CASE REPORT

Percutaneous transcatheter embolisation of active haemorrhage following radiofrequency ablation of hepatocellular carcinoma

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SUMMARY

A 72-year-old woman with hepatitis C virus cirrhosis underwent a surveillance ultrasound examination which identified a new hepatic lesion. A workup triphasic CT examination demonstrated a 3.7 cm lesion at the hepatic dome with arterial enhancement and portal venous washout consistent with hepatocellular carcinoma. She subsequently proceeded for treatment with radiofrequency ablation (RFA). RFA was technically successful, but the patient became hypotensive and tachycardic postprocedure. A CT angiogram demonstrated active arterial intraperitoneal haemorrhage from the RFA site. The patient returned to the interventional suite for catheter angiography which confirmed the presence of active haemorrhage from the hepatic arterial branch supplying segment VIII. The bleeding vessel was selectively catheterised with a microcatheter, and successfully embolised with 250–355 μ m polyvinyl alcohol particles.

successfully managed by percutaneous transcatheter embolisation.

CASE PRESENTATION

Our institution does not require ethics approval for case reviews.

An asymptomatic 72-year-old woman with hepatitis C virus (HCV) cirrhosis had a new hepatic lesion identified on surveillance ultrasound (US), which is performed every 6 months at our institution as per the American Association for the Study of Liver Diseases and the European Association for the Study of the Liver-European Organisation for Research and Treatment of Cancer guidelines.^{1 2} This new lesion was subsequently investigated with CT. Given that her medical history was otherwise unremarkable for her age and that she was able to care for herself with occasional assistance, she and her family felt that treatment for an unresectable disease, if discovered, was within her goals of care.

BACKGROUND

Image-guided thermal ablation procedures, including radiofrequency ablation (RFA), play an increasingly important role in the non-surgical management of primary and secondary hepatic malignancies. Although rare, these techniques are associated with vascular, biliary and extrahepatic complications. Radiological and non-radiological personnel should be familiar with these complications and side effects to accurately counsel and manage patients undergoing image-guided thermal ablation procedures. In this report, we describe a case of life-threatening arterial haemorrhage following RFA for hepatocellular carcinoma (HCC)

INVESTIGATIONS

Following the surveillance US, the patient underwent a multiphase CT scan of the liver, which showed a 3.7 cm lesion in segment VIII (figure 1) that demonstrated imaging features (>20 mm, arterial enhancement, portal venous washout) consistent with a Liver Imaging Reporting and Data System classification of LR-5, which is 'definitely HCC'.³ Pretreatment biopsy was not required in accordance with the consensus guidelines on the management of LI-RADS 5 lesions.⁴ Her disease status was Child-Pugh A, Barcelona clinic liver cancer (BCLC) A and Karnofsky performance status 70 at the time of imaging. All patients with

Figure 1 (A) Arterial phase CT demonstrating an avidly enhancing lesion (black arrow) in hepatic segment VIII. Systemic venous collaterals are consistent with portal hypertension (white arrow). (B) Portal venous phase CT depicts hypoattenuation or 'washout' within the lesion (black arrow) which is diagnostic of hepatocellular carcinoma. The attenuation of the venous collaterals following the blood pool (white arrow).

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Figure 2 Ultrasound readily identifies the segment VIII hepatocellular carcinoma (arrow) which is heterogeneous, well circumscribed and exhibits some through transmission.

HCC receive a staging chest CT at 0, 12 and 24 months in our practice, and the baseline CT chest was unremarkable.

DIFFERENTIAL DIAGNOSIS

Vascular complications of RFA include haemorrhage, hepatic arterial pseudoaneurysm, arteriovenous fistula formation, portal or hepatic venous thrombosis and hepatic infarction.⁵ Once contrast extravasation is identified, catheter angiography can be used to identify the nature of the lesion and therapy can often be delivered during the same session.

TREATMENT

The patient was subsequently booked for RFA following multi-disciplinary case review and patient consent. The segment VIII HCC was also readily depicted on ultrasonography (US) immediately prior to RFA (figure 2). Using sterile technique and local anaesthesia with moderate sedation, three Cool-Tip radiofrequency probes (Medtronic, Minneapolis, Minnesota, USA) were inserted into the tumour site under US guidance with satisfactory tip position confirmed by CT (figure 3).

Immediately following the procedure, the patient became hypotensive and tachycardic with severe, unremitting right upper quadrant pain that was worse than expected. An arterial-phase CT was performed and identified haemoperitoneum with active intraperitoneal haemorrhage adjacent to the ablation zone (figure 4). The patient was then returned to the interventional suite for definitive endovascular management. Femoral access was obtained and a digital subtraction angiogram confirmed the presence of active haemorrhage from the hepatic arterial branch

supplying segment VIII (figure 5). A microcatheter was advanced and polyvinyl alcohol (PVA) particles (250–355 μm) were injected (Contour, Boston Scientific, Marlborough, Massachusetts, USA). The procedure was successful with no residual haemorrhage postembolisation.

OUTCOME AND FOLLOW-UP

The patient recovered and was discharged at day 3. Clinical and imaging follow-up at 24 months has been unremarkable with no tumour recurrence or residual disease at the RFA site.

DISCUSSION

According to the Canada Communicable Disease Report of 2011, it is estimated that between 0.64% and 0.71% of the overall Canadian population are living with chronic HCV infection. A 40% of these individuals are undiagnosed. The Canadian cancer registry reports that the age-adjusted incidence rate in men 40–84 years was 5.4 per 100 000 in the years 1976–1980, and rose to 15.4 per 100 000 in the years 2006–2010. The incidence rate for women in Canada is lower, but also shows an increasing trend. Modelling experiments suggest the peak in Canada will occur in 2025.⁶ Image-guided thermal ablation is among a number of minimally invasive procedures, including chemoembolisation and radioembolisation, performed for locoregional treatment of primary and secondary hepatic malignancies. These procedures are in widespread clinical use for HCC treatment and are employed in all of the early, intermediate and advanced stages of the disease.⁷ In early-stage or intermediate-stage disease, the goal of locoregional treatment is to control disease progression and/or to increase eligibility for curative surgical resection or transplantation. In advanced disease, locoregional treatment may effectively manage symptoms, prolong survival and improve quality of life.⁷

Specific thermal ablative therapies include RFA, microwave ablation (MWA), laser ablation and cryotherapy. RFA uses a percutaneously placed electrode to deliver a targeted high-frequency electrical current to achieve tumour cell death via coagulative necrosis with sparing of adjacent normal parenchyma.⁷ In our practice, we typically perform electrode placement under US guidance, but will occasionally use CT for confirmation if lesions are at the dome of the liver or if US visibility is poor. A prospective study of RFA for HCC reported a primary efficacy rate of 93% for tumours measuring 1.2–3.5 cm.⁸ The local tumour progression rates at 1, 3 and 5 years were 4%, 14% and 14%, respectively, with corresponding survival rates at these time points of 92%, 72% and 64%.⁸ The efficacy of RFA depends in part on the proximity of the tumour to vessels >3 mm in calibre that can limit tumour cell heating and death due to the heat-sink effect.⁷ It is also affected by tumour size as complete tumour necrosis is more difficult to achieve in larger tumours.⁹ It is currently accepted that small

Figure 3 (A) Non-contrast CT fluoroscopy demonstrating adequate placement of the metallic radiofrequency ablation system electrodes at the tumour site (arrows). (B) Intraprocedural ultrasound also confirms the placement of a hyperechoic electrode adjacent to the hepatocellular carcinoma (arrow).

Figure 4 (A–C) Postradiofrequency ablation arterial phase CT at different levels showing new hemoperitoneum (white arrow) and active intraperitoneal contrast extravasation or haemorrhage (black arrow). Hypoattenuation of the segment VIII ablation zone is in keeping with coagulation necrosis (arrowhead).

vessels may be involved in ablation and will not necessarily cauterise. Some groups have found that external manual compression helps to achieve haemostasis and/or overcome the heat sink. Given that there was normal parenchyma between the lesion and liver capsule, we elected not to compress in this case.

The BCLC staging system for HCC has been widely adopted in clinical practice.² Treatment options for patients with very-early-stage and early-stage disease include surgical resection, transplantation and RFA. The latter is typically employed in patients with three or fewer hepatic nodules measuring below 3 cm or those with focal unresectable early-stage HCC.⁷ In this case, primary surgical resection and transplant were not considered given the patient's age and tumour size, and we elected to treat with RFA. We inserted a three-probed electrode to achieve adequate tumour coverage given the size of 3.7 cm. MWA is an alternate ablative technique for tumours >3 cm as it creates a larger ablation zone than RFA,⁷ but the technology was unavailable at our institution at the time. Alternatively, lesions >3 cm may be treated with transcatheter arterial chemoembolisation (TACE), but this policy is not standardised. Certainly, RFA,

MWA and TACE would have been equally appropriate choices for treatment of this patient.²

While the efficacy and safety of RFA for HCC is well established, there is the possibility that vascular, biliary and extrahepatic complications may arise.⁵ Overall, reported major complication rates of RFA range from 2.4% to 13.1%; these are lower than the 9–22% rates reported for surgical resection.⁵ The clinical presentation of these complications is varied, but a combination of hypotension, tachycardia, fever and abdominal pain may be encountered. CT is typically the most appropriate first-line radiological test to characterise potential complications and to guide appropriate intervention. A multiphasic CT examination, including a combination of non-contrast, arterial, portal venous and delayed phase imaging is recommended in this setting.

The risk of significant haemorrhage is <2%,⁵ but fatal haemorrhage has been reported.¹⁰ Risk factors for haemorrhage include placement of multiple RFA electrodes, coagulopathy in the setting of underlying cirrhosis and subcapsular or perivascular tumour location.^{5 10} In our case, three RFA electrodes were

Figure 5 (A–C) Digitally subtracted angiogram demonstrating progressive active contrast extravasation or haemorrhage from the hepatic arterial branch supplying segment VIII (arrows). (D–E) Angiogram postselective polyvinyl alcohol particle injection (250–355 μm) demonstrating procedural success with no residual active haemorrhage.

inserted which was likely a contributing factor. The RFA site was also in close proximity to the liver capsule which limits the tamponading effect of adjacent parenchyma postelectrode removal. We did cauterise the needle tracts postablation to limit the risk of haemorrhage; however, we could also have considered pre-RFA arterial embolisation as one large retrospective study found that not performing arterial embolisation prior to RFA was a significant risk factor for increasing major haemorrhage (OR 4.3; 95% CI, 1.5 to 12.7).¹¹

Biliary complications of RFA occur due to thermal injury of the biliary ductal walls, and may result in bile leakage and biloma formation.⁵ Biliary strictures may also develop and if central, may go on to cause cholangitis or abscess formation.⁵ The risk of hepatic abscess formation ranges from 0.3% to 2.0%.⁵ CT is typically used as a first-line test in the evaluation of a patient with a suspected biliary injury, but given the significant overlap in the appearance of a biloma and hepatic abscess, additional radiological tests, such as MRI and hepatobiliary scintigraphy, may be required to improve the specificity for the detection of biliary injuries.¹²

Extrahepatic complications of RFA are rare and may arise from direct electrode transgression of an adjacent organ. Specific entities include diaphragmatic injury, pneumothorax (<1%), hemothorax and colonic injury (0.1–0.3%).^{5 7 10 13} Additional extrahepatic complications include tumour seeding of the electrode tract and thermal skin injuries distant to the site of RFA. Reported rates of tumour seeding of the electrode tract range from 0.3% to 4%.⁵ Thermal skin injuries at RFA grounding pad sites are now rare following routine adoption of large-sized pads.¹⁰

Approximately 32–58% of patients undergoing thermal ablation for primary and metastatic hepatic malignancies will experience postablation syndrome. This condition results from an inflammatory response to postablative tissue necrosis and manifests as a influenza-like illness.⁵ Associated symptoms may include fever, malaise, nausea and vomiting, which should resolve with conservative and medical management. Fevers extending beyond 2 weeks postablation raise the possibility of infection.⁵ Additional post-RFA side effects include pain, asymptomatic perihepatic fluid and/or haemorrhage, asymptomatic pleural effusions and mild gastrointestinal symptoms.⁵

Management options for vascular RFA complications include conservative, medical, endovascular and surgical approaches. Arterial haemorrhage may require transfusion, transarterial embolisation and/or surgical intervention, whereas venous haemorrhage is typically self-limiting and may be managed conservatively.^{5 10} In this case of active arterial haemorrhage, we considered both endovascular and surgical options, and elected to proceed with percutaneous transcatheter embolisation as it is highly effective, minimally invasive and well tolerated. Selection of an appropriate embolic agent(s) is guided by knowledge of vessel size, need for permanent or temporary occlusion and desirability for organ death.^{14 15} In our case, we sought permanent arterial occlusion and tissue death in hepatic segment VIII given the active haemorrhage and tumour site. We elected to selectively inject PVA particles ranging in size from 250 to 355 µm after successfully placing a microcatheter in the appropriate hepatic arterial branch. Coil embolisation would also have been appropriate and has previously been described in this setting,¹⁰ but we elected to avoid use of metallic coils as the diagnostic quality of subsequent CT examinations would be limited by beam hardening and bloom artefact at the tumour site. Gelfoam is an additional embolic agent, but we do not typically use it in our practice as it is a temporary agent.

Image-guided thermal ablation is typically performed in interventional radiology suites and it may be appropriate to forego initial CT in some patients with suspected vascular complications in favour of rotational angiography with three-dimensional reconstruction or traditional catheter angiography. These techniques have a high accuracy for detecting arterial complications, such as active haemorrhage, pseudoaneurysm formation and arteriovenous fistula, and have the added benefit of allowing for definitive endovascular therapy at the time of diagnosis.

Learning points

- ▶ Radiofrequency ablation (RFA) is a safe and effective method of locoregional hepatocellular carcinoma control in appropriately selected patients.
- ▶ Potential complications of RFA may be vascular, biliary or extrahepatic in aetiology. Early recognition of clinical signs and symptoms of a potential complication is essential for early diagnosis and appropriate treatment. Multiphasic CT examination is an appropriate first-line test in patients with suspected RFA complications.
- ▶ Percutaneous embolisation is a minimally invasive, well-tolerated approach to achieving haemodynamic stability in patients with iatrogenic arterial injury in RFA.
- ▶ RFA should be performed in centres with access to specialists trained in endovascular procedures in the event of complications.

Contributors AAD wrote the manuscript and participated in the case. MDR-B and JW-C edited the manuscript.

Competing interests None declared.

Patient consent Obtained.

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