Non Surgical Management of Pseudoaneurysms

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Abstract

Background : The incidence of pseudoaneurysm has increased due to the large number of vascular procedures performed and the widespread use of anticoagulation therapy during procedures. Non-invasive methods for management of pseudoaneurysms comprise of ultrasound guided compression (USGC), thrombin therapy, arterial embolisation and endovascular stent graft insertion. We discuss our experience in the management of fourteen cases of pseudoaneurysms using non surgical techniques. **Methods :** During a two year period, fourteen patients presenting with pseudoaneurysms of different regions were treated. **Result :** Of the fourteen patients, eleven were iatrogenic and three were attributable to trauma. There were six cases of pseudoaneurysms of the femoral artery following coronary angiography studies. One patient developed pseudoaneurysm of right popliteal artery after external fixation of fracture right tibia and fibula. Three cases of renal artery pseudoaneurysms occurred following percutaneous nephrolithotomy (PCNL). The cases were evaluated using a varying combination of color doppler, multidetector computerised tomography (CT) and angiography. These cases were treated with ultrasound guided compression (USGC), stent graft and coil embolisation. The selection of method was based on the location and size of pseudoaneurysms besides the efficacy of the technique. USGC was performed in seven, of which six were in the femoral artery and one supraorbital. The technique was unsuccessful in three of the seven, wherein stent graft was deployed in the femoral artery. Coil embolisation was utilised in three cases of renal artery pseudoaneurysms following PCNL. **Conclusion :** Follow up with color doppler and CT angiography within a week, 6 and 12 months period showed successful regression of pseudoaneurysms in all cases.

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Key Words : Pseudoaneurysm; Arterial trauma; Ultrasound guided compression; Coil embolisation; Endovascular stent graft.

Introduction

The incidence of pseudoaneurysms has increased in hospital based practice, due to the large number of invasive procedures performed [1]. The commonly incriminated procedures are percutaneous catheter angiographies, central venous line insertions, percutaneous nephrolithotomy (PCNL) and surgical procedures adjacent to vessels. The widespread use of anticoagulation therapy during procedures has further contributed to the increased occurrence of pseudoaneurysms. Besides these iatrogenic causes, trauma is a common aetiology for pseudoaneurysms. Currently the treatment options for pseudoaneurysms include ultrasound guided compression (USGC), thrombin therapy, arterial embolisation, endovascular stent graft insertion and surgery. The method of treatment for pseudoaneurysms depends on factors like the size, its location, availability of material, expertise and cost factor. Large symptomatic pseudoaneurysms often require intervention to prevent the complications while the smaller lesions need conservative monitoring, with a careful watch on its progression.

Material and Methods

During a two year period, fourteen patients at our institution (12 men, 2 women; age range: 6–84 years; mean 45 years), presenting with pseudoaneurysms of different regions were treated the details of which are given in Table 1. Of the 14 patients, 11 were due to iatrogenic causes while three were attributable to trauma. These three comprised the right supraorbital aneurysm following a cricket ball injury, subclavian artery aneurysm following chronic trauma by cervical rib and one internal carotid artery (ICA) pseudoaneurysm following road traffic accident (RTA) which presented with stroke involving left middle cerebral artery (MCA) territory. Six patients had a false aneurysm greater than 3 cm in diameter. Majority of the patients were anticoagulated and 12 were symptomatic.

Diagnostic ultrasonography and color doppler was performed in all cases using GE Logic 500 Pro machine for establishing the diagnosis. Aneurysms measuring more than 2 cm were considered significant. A definitive diagnosis of pseudoaneurysm was made after detection of neck connecting the pseudoaneurysm with the parent artery in eleven cases, and vein in one case. A pathognomonic “to and fro” spectral waveform pattern indicating alternating flow direction into the aneurysm in systole and away in diastole,

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Table 1**Patient presentation and non surgical management of pseudoaneurysms**

Age	Sex	Symptoms	Location of pseudoaneurysm	Treatment	Follow up
64	M	Progressively increasing swelling post coronary angiography	(Rt) Femoral artery	USG Compression	Regression
76	M	Progressively increasing swelling post coronary angiography	(Lt) Femoral artery	USG Compression	Regression
68	M	Progressively increasing swelling post coronary angiography	(Rt) Femoral artery	USG Compression	Regression
6	M	Swelling following cricket ball injury	(Rt) Supraorbital artery	USG Compression	Regression
84	F	Progressively increasing swelling post coronary angiography	(Rt) Femoral artery	USG Compression Femoral Stent Graft	Not successful Regression
48	M	Progressively increasing swelling post coronary angiography	(Rt) Profunda femoral artery	USG Compression Femoral Stent Graft	Not successful Regression
45	M	Progressive abdominal distension post coronary angiography	(Rt) Femoral artery	Femoral Stent Graft	Regression
43	M	Swelling following RTA, fracture tibia and fibula after external fixation	(Rt) Popliteal artery	Popliteal artery Stent Graft	Regression
36	F	Swelling base of neck with cold left upper limb Cervical rib excised, swelling did not regress, angiography showed pseudoaneurysm	(Lt) Subclavian artery	Subclavian artery Stent Graft	Regression
56	M	Swelling following subclavian line insertion for CVP monitoring	(Rt) Subclavian vein	Subclavian Vein Stent Graft	Regression
27	M	Hematuria following PCNL	3 rd Accessory renal artery (Rt) kidney	Coil Embolization	Regression of hematuria
45	M	Hematuria following PCNL	(Rt) Kidney lower pole	Coil Embolization	Regression of hematuria
30	M	Hematuria following PCNL	(Lt) Kidney lower pole	Coil Embolization	Regression of hematuria
30	M	Lt MCA stroke following RTA	(Lt) Internal carotid artery	Stent Graft	Exclusion of pseudoaneurysm

was evident in 12 cases. It was not identifiable in one case with the subclavian venous leak. The pseudoaneurysm in the left ICA was diagnosed on CT angiography. The CT angiography was performed using a Somatom Sensation 4 Multidetector scanner (Siemens, Erlangen), equipped with Medrad Vistron Pressure Injector and CARE Bolus software. A combination of 2.5 mm detectors (4x2.5) was used in all cases. An automated run using care bolus was utilised in all cases, with a threshold attenuation of 100 HU placed at aorta, while monitoring the contrast density. 100 ml of 300 mg I/mL solution Omnipaque (Nycomed) of contrast material was injected through a 18 gauge antecubital venfluo using a power injector at a rate of 3 cc/sec. Saline bolus chase of 30 ml was used in all cases. DSA (digital subtraction angiography) was performed on ten cases using Siemens 1000 MA Polystar Top machine.

Result

Fourteen cases were treated successfully using ultrasound guided compression (USGC), stent graft and coil embolisation. The method of selection was based on the size and location of pseudoaneurysms and the efficacy of the techniques. USGC was performed in seven, of which six were in the femoral artery and one supraorbital. The technique was unsuccessful in three of the seven, wherein stent graft was deployed in the femoral artery. The right supraclavicular venous leak was treated successfully with stent graft in the venous side. Coil embolisation was utilised in three cases of renal artery

pseudoaneurysms following PCNL.

USGC was performed in seven cases, using a 7.5 MHz linear array color probe. All patients received analgesia and sedation prior to the procedure. The site of the arterial jet and the neck of aneurysm was localized and gradually compressed with the scanner probe obliterating the flow in the aneurysm sac without compromising parent artery patency. Compression was performed for 10 minutes, repeated maximally to three compressions per session. The patients were re-scanned within two weeks to confirm cessation of flow (Fig. 1).

Stent-grafts were placed percutaneously using Siemens 1000 MA Polystar Top machine, under local anesthesia and light sedation. During the procedure, patients were anticoagulated empirically with 5000 units of heparin intravenously. A guide wire was placed across the pseudoaneurysms to allow stent-graft placement of suitable length and diameter, followed by touch-up balloon angioplasty. Following satisfactory deployment a check angiogram was performed in all cases to confirm cessation of flow via neck into pseudoaneurysm as well as patency of the parent vessel (Figs. 2 A & B) and distal flow. Placement of the endovascular stent-grafts was successful in all patients with no conversion to open surgical procedures.

Follow up of cases was done with color doppler and CT angiography studies performed within a week, 6, and 12 months in all cases.

Fig.1 Color doppler of left femoral artery, showing pseudoaneurysm following angiography. Initial USG scans reveal arterial leak and neck of aneurysm rescanned during follow up after USG compression shows regression in pseudoaneurysm.

Discussion

A pseudoaneurysm is a communicating hematoma, which results from penetrating trauma of a vessel [2]. Left untreated, this lesion develops into a cavity whose walls are made of adventitia, perivascular tissue and fibrous tissue originating from the organised hematoma. The natural history of pseudoaneurysms is largely unknown. Iatrogenic pseudoaneurysms are known complications of angiographic procedures. The risk factors for development of pseudoaneurysm includes antegrade puncture, anticoagulation, large introducer sheaths, faulty puncture technique and inadequate compression [3].

Pseudoaneurysm at inguinal region following catheterization, presents with a painful, pulsating enlarging groin mass, associated with a thrill and/or bruit. Pseudoaneurysm in kidney presents with recurrent and intermittent hematuria following procedures like PCNL, renal biopsy and occasionally after surgery. Coil embolisation is an effective modality in shutting down the offending pseudoaneurysm (Figs. 3A & B).

The risk factors for development of pseudoaneurysms of femoral artery comprise of obesity, use of thrombolytic agents, antegrade puncture, heavily calcified arteries, repeated multiple punctures and low puncture site [4]. The incidence varies in different reports being as low as 0.8% in large retrospective series [5]. Katzenschlager et al [6], from series of 581 procedures, showed that the incidence of 14% of pseudoaneurysms went down to 1.1%, by the use of a strict protocol of five minute minimal compression time after cessation of bleeding [6].

Spontaneous thrombosis may occur in small

Fig. 2A Subclavian artery pseudoaneurysm. Clockwise from left are a) Axial CT section showing dilatation of subclavian artery, b) Coronal MPR shows the aneurysm tapering into the axillary artery with distal run off, c) 3D virtual reality (VR) technique depicts the complex relationship between pseudoaneurysm, cervical rib and left clavicle.

Fig. 2B : Stent graft treatment of subclavian artery pseudoaneurysm. At left are DSA images showing an increase in pseudoaneurysm size. At right a color doppler image shows turbulence within pseudoaneurysm. DSA images display flow across the stent graft and isolation of pseudoaneurysm with adequate distal run off.

pseudoaneurysms, but is difficult to predict. It is less likely to occur if the volume of the pseudoaneurysm is greater than 6 ml (1.8 cm diameter) or in the presence of continued anticoagulation [3]. The treatment for pseudoaneurysms available comprises compression with sandbags or compression devices, ultrasound guided compression, catheter embolisation, stent graft and surgical repair [3]. Surgery is currently indicated when there is evidence of rapid expansion of the pseudoaneurysm with threat of rupture, limb ischemia or distal emboli, extensive soft tissue damage, infection, or if other techniques have failed [3].

USGC for pseudoaneurysms was first reported by Fellmeth et al [7]. Currently, its success rates varies from 74-95% [8,9]. USGC is non-invasive, cost effective and well tolerated by patients, although it can fail, particularly with anticoagulants. The success of compression therapy is less likely, if the pseudoaneurysm is large in size, multiloculated, has high pressure flow, long standing, wider neck and in patients receiving high levels of anticoagulation [8]. Hand fatigue of the operator and patient intolerance of the procedure can contribute to failure. Complications of procedure include arterial thrombosis or distal embolisation [8]. USGC is contraindicated in the presence of a large groin hematoma with overlying skin ischemia, signs of infection and in injuries at or above the inguinal ligament [10].

Endoluminal repair by stent graft is an emerging strategy in treatment of pseudoaneurysms. A stent graft is a metallic stent with a biologically compatible polymer cover usually made of polyester or polytetrafluoroethylene. The polymer cover limits myointimal ingrowth along the length of the treated segment, improving patency. In our series, Hemobahn/Viabhan endoprosthesis was used in five cases (Figs. 4A,B). The Hemobahn endoprosthesis is flexible, self-expanding, endoluminal prosthesis with an expanded polytetrafluoroethylene (ePTFE) tube inside a nitinol sinusoidally shaped helically wrapped stent [11].

In humans, the subclavian artery was the first vessel to undergo treatment with stent graft therapy [12]. Significant advantages of endovascular therapy in pseudoaneurysms are the elimination of surgical procedures like thoracotomy, clavicular resection, or sternotomy (Figs. 3A,B). In a study by Hilfiker et al [13], nine patients with subclavian artery aneurysms or

fistulas were treated with stent-grafts. All devices used were custom-made, consisting of polytetrafluoroethylene (PTFE) covered, Palmaz, Wallstent, Z stents or polyester covered Z stent. An endoluminal stent graft placement is less invasive, eliminates requirement of general anesthesia and reduces hospital stay.

In a recent study by Tilleu [14], 21 patients with 23 popliteal aneurysms were treated with Hemobahn stent grafts. During follow-up at 15 months, 5 of 23 stent-grafts showed features of occlusion, suggesting lower midterm patency rates as compared to traditional surgical repair.

Thrombin therapy is a successful procedure for pseudoaneurysms with a reported success rate of 93 - 100% [15]. Its use in treatment of peripheral arterial pseudoaneurysm was reported by Cope and Zeit in 1986 [16]. The procedure entails instillation of 2 ml of bovine or human thrombin (containing 2000 units) using a 22-G needle into the centre of pseudoaneurysm cavity under sonography guidance. The dose is determined principally by the volume of cavity of the pseudoaneurysm. During the procedure color doppler identifies at first a flash of colour indicating thrombin interaction with flowing blood, followed by complete thrombosis determined by presence of echogenic thrombus and finally evidence of loss of flow within the cavity. Complication includes ischemia of limb, a condition that occurs when thrombin enters the native circulation causing distal thrombotic complications [3]. Contraindications for thrombin therapy are active infection in the region, a large hematoma, skin necrosis, lower limb ischemia with poor run-off and a large neck or defect in the artery wall. Primary surgical repair is reserved for patients with failed ultrasound-guided compression, threat of aneurysm

Fig. 3A Color doppler of right kidney in an adult male presenting with recurrent hematuria following PCNL shows pseudoaneurysm. Post embolisation color doppler images reveal obliteration with regression in size.

Fig. 3B DSA of right kidney in same patient shows pseudoaneurysm. Post embolisation DSA images reveals obliteration of pseudoaneurysm. Note the distribution of coils along the renal artery on CT abdomen.

Fig. 4A: Doppler study of right popliteal region in a patient following fracture tibia, stabilized with screws shows popliteal artery pseudoaneurysm. Note the screw tip within the pseudoaneurysm. Axial CT shows extent and size of pseudoaneurysm. Sagittal MPR reveals the screw traversing the tibia with its tip within the pseudoaneurysm

Fig. 4B : DSA image of right popliteal artery with arterial leak into pseudoaneurysm. DSA after stent graft shows complete isolation of pseudoaneurysms with patency of popliteal and tibial arteries. Plain film of right knee joint in flexion shows normal configuration of stent graft with no kinking.

rupture, presence of distal ischemia or infection of pseudoaneurysm or necrosis. Evidently, surgery is reserved for failures of USGC and embolization, or when their application is unsuitable.

Conflicts of Interest

None identified

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