

Percutaneous Thrombin Injection for Closure of Femoral Pseudoaneurysms: Preliminary Experience

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An arterial pseudoaneurysm is an uncommon complication of cardiovascular procedures associated with considerable morbidity and increased hospital costs. Percutaneous thrombin injection is one approach to therapy. We describe our initial experience with this technique in 3 patients, with special attention to the utility of sonographic guidance. In all cases complete closure was achieved, although one patient required additional brief extrinsic compression with the ultrasound probe.

Key words: *Catheterization. Pseudoaneurysm. Thrombin.*

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Inyección percutánea de trombina para el cierre de pseudoaneurismas femorales: experiencia preliminar

El pseudoaneurisma arterial es una complicación poco frecuente de los procedimientos cardiovasculares que conlleva una importante morbilidad e incremento en los costes de hospitalización. Una alternativa terapéutica es la administración percutánea de trombina. Describimos nuestra experiencia preliminar con esta técnica en 3 pacientes, con especial enfoque sobre la utilidad del control ecográfico. Se logró el cierre completo en los 3 casos, aunque en uno de ellos el procedimiento se completó con un breve período de compresión extrínseca con la sonda de ultrasonidos.

Palabras-clave: *Cateterismo cardíaco. Pseudoaneurisma. Trombina.*

INTRODUCTION

The most widespread non-surgical treatment for arterial pseudoaneurysms (AP) is external compression, which under ideal conditions is performed with ultrasound guidance.¹ Compression has some limitations, among them the length of the procedure and the intense pain associated with it that in many cases is difficult to control and may cause intense vasovagal crises with a certain amount of frequency, forcing the procedure to be halted. Also, in the presence of concurrent anticoagulation measures, the success rate may be lower and compression more prolonged.² On the other hand, surgical repair significantly increases the length of

hospital stay and costs, and subjects these patients (who frequently have serious underlying heart disease) to the risks of anesthesia as well as those of the intervention itself.

In this context, the direct injection of thrombin in AP has been described as an efficient, well-tolerated, quick, and non-aggressive alternative, and therefore of great interest to cardiology practice.³ In this study, we describe our initial experience with this technique, with special emphasis on certain methodological aspects, such as ultrasound guidance, a measure designed to minimize complications and increase efficacy.

Case 1

A 72-year-old woman, with the diagnosis of a femoral PA on Doppler ultrasound 2 days after diagnostic catheterization performed due to severe pulmonary hypertension. The maximum diameter was 3–5 cm. Closure by external pressure with a C-clamp with the patient under sedation was unsuccessful. Due to the patient's elevated surgical risk, we decided to adminis-

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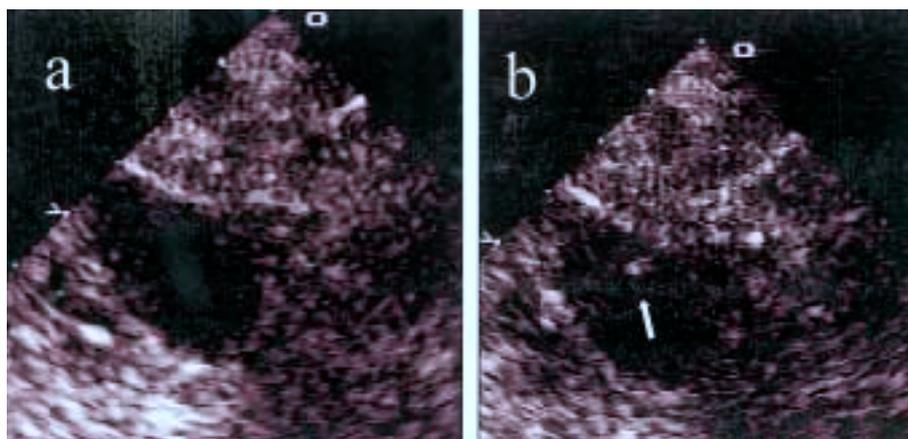


Fig. 1. A: Ultrasound images of the femoral pseudoaneurysm in case 2. B: The location of the puncture needle (arrow) in the cavity of the pseudoaneurysm.

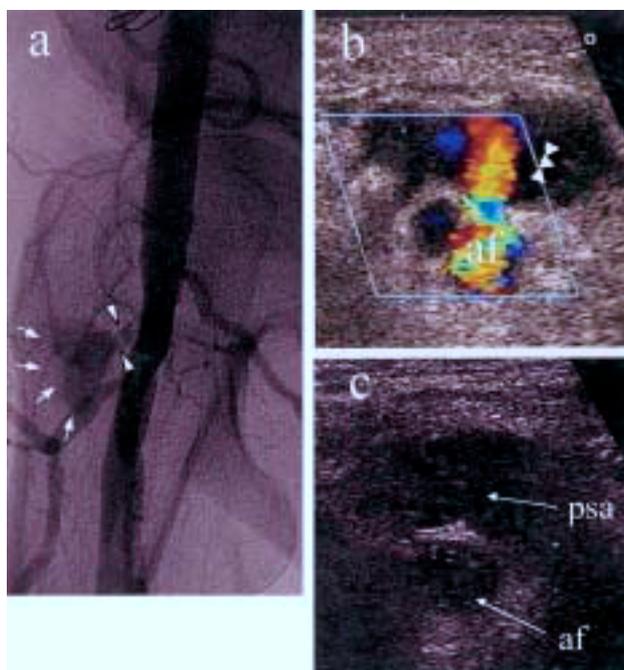


Fig. 2. Selective angiography of the common right femoral artery of the patient described in case 3, showing a femoral pseudoaneurysm (A, arrows). B: Ultrasound images showing that the cavity is partially thrombosed (arrows). C: Intrasacral administration of saline serum. The passage of some of the bubbles through the arterial lumen. FA indicates femoral artery; PS, pseudoaneurysm.

ter percutaneous thrombin with ultrasound guidance.

The procedure was performed in the hemodynamic laboratory. While maintaining visualization of the aneurysm cavity and the femoral artery via ultrasound, and after careful palpation of the area, an intramuscular needle (22 G) connected to a 5-mL syringe of saline serum was inserted. In an attempt to avoid intra-arterial injection, the entry of the needle into the aneurysm sack was documented and its location was checked by fluoroscopy with the injection of diluted contrast medium. Once the distal end of the needle

was situated in the PA, diluted thrombin (1 mL=500 U) was slowly administered. The thrombin was obtained by commercial means, as was the femoral closure device (from DUET, Vascular Solutions Inc., Minneapolis, MN, United States). After a 1-minute infusion, thrombosis of the PA was observed, and closure was verified by Doppler color ultrasound. Twenty-four hours later, the success of the procedure was verified by echocardiography.

Case 2

A 72-year-old woman diagnosed with severe aortic stenosis came to our unit 5 days after catheterization with severe pain in her right groin. Physical examination was consistent with a right PA, and this diagnosis was confirmed by Doppler ultrasound. The PA measured 3.0 cm at its greatest diameter.

The thrombin solution was obtained from the same source as in case 1. Different from the preceding case, we decided not to use fluoroscopic monitoring, but only used ultrasound guidance. A 22-G intramuscular needle was used, connected to a 10-cm extension with a 3-way key at the other end. This allowed interchange of the syringes with minimum movement of the needle. Two 5-ml syringes were connected to the key: 1 with 0.9% saline serum and the other empty. After percutaneous puncture guided by ultrasound images and palpation, saline serum was administered as ultrasound contrast. After confirming the intrasacral position of the needle (Figure 1), the saline solution was replaced by a thrombin solution (1 mL=500 U), which was administered slowly (approximately 2 ml/minute). After injection of 2500 U of thrombin, thrombosis of the PA was achieved. The success of the procedure was confirmed at 24 hours by a new echocardiograph. After 24 hours anticoagulation was re-started, initially with low molecular weight heparin.

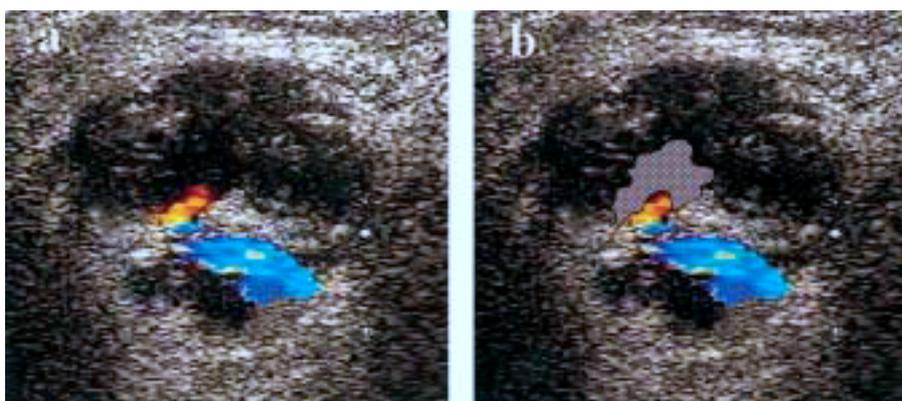


Fig. 3. A: Ultrasound of patient 3 after the administration of 3500 U of thrombin into the pseudoaneurysm sack. B: residual cavity is spotted grey. The rest of the cavity has an aspect compatible with a thrombus.

Case 3

A 70-year-old male with a left femoral PA diagnosed 5 days after diagnostic coronary angiography. Ultrasound revealed a maximum PA diameter of 2.5 cm and the cavity was partially thrombosed (Figure 2). A percutaneous closure with thrombin was scheduled. The thrombin was obtained from the same source as in the 2 previous cases. Preparation of the material used was the same as in case 2, and saline serum was also used as ultrasound contrast to confirm the position of the needle. Upon injecting the saline, it was clearly seen that there was a small passage of bubbles to the arterial lumen (Figure 2C). Given the risk of arterial thrombosis, we decided on a slower and more diluted thrombin injection as compared to the previous cases (1 mL=250 U, at a rate of approximately 2 ml/minute). Ultrasound guidance showed a substantial increase in the thrombotic mass inside the PA at the distal end of the needle. Nevertheless, after administering 3500 U of thrombin there was a small area that remained unthrombosed, communicating with the arterial lumen as shown by Doppler color ultrasound (Figure 3). This communication had a slight relationship to a discontinuity in the arterial wall caused by arterial puncture. We thought the risk of intra-arterial injection of thrombin would be substantial if the distal end of the needle were turned toward this area, and therefore decided to complete the procedure with extrinsic compression. The material was removed and direct pressure with ultrasound probe was initiated, achieving complete closure of the PA in 7 minutes. The success of the procedure was checked after 24 hours by Doppler ultrasound.

DISCUSSION

Direct percutaneous injection of thrombin for closure of PA was used for the first time in 1986.⁴ From that time on, different groups of investigators, primarily in the vascular radiology field, have reported favorable results, with a low complication rate.^{3,5,6}

The method is relatively easy and does not require sedation or intravenous analgesia, and has a low incidence of recurrence. The principal inconvenience of this method is the risk of intra-arterial injection, with the consequent vascular thrombosis. The incidence of this complication is low or null in the majority of the series. Nevertheless, Cope et al⁴ reported distal arterial occlusion in 2 of their 4 cases. This data has resulted in the development of various methods that minimize the risk of intra-arterial injection. The inflation of an angioplasty balloon, introduced through the contralateral artery, into the femoral artery during the injection may impede the passage of the drug into arterial circulation,⁷ requires puncture of another artery, prolongs the procedure, and increases the cost. Simultaneous compression of the neck of the PA with an ultrasound probe is another option that in theory protects the distal circulation, but it is technically complex, given the difficulty of closing only the neck without at the same time obliterating the PA cavity or distorting the anatomy in such a way that the injection of thrombin into the cavity is impeded.

On the other hand, the use of guided ultrasound for the procedure has great advantages, as it defines the anatomy and the amount of communication between the PA and the arterial lumen. This information allows not only guidance of the puncture, but also permits graduating the speed and quantity of the injection material. In the case of partial thrombosis, it allows the relocation of the needle and, ultimately, can guide the final compression if it is estimated that, as in case 3 of our series, additional thrombin injections represent a substantial risk of femoral thrombosis. To this end, we used saline serum injections in the PA sack, which allowed simple and repeatable characterization of the amount of communication with the arterial lumen. Although the low number of patients in our series did not allow us to reach definitive conclusions regarding their contribution to the safety of the procedure, the large amount of information gathered makes it highly probable that this is indeed the case. On the other hand, the technique can be applied generally as it is within the reach of most cardiac or vascular ultrasound laboratories.

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