Arterial False Aneurysms and their Modern Management

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Key words: post-catheterization, upper extremity, pseudoaneurysm, thrombin injection

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Abstract

Background: Both diagnostic and therapeutic options in the management of iatrogenic false aneurysms have changed dramtically in the last decade, with surgery being required only rarely.

Objective: To describe our experience, techniques and results in treating pseudoaneurysms at a large medical center with frequent arterial interventions. We emphasize upper limb lesions.

Materials and Methods: We reviewed the data of all consecutive patients diagnosed by color-coded duplex Doppler between August 1992 and July 1998 as having upper limb and lower limb pseudoaneurysms (mainly post-catheterization). We accumulated 107 false aneurysms (mainly post-catheterization lesions): 5 were upper limb lesions and 102 were groin aneurysms

Results: In the lower limb cases 94 of the 102 lesions were not operated upon (92.1%). Seventy lower limb cases were treated non-operatively by ultrasound-guided compression obliteration with a 95.7% success rate (67 cases). Two cases were treated by percutaneous thrombin injection (2%) and 23 by observation only (22.5%). Altogether 12 patients underwent surgery (11.2%): 4 upper extremity and 8 lower extremity cases. None of the lower limb group suffered serious complications regardless of treatment, but all five upper limb cases did, four of them necessitating surgical intervention. Three of the five upper limb cases had a grave outcome with severe or permanent functional or neurological damage.

Conclusion: Most post-catheterization pseudoaneurysms can be managed non-surgically. False aneurysms in the upper extremity are rare, comprising less than 2% of all lesions. However, upper extremity pseudoaneurysms present a potentially more serious complication and require early diagnosis and prompt intervention to minimize the high complication rate and serious long-term sequelae. Prevention can be achieved by proper puncture technique and site selection, and correct post-procedure hemostatic compression with or without an external device. Some upper limb lesions are avoidable if the axillary artery is not punctured.

IMAJ 2001;3:5-8

Pseudoaneurysms are usually the result of local arterial damage following diagnostic or therapeutic catheterizations. Less often they develop at other vascular access puncture sites such as arterial lines, following trauma or after surgery. They are pulsatile hematomas that result from leakage of blood into the peri-arterial soft tissues, with subsequent encapsulation and failure of the arterial wall defect to heal. Differential diagnosis includes simple hematoma, tissue edema, thrombosed pseudoaneurysm or lymphadenopathy. Post-catheterization lesions occur at a rate of about 0.05% after diagnostic catheterizations and up to 1.2% after more complex procedures [1–3]. While there are no reliable data on the incidence of non-post-catheterization lesions, the increased use of anti-coagulants following interventional procedures has been implicated in the rising incidence of false aneurysms at puncture sites.

We report our experience with 107 lesions of mainly post-catheterization cases, focusing on five cases that occurred in the upper extremities compared to 102 groin lesions. The use of various non-operative closure techniques (observation, compression, and thrombin injection) can be particularly successful in cases involving the groin arteries (93.1% success rate in our series) but may have a worse outcome in upper limb cases. Therefore, in upper limb lesions a more aggressive and often surgical approach should be considered in order to reduce their risk and high complication rate.

Patients and Methods

During a 6 year period, August 1992 through July 1998, 107 symptomatic patients (mainly post-catheterization cases) were diagnosed by duplex Doppler ultrasound as having false aneurysms. We do not routinely screen for pseudoaneurysms in all catheterized patients. Scans were done upon the clinical suspicion of hematoma, pulsatile mass, or a pulsating mass. Most of our diagnostic studies were negative for the presence of a patent pseudoaneurysm (73%).

In 107 cases lesions developed at arterial catheterization or puncture sites done for diagnostic angiogram (39 cases), endovascular procedures (60 cases), arterial blood pressure lines (2 cases), incidental trauma (2 cases), blood donation access site (1 case), other iatrogenic trauma (drilling during orthopedic surgery in 1 case), and insertion of an intra-aortic balloon pump (2 cases). The vast majority, 99 cases (92.5%), occurred following diagnostic and therapeutic angiographies (peripheral and coronary). Five cases were in the upper limbs (4.7%) and 102 in the groin (95.3%). The patients included 64 men and 43 women (60% and 40% respectively) with a mean age of 64 years (range 1882). Gender distribution was 60% males and 40% females with a mean age of 64 years (range 18–82).

In the lower limbs 94 of the 102 lesions were not operated upon (92.1%). Seventy lower limb cases were treated non-surgically by ultrasound-guided compression obliteration, with a 95.7% success rate (67 cases). Compression periods lasted from 10 to 40 minutes with a brief peep every 10 minutes to observe thrombosis. Compression therapy was offered for all lesions that did not undergo spontaneous thrombosis within 7 to 10 days of conservative observation followed by a repeat duplex scan. Two cases were treated by percutaneous thrombin injection (2%) and 23 were observed only (22.5%). Altogether 12 patients underwent surgery (11.2%): 4 upper extremity and 8 lower extremity cases. Follow-up scans were performed on day 1 and days 7–10 after the compression obliteration or the thrombin injection.

Results

Based on a mean rate of 2,500 annual coronary procedures and a mean of 500 peripheral angiograms annually, we calculated that the incidence of pseudoaneurysms was 0.59%. The time interval between insult and diagnosis ranged from 1 to 10 days.

A total of 107 lesions were diagnosed, mostly but not only post-catheterization. Diagnosis was based on color-coded duplex Doppler. Five cases were in the upper limbs (4.7%), 2 post-catheterization and 3 due to other causes; and 102 lesions were in the groin (95.3%), mostly post-catheterization. Ultrasound-guided compression obliteration was the primary mode of treatment in 70 of the lower limb cases and was successful in 95.7% of the attempts. No sedation or analgesic was used. Compression therapy was offered for all lesions that did not undergo spontaneous thombosis within 7 to 10 days of conservative observation, followed by a repeat duplex scan. During this 7 to 10 days of observation 23 cases thrombosed spontaneously regardless of their size. In two cases direct thrombin injection was used to achieve luminal clotting and to avoid surgery. Altogether 12 cases were operated upon: 8 of the 102 patients in the lower limb group and 4 of 5 from the upper limb group (7.8% and 80% operative rate respectively). No complication occurred in the lower limb group, but four in the upper limb group had serious peri-operative complications, significant morbidity and prolonged convalescence.

Twenty-two cases of the total group had multi-chamber-type lesions (20.5%). The internal cavity diameter of the lesions ranged from 1.2 to 6.3 cm (mean 2.4 cm). Among those with lower limb lesions 70 cases underwent ultrasound-guided compression obliteration with a 95.7% success rate.

Owing to recent reports on the use of percutaneous thrombin injection to treat iatrogenic femoral artery pseudoaneurysms [4,5], late in this series we adopted this method and successfully treated two cases where compression obliteration had failed. We injected 1,000 units of human thrombin under direct ultrasound visualization into the lumen of the false aneurysm. The result was an instantaneous thrombus formation and flow cessation.

Five of our patients had upper limb lesions. Case 1 was an axillary artery pseudoaneurysm following transaxillary peripheral angiogram, and case 2 an axillary pseudoaneurysm following insertion of an axillary arterial line. Case 3 was a brachial pseudoaneurysm following coronarography through an antecubital approach, case 4 a brachial pseudoaneurysm following an antecubital puncture for blood donation, and case 5 a brachial pseudoaneurysm following repeated arterial punctures. In case 1, which was previously reported in the literature [6], severe prolonged motor and sensory neurologic deficits developed in the patient's left arm after a transaxillary peripheral angiogram due to brachial plexus neuropraxia that lasted for 10 months and was followed by a reasonable functional recovery. In case 2 surgery was performed 4 days after presentation. Severe combined motor and sensory brachial plexus neurological deficits had developed on the day before operation, causing a prolonged neurologic morbidity lasting 1 year. Case 3 suffered two failed attempts of ultrasound-guided compression obliteration; in addition, the lesion did not thrombose spontaneously but grew to a tender and tense hematoma spreading upwards along the muscular sheaths of the forearm. The patient underwent surgery and had an uneventful recovery. In case 4 compression-guided obliteration was not attempted and the lesion failed to thrombose spontaneously. The lesion showed a constant growth with upward extension of a painful tense hematoma along the muscular sheaths of the forearm. It was surgically repaired but due to muscular contracture a manipulation of the elbow had to be performed at the time of the operation. Prolonged physiotherapy and the use of a continuous passive movement device led to functional recovery of the elbow. Case 5 developed a pulsatile mass at the site of repeated arterial puncture on the left arm. The lesion was extremely superficial, being covered only by skin. A failed attempt at compression obliteration led to the use of direct thrombin injection into the lesion. The pseudoaneurysm thrombosed instantaneously but 2 weeks later skin necrosis of a pressure sore type appeared on top of the lesion and the underlying clot burst, necessitating emergency surgery.

Discussion

Pseudoaneurysms are at times difficult to diagnose. Intrinsic pulsations may mimic transmitted ones and overlying tissues may obscure pulsation. Palpable pulsatility is therefore non-specific. An audible bruit is suggestive but is uncommon and by no means diagnostic. Angiography was the definitive mode of diagnosis until 1987 when Mitchell et al. [7] reported the diagnosis of pseudoaneurysm with color Doppler ultrasound, and today this is the diagnostic procedure of choice.

According to most reports pseudoaneurysms occur in approximately 0.05–1.2% of all invasive arterial procedures [13], although an enormously high incidence of 9% has also been reported [8]. It is agreed that the more complex the preceding invasive procedure, the higher the incidence. They occur more often in elderly hypertensive patients having heavily calcified arteries, in anti-coagulated patients, and when improper techniques are used. Their increased incidence today can be attributed to the use of larger caliber catheters and the greater enthusiasm for percutaneous coronary and peripheral endovascular procedures. The wide use of potent anti-thrombotic and anti-coagulant therapy is also a causative factor.

Prevention can be achieved by proper puncture technique and site selection, and by correct post-procedure hemostatic compression with or without an external device. Some upper limb lesions are avoidable if the axillary artery is not punctured.

Ultrasound-guided compression obliteration is the first-line treatment and is still one of the most frequently used therapeutic approaches [9,10]. The technique has been adopted even in very unusual locations like the extracranial vertebral artery [11]. Relative or absolute contraindications for compression therapy are limb ischemia, local skin ischemia/necrosis, compromised run-off vessels, very large defects, and suspicion of infection. We also regarded full anti-coagulation as a relative contra-indication, although Cox et al. [1] reported a high success rate of the obliterative procedure even in fully anti-coagulated patients (86% success in anti-coagulated versus 98% in non-anti-coagulated patients). Anti-platelet agents were not a contra-indication. Anti-coagulation was not a containdication for direct thrombin injection. Fellmeth and co-workers [9] reported a very significant complication rate for the procedure and therefore treated only those cases where spontaneous obliteration did not occur within 28 days. Several other series used observation alone as the initial therapeutic approach because of the natural tendency of small lesions to undergo spontaneous self-obliteration. Such an approach needs close monitoring and follow-up of a compliant population, which is not always the case.

Reviewing our cases revealed that false aneurysms in the upper extremities (both post-catheterization and following other etiologies as well) are much less common than lower extremity lesions but carry a much higher morbidity. Upper limb lesions were previously described following penetrating trauma [12,13], after shoulder dislocation [14], following blood donation [15], and obviously after various forms of angiography or endovascular procedures [16]. A probable explanation for their low incidence is the healthier and non-atherosclerotic nature of the arterial wall in the upper extremity, and hence better elastic properties and more competent sealing ability after arterial punctures. On the other hand, when such lesions do occur they are influenced by three factors that are responsible for the serious and high complication rate. One is the limited capacity of the neurovascular bundle to contain the volume of the accumulating blood from the puncture site, causing a tense and high pressure compartment in the bundle with a deleterious neurologic effect. The second is the tendency of the blood to dissect quite easily between the fascial and muscular layers in the arm and the axilla; and the third is the difficulty in achieving good post-catheterization compression in the axillary region.

Various authors mention complications of upper extremity lesions and advocate surgical repair [17], endovascular stent graft insertion [18], balloon catheter vascular control [19], or compression obliteration [20]. Even thrombin injection was recently reported in this context, albeit causing gross complication when used in an upper limb lesion in an infant [21]. It is generally recognized that morbidity is more serious in these lesions.

It is clear that non-surgical, minimally invasive or even non-invasive diagnostic and therapeutic procedures are gaining popularity as the preferred method for various surgical situations, such as laparoscopic surgery vs. open surgery, or computed tomographic angiography vs. conventional angiography. This tendency towards less invasive and traumatic procedures obviously includes also the diagnostic and therapeutic approaches to pseudoaneurysms. Following color-coded duplex Doppler diagnosis our recommended algorithm was to wait for 7 to 10 days for spontaneous self-obliteration unless symptoms made intervention inevitable. If, on the repeat scan, the lesion was almost completely obliterated we continued with a further 7 to 10 days of observation. If the repeat scan revealed no change or only minimal change we tried ultrasound-guided compression obliteration unless contraindicated by anti-coagulation, local skin problems, infection, inaccessible neck in unusually located lesions, or in cases with compromised and poor run-off. Failure of a first-attempt compression obliteration led to a second attempt. A second failure led to surgery unless direct thrombin injection could be performed. In order to preclude any additional procedure-related morbidity no other endovascular repair (such as stent graft insertion or embolization) was considered. However, based on our own experience, review of the literature and the fact that a very high morbidity rate occured in the cases with upper limb lesions as a result of delayed diagnosis, delayed treatment and delayed surgery, we advocate prompt diagnosis and a more urgent therapeutic approach, including conventional surgery in these upper limb lesions if morbidity is to be reduced.

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