
Percutaneous Obliteration of Common Femoral Artery Pseudoaneurysm

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Abbreviations

PA Pseudoaneurysm

INTRODUCTION

Pseudoaneurysms (PAs) are one of the most common complications of femoral artery catheterization. In addition, arterial hemorrhage due to non-iatrogenic traumatic vascular injury or anastomotic leakage may also result in PA formation. A PA represents active hemorrhage contained within a hematoma, and is at constant risk of rupture if not diagnosed and treated expeditiously. Surgical repair is indicated in patients presenting with PAs due to previous vascular surgical interventions, infection, or non-iatrogenic trauma. Nonsurgical treatments for iatrogenic arterial PAs include compression, direct percutaneous thrombin injection, and endovascular stent graft placement. PA com-

pression may be guided by palpation (“blind”), precompression ultrasound examination for localization with subsequent manual compression, or real-time ultrasound-guided compression using the transducer itself. Percutaneous thrombin injection under ultrasound guidance is the treatment of choice for noncomplicated femoral PAs, particularly those which have a narrow, long, and superficial neck amenable to compression. Simultaneous balloon occlusion of the artery across the site of arterial communication may be helpful in increasing safety of thrombin injection for a PA without a neck or with a short and wide neck. In the rare instance of thrombin failure due to a large arterial defect or in cases of accompanying arteriovenous fistula, a covered stent (stent graft) may be placed to repair the defect; however, consideration should be given to the position of the stent relative to the apex of hip flexion, as the excess motion may impact stent integrity and patency. The use of human thrombin is favored over bovine thrombin, as the latter has greater potential to induce allergic reactions. Autologous thrombin, which is cheaper than commercial bovine or human thrombin, can also be used; its application is simple, safe, and reliable.

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COMMON INDICATIONS [1, 2]

- *Pseudoaneurysm compression:* Iatrogenic femoral PA with ALL of the following characteristics: small, <2 weeks old, long neck, intact overlying skin, no anticoagulation. Selected non-iatrogenic femoral PAs may also be appropriate for this treatment if mechanism resulted in similar vascular injury (e.g., small-caliber stab wound).
- *Direct percutaneous thrombin injection:* All iatrogenic femoral pseudoaneurysms can be potentially treated using this method. Selected non-iatrogenic femoral PAs may also be appropriate for this treatment.

COMMON CONTRAINDICATIONS [1, 3, 4]

Contraindications to pseudoaneurysm compression:

- Pain intolerant patients
- Painful pseudoaneurysms
- Morbid obesity
- Large pseudoaneurysm, obliterating adjacent vessels
- No compressible pseudoaneurysm neck
- Pseudoaneurysms with ipsilateral deep venous thrombosis

Contraindications to direct percutaneous thrombin injection:

- Previous exposure to bovine thrombin
- Aneurysmal sac <1 cm (*has higher rate of thrombin leakage and subsequent thrombosis of the femoral artery*)
- No compressible pseudoaneurysm neck (*unless adjunctive balloon occlusion used*)

Contraindications to both methods:

- Pseudoaneurysm associated with arteriovenous fistula

- Suspected pseudoaneurysm infection
- Breakdown of overlying skin
- Unstable patients
- Rupture or impending rupture

POSSIBLE COMPLICATIONS [1–8]

Complications encountered with pseudoaneurysm compression:

- Pain and pain-associated complications (*vasovagal reaction, atrial fibrillation, hypertension*); 0–4.1 %
- Pseudoaneurysm rupture; 0–0.9 %
- Distal arterial embolization; 0–0.8 %
- Ipsilateral deep venous thrombosis; 0–0.3 %
- Pulmonary embolism; *rare*

Complications encountered with direct thrombin injection:

- Thromboembolic complications due to thrombin leakage into the femoral artery; 0–2.6 %
- Allergy to the injected material; 0–0.4 %
- Superimposed infection; 0.05–0.9 %
- Pseudoaneurysm rupture; 0–0.8 %
- Pain; 0–0.4 %
- Deep venous thrombosis
- Reperfusion of previously completely thrombosed pseudoaneurysms (*i.e., treatment failure*)

PREPROCEDURAL ASSESSMENT AND PLANNING

- History, indications and physical examination (*Appendix 1* in Chap. 149)
- Evaluation of diagnostic imaging studies (ultrasound/CT angiography) to determine the relevant vascular anatomy and the location, shape, and size of the pseudoaneurysm

- Periprocedural management of coagulation status (*Appendices 2* in Chap. 150 and *3* in Chap. 151)
- Antibiotic prophylaxis: Not routinely recommended
- Imaging modality for guidance: Ultrasound
- Positioning: Supine

PROCEDURE NOTE

Procedure: Percutaneous obliteration of left/right common femoral artery pseudoaneurysm by direct ultrasound-guided compression/thrombin injection

Staff:

Fellow:

Resident:

Clinical Information: Describe history and list indications

Allergies: None known/Allergic to [specify/type of allergy]

Anesthesia: Local anesthesia/conscious sedation

Medications: List any relevant medications used (anesthesia, sedation, thrombin/tissue adhesive agent)

Contrast Used: () mL of [type] contrast media was used for angiography/None

Field: Sterile

Procedure classification: Clean

Position: Supine

Monitoring: Intravenous access line was secured and vital signs were continuously monitored by nursing staff/anesthesia team throughout the procedure

Total fluoroscopy time: () minutes/not applicable

Cumulative radiation dose: () mGy/not applicable

Description of Procedure (*direct percutaneous intrapseudoaneurysm injection of thrombin*):

The risks, benefits, alternatives, and procedure itself were explained to the patient/patient's Power of Attorney/patient's legal guardian, and

informed written consent was obtained. Time out was performed to confirm the correct patient, procedure, and site. The site of the procedure was identified and marked.

The patient was positioned supine. Baseline distal arterial pulses were determined bilaterally. Color-flow Doppler and grayscale ultrasound examination was performed to evaluate the pseudoaneurysm for size, complexity (number of lobes), neck location and dimensions, and hemodynamics. The relationship of the pseudoaneurysm with the supplying femoral artery was determined. Additional arterial injuries and arteriovenous fistula formation were excluded. The overlying skin was inspected to ensure it was intact, and to exclude necrosis and infection.

Thrombin Injection:

The ideal needle access site and trajectory were determined. The skin of the right/left groin was prepped and draped in the usual sterile fashion. [Balloon inflation for balloon-assisted thrombin injection should be performed at this time*]. Using real-time ultrasound guidance, a (25/22/21)-gauge needle was advanced into the pseudoaneurysm sac/junction of neck and sac (less preferred)/neck (not preferred). Then, thrombin was injected slowly and steadily (0.1–0.3 mL/s) under real-time color-flow Doppler ultrasound visualization. The formation of isoechoic to hyperechoic thrombus gradually filling the pseudoaneurysm was observed. Residual pockets showing vascular flow were identified, and the needle was redirected into these pockets for additional thrombin injection/gentle pressure was applied to achieve complete thrombosis. A total of () units of thrombin were injected. Color-flow Doppler ultrasound examination showed complete/nearly complete thrombosis of the entire pseudoaneurysm and absence of high flow through the sac and the procedure was concluded.

Sterile dressing was applied and the patient was transferred to the floor/recovery room following the procedure in a stable condition. Staff was present for the entire procedure.

***Balloon Placement and Inflation for Balloon-Assisted Thrombin Injection:**

The contralateral common femoral artery, femoral head, and inguinal ligament were located by palpation/fluoroscopy/ultrasound and marked. The site of arterial puncture was determined using combined information from palpation, ultrasound, and fluoroscopy. Local anesthesia was administered. Common femoral artery access contralateral to the pseudoaneurysm was obtained using a ()-gauge [type] needle and the Seldinger technique under direct ultrasound visualization/by palpation. Once good pulsatile arterial flow was detected, a ()-inch [type] guidewire was advanced through the needle, into the aorta under direct fluoroscopic visualization, and a ()-French vascular sheath was placed. A ()-French [type] catheter and a ()-inch [type] guidewire were navigated into the contralateral common iliac artery. Arteriography was performed by the manual injection of ()-mL of contrast to localize the pseudoaneurysm. The wire was then advanced until its tip was distal to the femoral pseudoaneurysm. The diagnostic catheter was exchanged over the wire for a () × () mm balloon catheter. The balloon was positioned and inflated across the pseudoaneurysm neck.

Following the procedure the right/left femoral artery sheath was removed, and adequate hemostasis was achieved by compression for () minutes/using [type] vascular closure device. The lower extremity pulses were checked following the procedure and were [comparable to the pre-procedure pulses/specify if otherwise needed]. The patient was transferred to the floor/recovery room following the procedure in a stable condition. Staff was present for the entire procedure.

Notes:

- *Balloon occlusion of the pseudoaneurysm neck* is not routinely recommended due to its invasive nature and added complications. The application of this protocol is proposed in cases when the neck is <3 mm in length, wider than a point source [8], or otherwise

unsuitable for effective percutaneous compression.

- *Pseudoaneurysm containing a single lobe:* a thrombin dose of 500–1000 IU is generally adequate [8]; inject thrombin slowly until flow in the PA ceases.
- *In patients with complex bi- or multilobed pseudoaneurysms:* Some authors recommend first injecting into the lobe farthest from the native femoral artery, with subsequent injection(s) into the lobe(s) communicating with the neck if they remain patent; in the believe that this minimizes the risk of propagation of thrombus into the femoral artery. By contrast, other authors recommend instead starting injection in the lobe closest to the artery, which should occlude flow to the distal lobe as it thromboses [8].

Description of Procedure (*real-time ultrasound-guided compression*):

The risks, benefits, alternatives, and procedure itself were explained to the patient/patient's Power of Attorney/patient's legal guardian, and informed written consent was obtained. Time out was performed to confirm the correct patient, procedure, and site. The site of the procedure was identified and marked.

Baseline distal arterial pulses were determined, bilaterally. The skin of the right/left groin was prepped and draped in the usual sterile fashion. Color-flow Doppler ultrasound examination was performed to evaluate the pseudoaneurysm for overall size, neck location, dimensions, and hemodynamics. The relationship of the pseudoaneurysm with the supplying femoral artery was determined. Additional arterial injuries and arteriovenous fistula formation were excluded. The overlying skin was evaluated to exclude necrosis and infection. The ideal trajectory for applying pressure was determined, with care taken to avoid gross compression of the pseudoaneurysm sac, femoral vein, and femoral artery. The ultrasound probe was then positioned directly over the pseudoaneurysm neck, and downward pressure was applied until flow into the pseudoaneurysm was observed to cease on

color-flow Doppler imaging. Compression was performed intermittently, with assessment of residual flow within the pseudoaneurysm, using (6–20) min intervals.

The pseudoaneurysm neck was not clearly identified by color-flow Doppler examination, and ultrasound-guided direct compression of the pseudoaneurysm sac itself was performed until cessation of flow in the pseudoaneurysm was achieved.

After confirming absence of flow within the pseudoaneurysm, the procedure was concluded and sterile dressing was applied. The patient was transferred to the floor/recovery room following the procedure in a stable condition. Staff was present for the entire procedure.

Note: Pressure is held in cycles of 10–20 min, and the pseudoaneurysm is then reassessed. If flow persists, compression is held for another cycle, typically stopping after 1 or 2 attempts. Patients are then put on bed rest for 6 h, and duplex ultrasonography is performed 24–48 h later to confirm persistent thrombosis.

Intra-Procedure Findings: List all relevant findings.

Immediate Complications: None encountered during or directly after the procedure. List complications if any.

Post-Procedure Plan [1]:

- Keep patient in complete bed rest with the right/left leg extended for () hours [recommended 2–12 h after thrombin injection, >6 h after ultrasound-guided compression].
- Check the procedure site and lower extremity pulses every 15 min for 1 h, then every 30 min for 4 h; inform interventional radiology team if any complications are observed.
- Follow up Doppler ultrasound examination within 24 h of the procedure, at 3–10 days and then at 3 weeks–6 months.
- If contralateral side is catheterized for balloon-assisted occlusion; please follow post-procedural instructions in Chap. 75

Impression:

- Percutaneous obliteration of left/right common femoral artery pseudoaneurysm by direct ultrasound-guided compression/thrombin injection.
- The patient tolerated the procedure well and left the interventional unit in a stable condition.
- The patient was unable to tolerate the procedure which was canceled/terminated prematurely.
- List any other relevant or important information/finding.

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