

# Ultrasound-Guided Thrombin Injection for Treating Iatrogenic Femoral Artery Pseudoaneurysm

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## Abstract

A pseudoaneurysm (PSA) is a false aneurysm that occurs after localized arterial wall injury related to an incomplete hemostatic plug at the injury site. With femoral access being the most common site for development of a PSA, any arterial site used for a percutaneous puncture can develop this complication. The overall incidence of PSA is decreased with replacement of the conventional femoral approach by a transradial approach for interventional procedures. Treatment strategies for uncomplicated PSA have been ultrasound-guided compression and ultrasound-guided thrombin injection, with surgery being reserved for complicated or unresponsive cases. Herein, we report a case of large femoral PSA managed successfully using an ultrasound-guided intracavity thrombin injection.

The incidence of femoral PSA after diagnostic catheterization ranges from 0.05% to 2%.<sup>1</sup> When coronary or peripheral intervention is performed, the incidence of femoral PSA increases from 2% to 6%.<sup>2</sup> In one series where diagnostic ultrasound was performed on 536 consecutive patients that had undergone catheterization, the incidence of PSA was 7.7%, with 83% of the PSAs associated with interventional procedures.<sup>3</sup> The

most catastrophic complication of PSA is rupture. Although the exact rate is unknown, the risk of spontaneous rupture of PSA is related to size >3 cm, presence of symptoms, large hematoma, or continued growth of the sac.<sup>4-7</sup> Infection of a PSA significantly increases the risk of rupture as well as septic emboli.<sup>8</sup>

## Case Presentation

A 52-year-old hypertensive male with ongoing tobacco use presented to our outpatient clinic for regular follow-up, one and a half months after percutaneous coronary intervention via a femoral route. On inquiry, the patient complained of a swelling in the right groin. A local examination showed a pulsatile non-tender mass with normal temperature and appearance of overlying skin. There was an audible bruit with no palpable thrill. The distal limb was normal, including intact neurovascular bundle. We investigated using routine blood tests and Doppler ultrasound of affected side, which showed a large (38 mm x 45 mm), oval-shaped, blood-filled aneurysmal cavity superficial to the common femoral artery (CFA) (Figure 1). The cavity had a thin wall lined by connective tissue and linear hematoma, and was communicating with the CFA through a narrow neck (4.5 mm), all consistent with the formation of a femoral pseudoaneurysm. To confirm this diagnosis, a color Doppler at the neck was performed and showed the typical interplay of

red and blue, traditionally labeled as the ‘ying-yang’ sign (Figure 2) or ‘Pepsi-Cola’ sign. Furthermore, the pulsed-wave Doppler exhibited a ‘to-and-fro’ pattern of blood flow via the neck (Figure 3). The patient was then evaluated by the interventionist and the vascular surgeon to determine how to best manage this iatrogenic complication. Options included ultrasound-guided compression, vascular surgery, and ultrasound-guided thrombin injection. The last option was selected as the appropriate first technique for treatment in this case.

Using sterile technique, two syringes each filled with 01 cc saline and thrombin were connected via a 3-way stopcock, front loaded with a 1.5-inch 22-gauge needle. Under local anesthesia, using ultrasound guidance, the needle tip was inserted into upper third of the PSA cavity (Figure 4). Once in place, the correct positioning of needle tip was confirmed first by aspiration of blood into the saline syringe and then injecting back the same, which produced intracavity bubble contrast. This was followed by the serial injection of 0.2 mL boluses of thrombin, while evaluating for thrombus formation under continuous ultrasonography (Figure 5). A total of 1 mL of thrombin was injected with immediate thrombosis in the cavity (Figure 6). The cessation of flow via the neck was confirmed by repeat PW and color Doppler at the neck (Figure 7). The patency of the distal vessels and CFA (Figure 8) was confirmed at the end of the procedure. The patient was put on

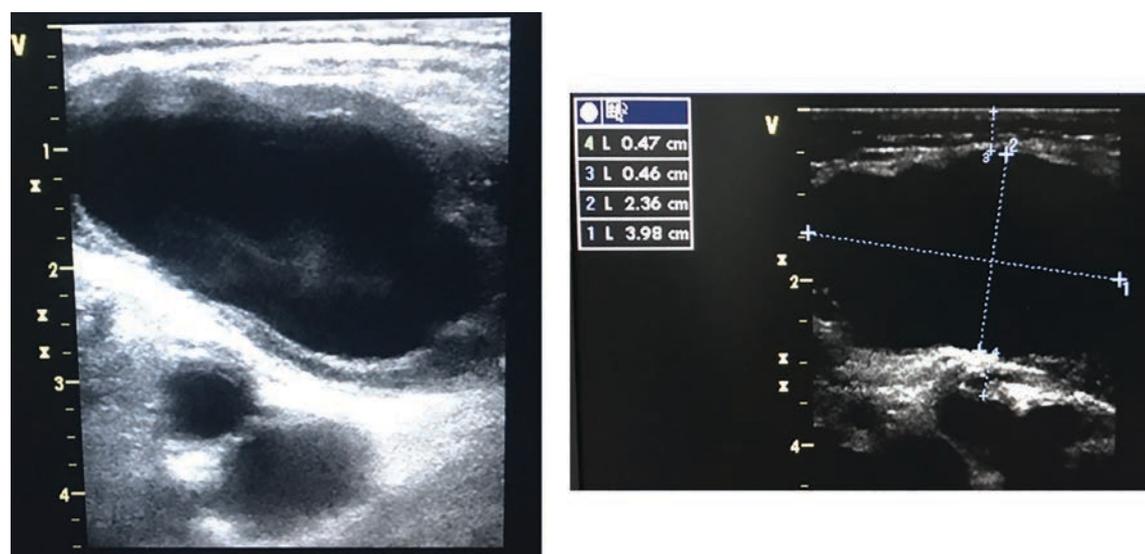


Figure 1. Baseline pseudoaneurysm (PSA) image (left) and measurements (right).

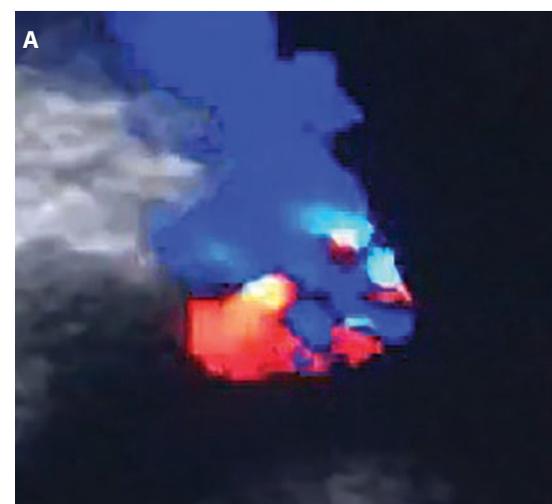


Figure 2A-B. Ying-yang sign.

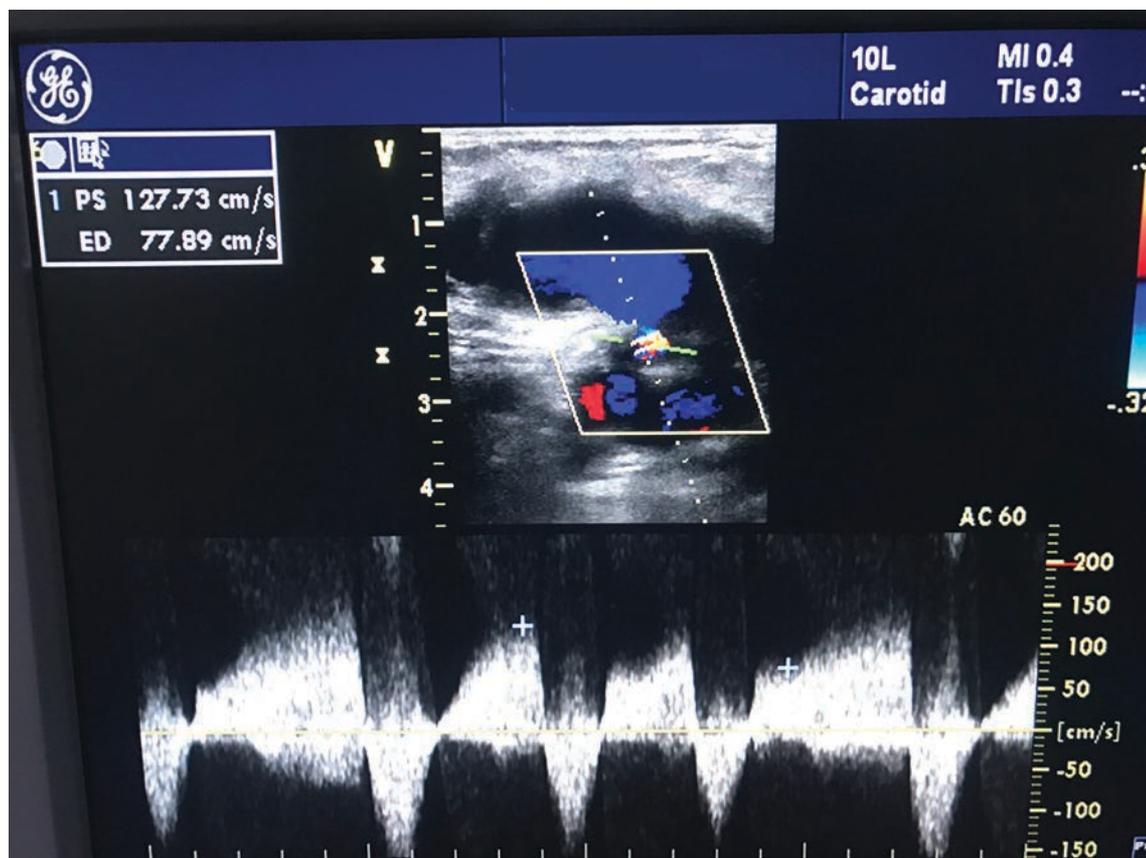


Figure 3. Pulsed wave (PW) Doppler at the level of the neck.

bed rest for 12 hours and then mobilized. There was complete and successful thrombosis of PSA cavity without any complication. On his follow-up visit, the patient was doing well.

**Discussion**

Iatrogenic pseudoaneurysm (IPA) is a contained rupture; there is a disruption in all 3 layers of the arterial wall. PSAs may occur under 4 circumstances: (1) after catheterization; (2) at the site of native artery and synthetic graft anastomosis (eg, aortofemoral bypass graft); (3) trauma; and (4) infection (eg, mycotic PSA). Post catheterization IPA is one the most common vascular complications of catheterization. IPAs most commonly occur when complex coronary and peripheral interventions are performed via a large-bore access site. Multiple factors are associated with the formation of pseudoaneurysm, such as antiplatelet agents (often aspirin and clopidogrel), anticoagulation, large sheath size (>8 French), age >65 years, obesity, poor post procedural compression, simultaneous artery and vein catheterization, hypertension, peripheral arterial disease, hemodialysis, complex interventions, and low or high puncture sites.

Ultrasound duplex and computed tomography (CT) scan are used to confirm a PSA. Differential diagnosis includes arteriovenous fistula, abscess, hematoma, tumors, vascular malformations, and inguinal hernia. Patients typically present with complaints of gradual, growing swelling with mild to moderate discomfort in uncomplicated cases post transfemoral access for intervention.

Until the early 1990s, the only treatment available

for PSA was surgery. Since that time, ultrasound-guided compression, ultrasound-guided thrombin injection, and a whole host of other treatment modalities such as FemoStop compression devices (Abbott Vascular),<sup>9</sup> coil insertion,<sup>10</sup> fibrin adhesives,<sup>11</sup> and balloon occlusion have been used with varying levels of success. Surgical repair was performed as the treatment of choice until 1991, when ultrasound-guided compression was introduced.<sup>12</sup> Lumsden et al<sup>13</sup> demonstrated complication rates as high as 21% in patients undergoing surgical repair. Bleeding, wound infection, lymphocele, and radiculopathy were the most prevalent complications. Since 1991, ultrasound-guided compression has been the first-line of treatment for PSA, but needs both time and labor. It may require intravenous analgesia and sedation; with patients on anticoagulation, the success rate is 30% to 73%. Failure rate is in the range of 5%

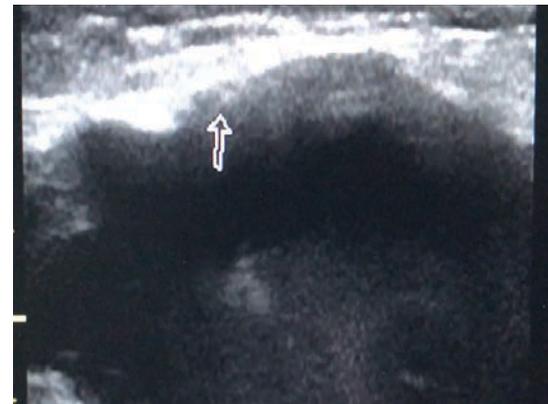


Figure 4. Visible needle tip entering the PSA cavity before start of injection.

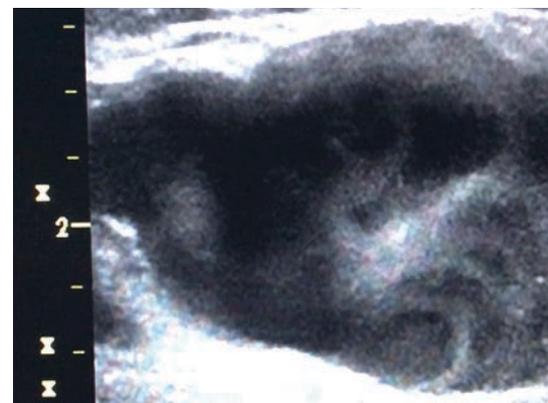


Figure 5. Partial thrombus formation after injection of thrombin begins.

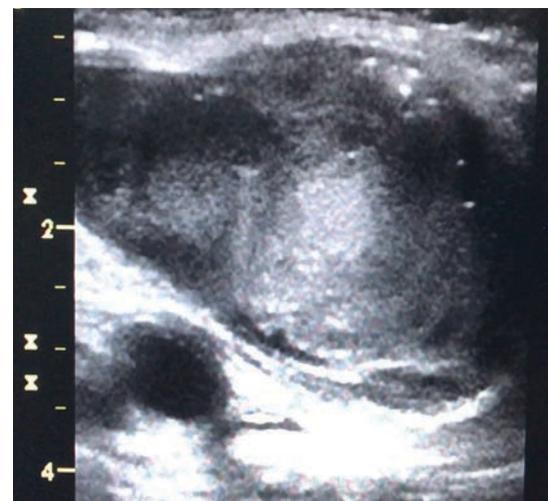


Figure 6. Full thrombosed PSA cavity.

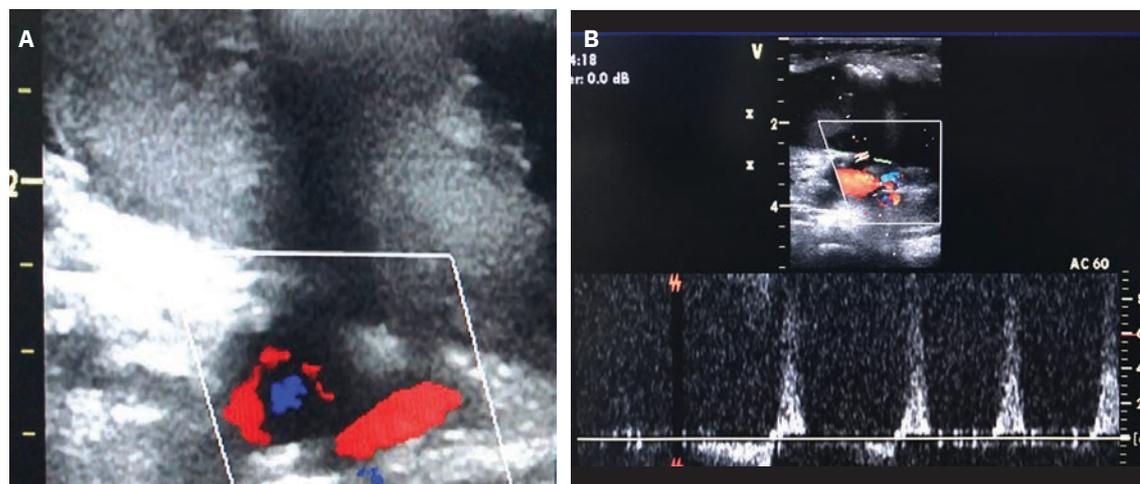
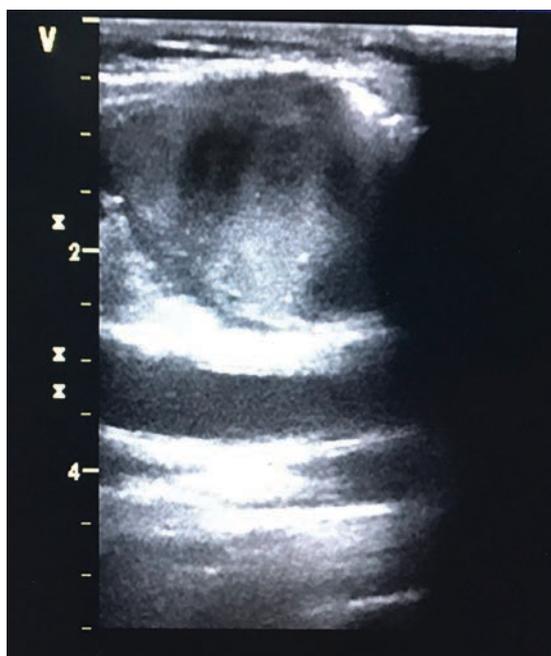


Figure 7A-B. (A) Diminution of color Doppler at neck after thrombin injection. (B) Diminution of PW Doppler at neck after thrombin injection.



**Figure 8.** Patent femoral artery at end of procedure.

## Technical ease, excellent clinical results, negligible complication rates, and patient comfort make ultrasound-guided thrombin injection the treatment of choice for repairing a post-catheterization pseudoaneurysm.

to 15%<sup>14-17</sup> and the recurrence rate is reported to be as high as 30% in the face of ongoing anticoagulation.<sup>17,18</sup>

Technical ease, excellent clinical results, negligible complication rates, and patient comfort make ultrasound-guided thrombin injection the treatment of choice for repairing a post-catheterization pseudoaneurysm. Confirmation of needle placement into the center of the pseudoaneurysm cavity is imperative to avoid injection into a native vessel. The success rate of ultrasound-guided thrombin injection ranges from 91% to 100%.<sup>2,19</sup> The overall complication rate from ultrasound-guided thrombin injection is 1.3%, with an embolic rate of 0.5%.<sup>2</sup> One study in 34 patients for ultrasound-guided thrombin injection to treat PSA reported a success rate of 97.1% and zero complications.<sup>20</sup> The most serious complications of thrombin injection are deep venous thromboembolism, pulmonary embolism,<sup>21</sup> or thrombosis of the artery, but are extremely rare. Hypotension, bradycardia, and allergic reactions can be potential reactions upon exposure to bovine thrombin, but also are extremely rare and easily treatable. An ultrasound-guided thrombin injection can be considered the current

state of the art, addressing iatrogenic PSA in an effective and safe manner.

### Conclusion

Formation of a PSA is a rare but dangerous complication after cardiac catheterization or peripheral interventions. Doppler ultrasound is the diagnostic test of choice, and is cost and time effective. Ultrasound-guided thrombin injection to treat PSA has a high success rate and low complication rate, making it the current state-of-the-art treatment for all large PSAs. The use of proper technique and following steps for ultrasound-guided thrombin injection while under direct ultrasound guidance are key to success. ■

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