MEDICAL PRACTICE

Ultrasound-guided thrombin injection for pseudoaneurysms: a case series at a local hospital

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Post-catheterization pseudoaneurysms are increasingly prevalent due to widespread use of endovascular procedures. Ultrasound-guided thrombin injection has emerged as a treatment of choice for these pseudoaneurysms. We review our experience performing this procedure for a series of cases from 2007 to 2010 with different clinical manifestations at a single hospital in Hong Kong. We achieved a high technical success rate with no complications.

Introduction

A pseudoaneurysm is a contained rupture of an artery with disruption of all three layers of the arterial wall. It may arise from a variety of causes, including inflammation, trauma, and most commonly as an iatrogenic complication of arterial catheterization. Post-catheterization pseudoaneurysms are increasingly prevalent due to widespread use of endovascular procedures. Reported point prevalence rates vary, ranging from approximately 0.05 to 2% for diagnostic procedures to approximately 2 to 6% for therapeutic procedures.[1] Ultrasound-guided thrombin injection has become the treatment of choice for post-catheterization pseudoaneurysms. Here, we review our experience of this condition in a series of cases with different clinical manifestations encountered at a single local hospital.

Methods

We first started thrombin injection for pseudoaneurysms in 2007. A retrospective search of all cases referred for ultrasound-guided thrombin injections from 2007 to 2010 was therefore performed. Case records and imaging studies were reviewed. The Table shows a summary of our cases.

Diagnosis

At our institution, Doppler sonography was the first-line imaging modality for diagnosing pseudoaneurysms. The diagnosis depended on demonstrating the typical swirling motion of blood within the pseudoaneurysm sac ("yin yang sign") [Fig 1a], and showing the 'to-and-fro' waveform of blood at the neck of the pseudoaneurysm, which results from blood entering and exiting the sac during systole and diastole (Fig 1b).

We also used ultrasound to document the size of the aneurysm, established the anatomy of its sac and neck as well as its relation to the underlying artery, and factors which could affect planning the path of the thrombin injection. Any co-existent arteriovenous fistula also needed to be excluded by ultrasound, as this would constitute a contra-indication to thrombin injection. For cases with a complicated anatomy, we performed contrast computed tomography (CT) with both arterial and venous phases, which enabled more accurate delineation of the anatomy (Fig 2).

Key words
Aneurysm, false; Catheterization; Thrombin; Ultrasonography

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TABLE. Patient characteristics and results of ultrasound-guided thrombin injection*

Patient No.	Age (years)	Sex	Cause	Site	Maximum diameter (cm)	Thrombin dosage (U)	Outcome	Complications
1	74	M	PCI	Right femoral	2.6	400	Success	Nil
2	80	M	Arterial line	Left brachial	3.6	1200	Success	Nil
3	78	F	PCI	Right femoral	N/A	2000	Failure	Nil
4	68	F	Arterial line	Left femoral	5.0	1000	Success	Nil
5	81	F	Arterial line	Left femoral	4.0	800	Success	Nil
6	79	M	PCI	Right femoral	4.0	600	Success	Nil

* PCI denotes percutaneous coronary intervention, and N/A not available

超聲波引導下凝血酶注射治療假動脈瘤：本地一所醫院的病例回顧

由於血管內程序的廣泛使用，導管插入引起的假動脈瘤越來越普遍。超聲波引導下凝血酶注射已成為治療這些假動脈瘤的首選。我們總結在2007至2010年間於香港一間醫院進行的一系列凝血酶注射的經驗。我們取得較高的技術成功率，且沒有併發。

Procedure

Informed consent was obtained before any procedure. Any contra-indications needed to be excluded, including gross superficial infection, co-existent arteriovenous fistula, and known allergy to thrombin. Before the procedure, the presence of ipsilateral distal pulses were documented (by palpation or sonography). We used bovine thrombin, manufactured by GenTrac, Inc (Middleton, Wisconsin, US), which had a theoretical risk of allergic reactions,

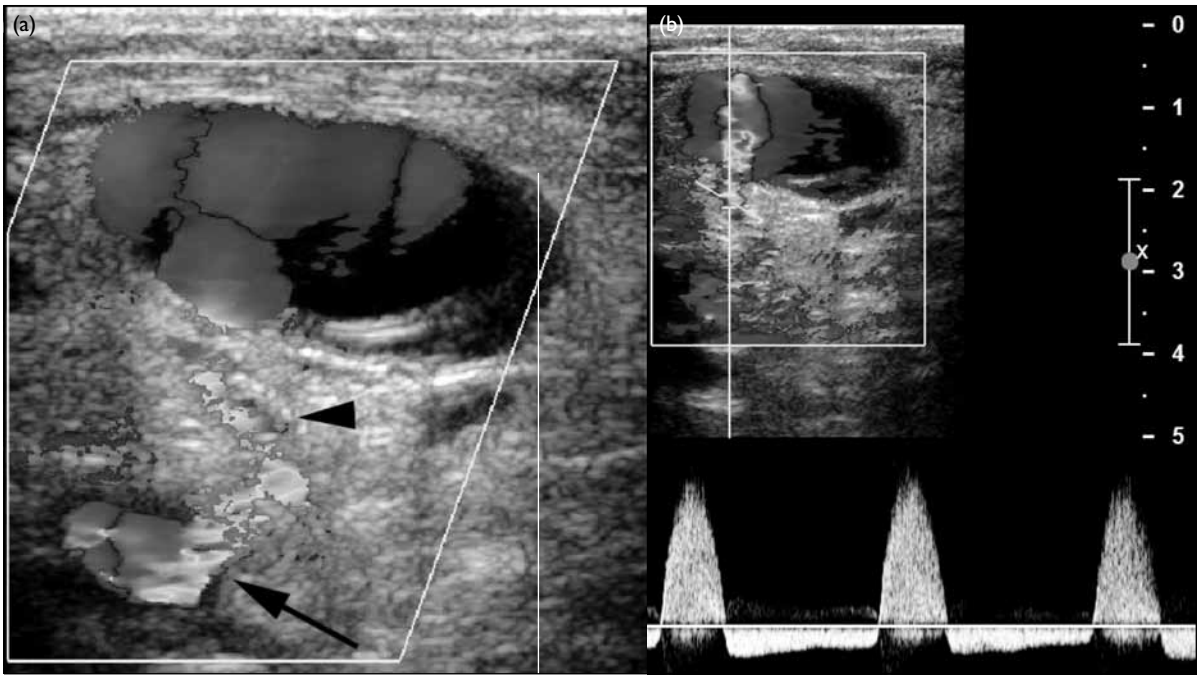

FIG 1. (a) Doppler ultrasound of a 74-year-old man (patient No. 1) who had recently undergone percutaneous coronary intervention. Transverse image of the right groin shows a large pseudoaneurysm demonstrating a "yin-yang" appearance on colour Doppler due to swirling turbulent blood flow. Note the 'neck' of the aneurysm (arrowhead) which shows communication with the right common femoral artery (arrow). (b) Doppler waveform at the neck shows 'to-and-fro' flow pattern, with blood in-flow during systole and out-flow during diastole

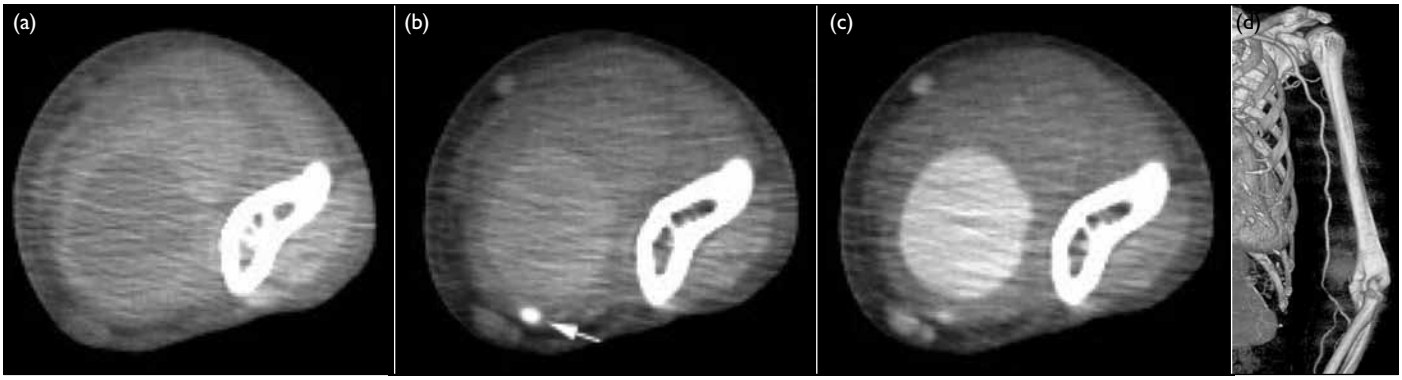

FIG 2. An 80-year-old man (patient No. 2) after removal of a left brachial arterial line. Ultrasound (not shown) showed a vascular lesion near the left distal humerus, but its relationship with the brachial artery was not well-demonstrated

(a) Unenhanced, (b) post-contrast arterial phase, (c) venous-phase computed tomography, and (d) 3-dimensional rendering image at the region of the left distal humerus. A rounded lesion showing intense contrast enhancement is seen closely related to the brachial artery (arrow), compatible with a pseudoaneurysm. The relatively slow contrast enhancement is probably due to a very narrow neck, rendering it difficult to visualise by ultrasound

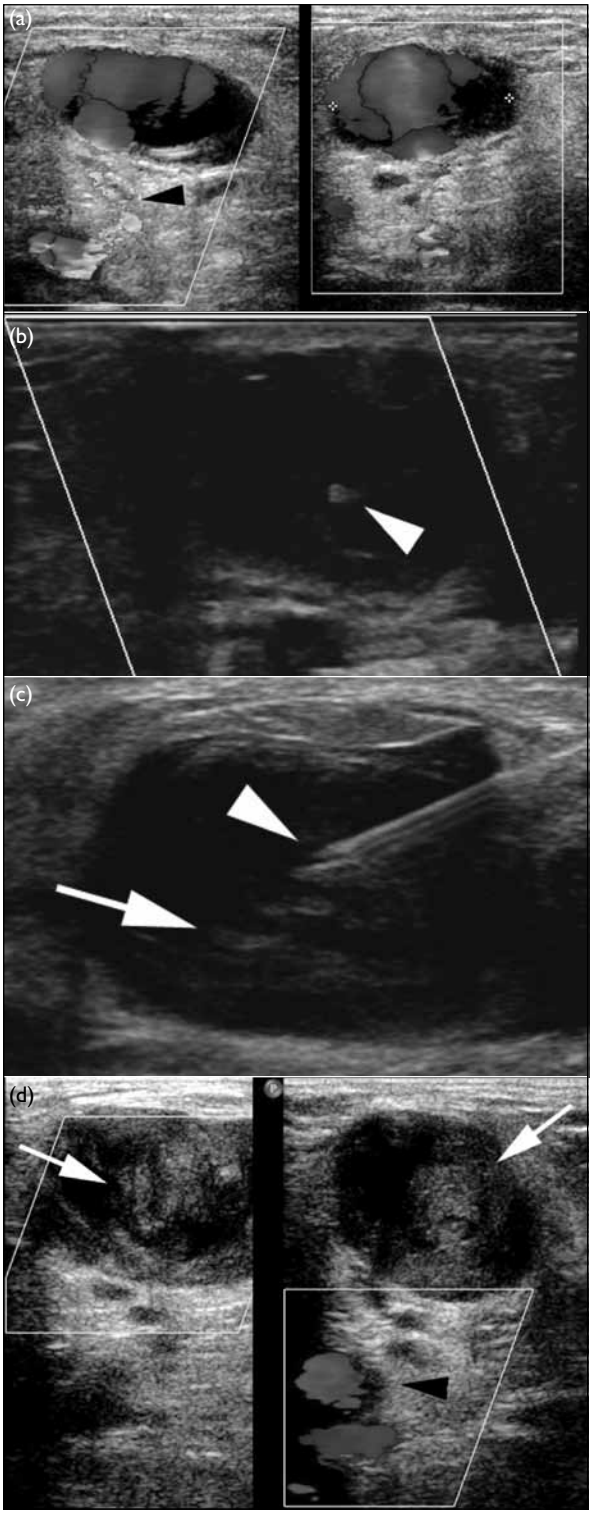

FIG 3. A 79-year-old man (patient No. 6) who had undergone percutaneous coronary intervention
(a) Doppler sonography shows a pseudoaneurysm at the right groin. Note flow within the neck of the pseudoaneurysm (black arrowhead). (b) The spinal needle tip (white arrowhead) is inserted into the centre of the pseudoaneurysm. (c) On slow injection of thrombin, thrombus (white arrow) is seen forming around the needle tip (white arrowhead). (d) Doppler sonography after completion of thrombin injection is shown. Note complete lack of flow within the aneurysm (white arrows) and at the aneurysm neck (black arrowhead)

but a recent review had documented the safety of such bovine thrombin injections.[2] The thrombin came in a powder form and needed to be reconstituted in normal saline. The recommended concentration was 1000 IU/mL.

A strict aseptic technique was adhered to. We used a 22G spinal needle for injection. The aneurysm was localised by ultrasound. Under sonographic guidance, the needle was advanced into the centre of the aneurysm and away from its neck, as we wanted to avoid any thrombin leaking into the native artery through the neck. After the position of the needle tip was confirmed, in each patient thrombin was injected slowly until Doppler flow within the pseudoaneurysm ceased (Fig 3).

After the procedure, the patient was re-evaluated for the presence of distal pulses with Doptone. The patient was sent to the ward and kept in bed rest for 2 hours. Follow-up Doppler ultrasonography was performed on each patient after 5 days and 1 month later (Fig 4).

Results

We performed thrombin injections for pseudoaneurysms in six patients from 2007 to 2010. The mean patient age was 77 (range, 68-81) years. The causes of these pseudoaneurysms were post–percutaneous coronary intervention complications in three patients, post-arterial line insertion in two, and post-trauma in one. The mean diameter of the pseudoaneurysm was 3.8 cm (range, 2.6-5.0 cm).

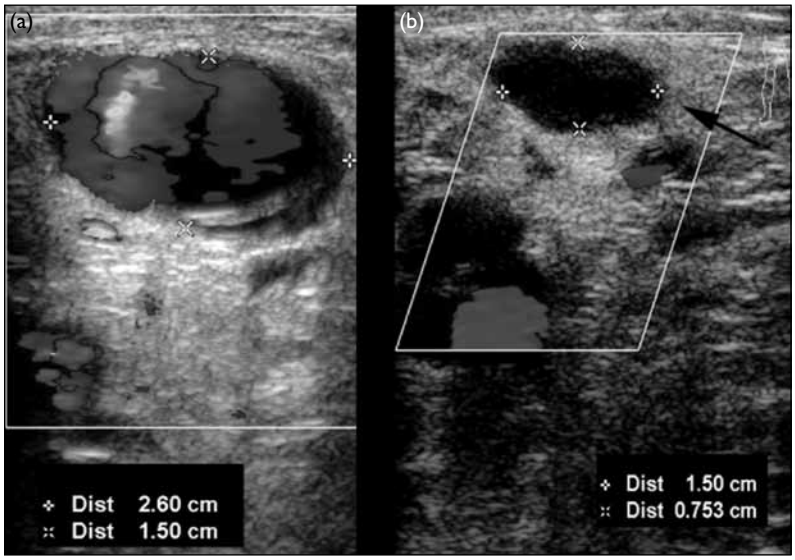

FIG 4. Patient No. 1 (same patient as in Fig 1)
(a) Pre-injection and (b) 1-month post-injection Doppler ultrasound images of the right groin show resolution of flow within the pseudoaneurysm. A residual small hypoechoic collection remains at the right groin (black arrow) compatible with a resolving haematoma

FIG 5. A 78-year-old woman (patient No. 3) who had undergone percutaneous coronary intervention
(a) Sonography shows a huge haematoma over the right groin. No abnormal flow could be detected within the haematoma. (b) Computed tomography (CT) confirms the huge right groin haematoma (black arrow) which does not demonstrate arterial flow. However a tiny tract (black arrowhead) is seen arising from the common femoral artery with a visible arterial jet flowing towards the posterior aspect of the right groin haematoma. (c) Ultrasound-guided thrombin injection to the tract was attempted, but this tract is only barely visible on Doppler ultrasound (white arrowheads) and could not be localised by the spinal needle. (d) The patient remained stable and follow-up CT shows resolution of the haematoma and vascular tract

The mean dose of thrombin injected was 1000 IU (range, 400-2000 IU). The technical success rate was five (83%) of six cases. Regarding the five successful cases, follow-up Doppler ultrasound and clinical evaluation confirmed resolution of the pseudoaneurysms without any complications. The patient in whom technical success was not achieved was a complicated case (Fig 5). The likely reason for technical failure was the very small target area for thrombin injection. Nonetheless, the haematoma and supplying vascular tract was treated conservatively, and was not evident on the follow-up CT.

Discussion

Traditional treatment strategies for pseudoaneurysms include observation, ultrasound-guided compression, and surgical repair. Small pseudoaneurysms may thrombose spontaneously, but it is difficult to predict this in advance. Failure to spontaneously thrombose is associated with lesions greater than 1.8 cm in diameter and with concomitant use of anti-coagulation.[3] Ultrasound-guided compression is a safe and non-invasive treatment modality to treat pseudoaneurysms. Success rates range from 70 to 90%.[4,5] However, such compression is painful for the patient, as well as time-consuming and demanding for the clinician. One study found the mean necessary compression time to be 33 minutes.[6] Surgery is usually reserved for a minority of patients who have failed other therapies. Other indications for surgery include superimposed infection, rapidly enlarging pseudoaneurysm, and a local mass effect causing distal ischaemia and/or neuropathy. Disadvantages of surgery are significant morbidity and longer hospital stays.[7]

Percutaneous injection of thrombin for pseudoaneurysms was first reported in 1986.[8] Many case series and studies in the early 2000s reported excellent results and low complication rates with ultrasound-guided thrombin injections, and this procedure is now the standard of care in many centres. Technical success rates are greater than 90%,[9] even in patients receiving anticoagulants or antiplatelet therapy. The most serious complication associated with thrombin injection is distal thromboembolism into the artery, which can be avoided by aiming the injection away from the neck of the pseudoaneurysm. In the unlikely event of downstream thrombosis, management options include anticoagulation,[10] intra-arterial thrombolysis,[11] and surgery. Other complications such as allergic reactions and anaphylaxis have been reported in the literature.[9] The overall complication rate is 1.3%,[2] with an embolism rate of 0.5%. Our overall rates for success (83%) and complications (0%) were comparable to reported rates in the literature.

In conclusion, ultrasound-guided thrombin injection is a safe and effective treatment option for the management of pseudoaneurysms. Our local experience is comparable to that reported in the literature, and supports ultrasound-guided thrombin injection as the treatment of choice.

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