support stenting using large caliber balloon-expandable stents, e.g. Palmaz stents (Johnson & Johnson, New Jersey, USA). Patients with proximal type 1 endoleaks who are not suitable for these relatively straightforward techniques require more advanced treatments, such as fenestrated aortic cuffs or the use of chimney grafts. However, some patients with proximal type 1 endoleaks cannot be treated by any of these techniques or may be resistant to these management strategies.

Distal type 1 endoleaks after EVAR are generally treated by endograft extension to the distal common iliac artery or into the external iliac artery if there is no space in the distal common iliac artery.

In rare instances, where patients with proximal or distal type 1 endoleaks cannot be treated by the abovementioned methods, embolisation should be considered as a treatment option.

Embolisation technique:

Because a vast majority of embolisation procedures for type 1 endoleaks are for proximal type 1 endoleaks, the description of the technique will focus on this indication.

Interventionists have used a variety of different embolic agents for the embolisation of type 1 endoleaks. These include coils (pushable and/or detachable) and liquid embolic agents (glue and Onyx).

The optimal type of endoleak for embolisation has a small communication with the aortic lumen. Endoleaks with a wide communication between the endoleak cavity and the aortic lumen are less suitable for embolisation.

In general, majority of the proximal type 1 endoleak embolisation procedures can be performed from a femoral artery access. Unusually, it is necessary to perform these from an upper extremity arterial access.

Access into the endoleak cavity is generally achieved with reversed curve catheters such as a Simonds or Sidewinder catheter from the femoral artery access. After manipulating the tip of the reversed curve catheter into the endoleak cavity, contrast medium is injected to define the size of the endoleak cavity.

After this endoleakogram has been performed, the endoleak cavity is embolised using the embolic agent of the operator's choice.

Outcomes:

The published experience of embolisation for type 1 endoleaks is limited. With appropriate patient selection, the technical success is over 95%. Mid-term clinical success with sustained occlusion of the endoleak may be achieved in over 70% of patients.

Recurrent endoleaks may develop in a small proportion of patients, although in most cases, the procedure can be repeated. Complications of endoleak embolisation are very low.

In summary, embolisation is effective for some type 1 endoleaks and should be considered as a treatment option for patients who cannot be treated by other methods.

IDEAS

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PART 2

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