CLINICAL STUDY

Outcomes of Ultrasound–Guided Thrombin Injection of Nongroin Arterial Pseudoaneurysms

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ABSTRACT

Purpose: To evaluate success and complication rates of percutaneous ultrasound-guided thrombin injection of nongroin pseudoaneurysms (PSAs).

Materials and Methods: Retrospective review of a prospectively maintained institutional database yielded 39 cases of arterial PSAs occurring at nongroin sites that were treated with percutaneous ultrasound-guided thrombin injection between 2000 and 2016 (average patient age 69.2 y ± 14.0). Of PSAs, 74.4% (29/39) arose in the upper extremities, and 92.3% (36/39) were iatrogenic. The brachial artery was the most commonly affected vessel (51.3% [20/39]), and arterial access was the most common cause (56.4% [22/39]). Average overall PSA size was 2.4 cm (range, 0.5–7.2 cm); average amount of thrombin injected was 320 IU (range, 50–2,000 IU). Technical success was defined as absence of flow within the PSA immediately after thrombin injection. Treatment success was defined as sustained thrombosis on follow-up imaging obtained at 1–3 days after treatment.

Results: Technical and treatment success rates of thrombin injections were 100% (39/39) and 84.8% (28/33), respectively. Longer term follow-up imaging (average 71 d; range, 12–201 d) was available for 7 of the treatment successes with 100% (7/7) showing sustained thrombosis. Comparing treatment successes and failures, there was no significant difference in average PSA size (2.3 cm vs 2.0 cm, $P = .51$) or average amount of thrombin injected (360 IU vs 180 IU, $P = .14$). There were no complications.

Conclusions: Ultrasound-guided thrombin injection is a safe, efficacious treatment option for PSAs arising in nongroin locations.

ABBREVIATIONS

CI = confidence interval, PSA = pseudoaneurysm

Pseudoaneurysms (PSAs) are one of the most common complications of arterial catheterization (1). Until the 1980s, the only method to repair these vascular defects was surgical intervention (1,2). However, a number of less invasive alternatives to surgery have been employed since then, including ultrasound (US)-guided compression and thrombin injection (3,4). Percutaneous thrombin injection for treatment of PSAs was first reported in 1986 and was subsequently modified to employ US guidance for increased accuracy and efficacy (3,5). Since then, the efficacy and safety of percutaneous US-guided thrombin injection of PSAs involving arteries in the groin—the common femoral artery and the proximal portions of the superficial femoral and deep femoral arteries—have been well established (1). However, efficacy and safety of thrombin injection of PSAs at sites outside of the groin have been limited to a few case reports and small case series (6–10). The goal of this study was to report the success and complication rates of thrombin injection of PSAs at nongroin sites.

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MATERIALS AND METHODS

This retrospective study was approved by the institutional review board, and the requirement for informed consent was waived. The research was performed in compliance with the Health Insurance Portability and Accountability Act.

Patients and Data

A prospectively maintained institutional database of image-guided procedures was retrospectively reviewed for cases of arterial PSAs occurring in nongroin locations treated with percutaneous US-guided thrombin injection between January 2000 and October 2016. There were 39 cases identified for this series, which comprised 29 female and 10 male patients (mean age 69.2 y ± 14.0). Nongroin cases were defined as PSAs arising from any artery other than the distal external iliac artery, common femoral artery, or proximal portions of the superficial femoral artery and profunda femoral artery. For these 39 cases, the following patient data were collected: anticoagulant or antiplatelet use, origin vessel of the PSA, greatest dimension of the PSA, PSA neck diameter, amount of thrombin injected, and known or suspected cause of the PSA.

Of patients, 20.5% (8 of 39) were receiving no form of antiplatelet or anticoagulation therapy, whereas 79.5% (31 of 39) were taking at least 1 such medication, including aspirin (38.5% [15 of 39]), warfarin (28.2% [11 of 39]), clopidogrel (23.1% [9 of 39]), heparin (15.4% [6 of 39]), or apixaban (2.6% [1 of 39]). Of patients taking heparin, 83.3% (5 of 6) were taking therapeutic doses, with 66.7% (4 of 6) receiving unfractionated heparin and 16.7% (1 of 6) receiving a low-molecular-weight heparin. A single patient (16.7% [1 of 6]) was taking a prophylactic dose of unfractionated heparin.

Characteristics of PSAs

Tables 1 and 2 summarize the origin vessels and etiologies, respectively, of the nongroin PSAs. The average overall size of PSAs was 2.4 cm ± 1.4 (range, 0.5–7.2 cm). The average overall PSA neck diameter was 2.1 mm ± 0.8 (range, 1–3 mm). The average overall amount of thrombin used to treat the PSAs was 320 IU ± 400 (range, 50–2,000 IU).

Table 1. Origin Vessels of Nongroin PSAs (N = 39)

Origin Artery of PSA	Number (%)
Upper extremity	29 (74.4)
Brachial	20 (51.3)
Radial	8 (20.5)
Ulnar	1 (2.6)
Lower extremity	1 (2.6)
Superficial calf	1 (2.6)
Other	9 (23.1)
Subclavian	2 (5.1)
Lower abdominal wall	2 (5.1)
Superficial axilla	1 (2.6)
Superior epigastric	1 (2.6)
Intercostal	1 (2.6)
Temporal	1 (2.6)
Anterior chest wall	1 (2.6)

PSA = pseudoaneurysm.

Table 2. Etiologies of Nongroin PSAs (N = 39)

Etiology	Number (%)	Affected Arteries (n)
Iatrogenic	36 (92.3)	
Arterial access	22 (56.4)	
Arterial line placement	10 (25.6)	Brachial (6), radial (3), subclavian (1)
Coronary angiography	5 (12.8)	Radial (3), brachial (2)
Arterial stent placement	3 (7.7)	Brachial (3)
Pacemaker placement	1 (2.6)	Subclavian (1)
Aortogram	1 (2.6)	Brachial (1)
Thromboembolectomy	1 (2.6)	Brachial (1)
Arterial laboratory draw	1 (2.6)	Radial (1)
Procedural	14 (35.9)	
PICC placement	6 (15.4)	Brachial (6)
Paracentesis	2 (5.1)	Lower abdominal wall (2)
Dialysis access	2 (5.1)	Brachial (1), radial (1)
Thoracentesis	1 (2.6)	Intercostal (1)
Mastectomy	1 (2.6)	Superficial axilla (1)
Breast biopsy	1 (2.6)	Anterior chest wall (1)
Liver biopsy	1 (2.6)	Superior epigastric (1)
Traumatic	3 (7.7)	Temporal (1), ulnar (1), superficial calf (1)

PICC = peripherally inserted central catheter; PSA = pseudoaneurysm.

Injection Technique and Follow-up

Once a PSA was identified, a board-certified radiologist assessed its appropriateness for thrombin injection. Baseline arterial duplex US imaging, including Doppler waveforms, was obtained of the PSA as well as the origin artery proximal and distal to the site of the PSA. Distal extremity arterial pulses were evaluated with palpation and/or US where applicable.

A board-certified radiologist performed all thrombin injections. The injections in this series were performed by 20 different radiologists. Using sterile technique and local anesthesia with 1% lidocaine, a small-gauge needle (typically 20–25 gauge) was percutaneously placed and advanced under US guidance until the tip of the needle was visualized within the PSA sac. Subsequently, recombinant topical thrombin (The Medicines Company, Parsippany, New Jersey) at a concentration of 1,000 IU/1 mL was incrementally injected in small aliquots of 100 IU into the PSA under gray-scale and intermittent Doppler imaging until the PSA appeared thrombosed as determined by elimination of Doppler signal in the PSA sac. After