Ultrasound-Guided Thrombin Injection Is the Treatment of Choice for Femoral Pseudoaneurysms

Steven G. Friedman, MD; John S. Pellerito, MD; Larry Scher, MD; Glenn Faust, MD; Brian Burke, MD; Toufic Safa, MD

Hypothesis: Ultrasound-guided injection of thrombin is the treatment of choice for femoral pseudoaneurysms.

Design: A prospective study of patients undergoing a single form of treatment for femoral pseudoaneurysms.

Setting: Patients were treated at 2 tertiary care, university-affiliated hospitals.

Patients: Forty consecutive patients with femoral pseudoaneurysms resulting from diagnostic and therapeutic catheterizations for peripheral arterial, coronary arterial, and cerebrovascular diseases were evaluated.

Intervention: Thrombin was injected directly into the pseudoaneurysms under ultrasonographic guidance.

Main Outcome Measure: Thrombosis of the pseudoaneurysm following thrombin injection was the goal of treatment.

Results: All 40 patients had initial complete thrombosis of their femoral pseudoaneurysms. In each case, except for one, the aneurysm was noted to have thrombosed on follow-up duplex ultrasonogram. There was one complication.

Conclusion: Ultrasound-guided thrombin injection is the treatment of choice for femoral pseudoaneurysms.

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In 1986, Cope and Zeit1 described a new technique for “clotting aneurysms” by direct injection of diluted thrombin. They conceived the idea based on the use of coils, cyanoacrylate glue, and balloons in other aneurysms, and the mixed results with compression of femoral false aneurysms.

Their first patient was an obese 85-year-old man with a large pseudoaneurysm of the right common iliac artery. He was successfully treated by percutaneous thrombin injection in 1981. During the next 4 years, Cope and Zeit successfully treated a ruptured femoral pseudoaneurysm in a 62-year-old man with Buerger disease, a peroneal pseudoaneurysm in an 18-year-old man after a calf laceration, and a false aneurysm of an accessory hepatic artery in an 85-year-old woman.

In 1987, Walker et al2 reported the successful treatment of a large deep femoral artery pseudoaneurysm in a 33-year-old man with the use of a thrombin injection. Despite the excellent results achieved by Cope and Zeit and Walker et al, this technique was not embraced. The next report of thrombin injection of pseudoaneurysms did not appear for a decade.

Since the report by Cope and Zeit, 18 additional studies have been published in the literature, numbering more than 400 patients. We report our experience with 40 patients and offer a review of the world literature.

RESULTS

All 40 patients had initial complete thrombosis of their femoral pseudoaneurysms. In each case, except for one, the aneurysm was noted to have thrombosed on a follow-up duplex ultrasonogram.

One complication resulted in a 72-year-old woman who had a small aneurysm. There was suboptimal visualization of the aneurysm and 1 mL of thrombin was injected. The aneurysm thrombosed, but 2 hours after the procedure, the patient reported foot pain. An angiogram revealed a linear density in the superficial femoral artery. Attempts at lysis with tissue plasminogen activator were unsuccessful and the patient received intravenous heparin. The symptoms resolved within 1 day and an aneurysmal thrombosis was confirmed within 24 hours. A second duplex ultrasonogram 1 week later revealed recurrence of the aneurysm, with-
PATIENTS AND METHODS

From August 1, 1998, to January 31, 2001, 40 patients were treated for femoral pseudoaneurysms using thrombin injections as the initial therapy. No patients received initial compression therapy during this time. There were 21 men and 19 women ranging in age from 19 to 89 years. The pseudoaneurysms resulted from diagnostic and therapeutic catheterizations for peripheral arterial, coronary arterial, and cerebrovascular diseases.

Patients were examined using an ultrasound system (ATL-UM 9 HDI, ATL-HDI 5000; Philips Medical Systems, Seattle, Wash; or a GE-Logiq 700; GE Medical Systems, Waukesha, Wis). A 5-MHz linear array transducer, or a 5–2-MHz curved array transducer was used for scanning and guiding the administration of the thrombin injection. Informed consent was obtained in all cases. The patient’s skin was swabbed with povidone-iodine (Betadine) and covered with a sterile drape. The transducer was covered with a sterile sleeve. A 22-gauge spinal needle was placed in a biopsy guide and advanced into the false aneurysm under direct ultrasound visualization. A radiologist (J.S.P. and B.B.) performed the initial examination for diagnosis. The pseudoaneurysm was identified and characterized with color-flow imaging. Pulsed Doppler ultrasonography was performed to demonstrate flow direction in the neck of the pseudoaneurysm. The color Doppler ultrasonograph was turned off during placement of the needle into the false aneurysm to improve visualization of the needle tip. Color Doppler ultrasonography was used to assess thrombosis during the administration of the thrombin injection.

The injection was performed by a vascular surgeon (S.G.F., L.S., G.F., or T.S.). Once the needle tip was seen within the false aneurysm, a 1-mL syringe was used to inject one half to 1 mL of a 1000-U/mL solution of bovine thrombin in all cases. Most patients required only 0.5 mL of thrombin to accomplish pseudoaneurysmal thrombosis. One patient required a second injection.

The needle tip was placed away from the pseudoaneurysm’s neck to avoid injection into the femoral artery. Color Doppler ultrasonography was performed after the injection to assess the degree of thrombosis and to check the patency of the femoral artery and vein. Distal pulses were also checked after the treatment was administered. No patients required local anesthesia or conscious sedation.

After successful aneurysmal thrombosis, all patients were kept at bed rest for several hours. A follow-up duplex scan was obtained the next day to assess for the recurrence of pseudoaneurysm.

Injection of thrombin was well tolerated by all patients. Procedure times ranged from 1 to 5 minutes.

## World Literature Review

<table>
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<th>Source, y</th>
<th>Total No. of Cases</th>
<th>Initial Successes, %</th>
<th>Total Successes, %</th>
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In the last year, triple the number of reports of thrombin injection of pseudoaneurysms were published than were printed during the preceding 15 years. The sudden popularity of this technique during the past year is because of the realization that thrombin injection of femoral false aneurysms is a safe, quick, and reliable treatment.

Of the 418 cases listed in the Table, thrombin injection was successful in 410 (a 99% success rate). In most cases, aneurysmal thrombosis occurred within seconds of the patient’s receiving the initial thrombin injection. Few patients required more than 15 minutes to complete the treatment.

The complication rate with this technique was strikingly low. No cases of limb-threatening ischemia were reported following thrombin injection of false aneurysms. Morrison et al3 reported 3 cases in which loss of a peripheral pulse was noted following thrombin injection. This was also associated with a significant drop in the ankle brachial index. None of these patients had symptoms of ischemia, and in each case, the ankle brachial index returned to normal within 1 day, without further intervention. Morrison et al theorized that the volume of thrombin injected, relative to the volume of the false aneurysm, was a critical factor that determined the potential for spillage into the arterial system. A large volume injected into a small cavity could precipitate this complication. The authors could not, however, identify common risk factors in their patients. This was also the likely cause of the single case of transient limb ischemia in our current case series.

Sheldon et al14 reported a case of generalized urticarial reaction that occurred 3 hours after thrombin injection in a 49-year-old woman. She was successfully treated with antihistamines. Morrison et al15 reported a case of a generalized urticarial reaction that occurred 3 hours after thrombin injection in a 49-year-old woman. She was successfully treated with antihistamines.


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treated with diphenhydramine hydrochloride and discharged from the hospital the next day.

Pope and Johnston\textsuperscript{10} reported a case of anaphylaxis after thrombin injection in a 50-year-old man. Within 2 minutes of receiving the thrombin injection, their patient developed itching, hypotension, and shortness of breath. The patient required intubation, the administration of epinephrine and corticosteroids, and fluid resuscitation. He was discharged from the hospital 2 days later. A subsequent thrombin skin prick test was positive. Pope and Johnston concluded that patients with a history of prior exposure to topical thrombin should undergo skin prick testing with a concentration of 1000 U/mL of thrombin prior to intravascular injection.

Kang et al\textsuperscript{16} have reported the efficacy of this technique for the treatment of false aneurysms in other locations. In addition to 74 femoral aneurysms, they also treated 5 brachial, 1 radial, 1 superficial femoral, and 1 posterior tibial false aneurysms with thrombin injection. In their entire case series, there was only 1 failure and 1 complication. One patient had a brachial artery thrombosis that resolved spontaneously. Twenty-nine of the false aneurysms in this case series were injected while the patient was receiving anticoagulant therapy, with excellent results. Lennox et al\textsuperscript{10}\textsuperscript{2} had success in all 18 of their patients undergoing thrombin injection while receiving anticoagulant therapy. Anticoagulation is not a contraindication to this technique.

Elford et al\textsuperscript{20} have described successful application of this technique for an axillary false aneurysm, and 3 of the original cases treated by Cope and Zeit\textsuperscript{1} were for pseudoaneurysms remote from the femoral artery. The use of thrombin injection has also been described for the treatment of hepatic pseudoaneurysms\textsuperscript{21,22} and intracerebral hemorrhage.\textsuperscript{23}

Ultrasound-guided thrombin injection of femoral pseudoaneurysms is safe, quick, painless, and effective. It is superior to compression therapy (less painful with a higher success rate) and surgery. Ultrasound-guided thrombin injection should be the initial treatment of femoral pseudoaneurysms. Additional studies are needed before it can be recommended as the treatment of choice for pseudoaneurysms in other anatomical locations.

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REFERENCES


