Closure of femoral artery pseudoaneurysm with human thrombin by ultrasound-guided puncture: A clinical case report

Cierre de pseudoaneurisma de arteria femoral con trombina humana por punción ecoguiada: Reporte de un caso clínico

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ABSTRACT
Pseudoaneurysms are iatrogenic complications of vascular and cardiac diagnostic and treatment procedures. They consist of the formation of a pulsating sac filled with blood, resulting from the rupture of the three layers of an artery, being contained by a fibrous cap or surrounding tissues, the incidence varies between 0.5% and 8% in the simplest procedures, and can reach between 16% and 24% in the most complex cardiovascular procedures. For many years, open surgery was the method of choice, however currently with the advancement of minimally invasive treatments, these have become the most used method.
***Keywords**: pseudoaneurysm, minimally invasive surgery, femoral artery.*

RESUMEN
Los pseudoaneurismas iatrogénicos son complicaciones de los procedimientos diagnósticos y de tratamiento vasculares y cardiacos. Consisten en la formación de un saco pulsátil lleno de sangre, producto de la ruptura de las tres capas de una arteria, quedando contenido por un capuchón fibroso o los tejidos circundantes; la incidencia varía entre un 0,5% hasta 8% en los procedimientos más simples, pudiendo llegar entre 16% y 24% en los procedimientos más complejos cardiovasculares. Por muchos años la cirugía abierta fue el método de elección; sin embargo, actualmente con el avance de los tratamientos mínimamente invasivos, estos se han vuelto el método más utilizado.
***Palabras claves:** pseudoaneurisma, cirugía mínimamente invasiva, arteria femoral.*

INTRODUCTION

A pseudoaneurysm (PA) is usually a consequence of some invasive medical procedure. Pseudoaneurysms of the extremities are the most frequent; among them, iatrogenic femoral PAs stand out, with a general incidence of iatrogenic femoral PA reported between 0.05% and 8%, specifically 2%–8% following coronary angioplasty/stent placement and 0.2%–0.5% when only diagnostic angiography is performed[1]; the overall rate of iatrogenic PA can reach up to 16% or 24% depending on the anatomical region, the development, and the application of more complex vascular, hemodynamic, or diagnostic procedures[1-2]. The morbidity of this complication is related to the use of large caliber introducers, anticoagulation, and antiplatelet therapy. A PA may evolve into thrombosis and spontaneous resolution, infection, local compression of adjacent neurovascular structures up to compartment syndrome, and rupture with hemorrhage[3].

Until 1991, open surgery was considered the therapy of choice in the management of PAs; in 1986, the first case of ultrasound guided injection was reported by Cope and Zeit, with the aim of thrombosing the aneurysmal sac[4]. The morbidity of surgery can reach 25% with a mortality of up to 3%, due to patient comorbidities that may have been the original cause of the intervention, predisposing to hematoma formation, inadequate healing, and infection of the surgical wound. Thanks to advances in minimally invasive techniques, a significant decrease in the morbidity and mortality of this complication has been observed; among these, ultrasound guided punctures with human thrombin injection stands out.

Thrombin is an enzyme that mediates the conversion of fibrinogen to fibrin in the final stages of the coagulation cascade. It bypasses the effect of traditional anticoagulants and stimulates the formation of a fibrin clot at the site where it is injected. The procedure is simple, minimally invasive, does not require general or special anesthesia—only local—and requires no prior preparation nor interruption of the patient's usual medical treatment (including anticoagulants or antiplatelets)[5].

The technique itself consists of placing a fine needle (19 to 25 G) into the pseudoaneurysm, as close as possible to the neck at the inflow, guided by ultrasound, avoiding the native artery, and injecting human thrombin in a dose ranging from 20 to 100 IU, with an average between 150 and 300 IU, waiting for thrombus formation inside the lesion[4–6].

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Received: 19/09/2025 - Revised: 6/10/2025 - Accepted: 13/11/2025
Revisor: Carlos Arce Aranda MSP y BS
Editor: Eduardo González Miltos Universidad Nacional de Asunción; San Lorenzo, Paraguay

The success rate of the procedure has been reported between 90–100%, with recurrence being low at less than 6%. According to the meta analysis published by Tisi and Callam[7], the risk of thrombotic or embolic complications is very low and largely theoretical, since thrombin is rapidly neutralized by antithrombin, causing its effect to disappear within seconds. In fact, no such complications were reported in the group of patients treated with thrombin injections.

Experience with this technique in other vascular territories is still limited, given the predominance of femoral pseudoaneurysms as the most studied. However, it is already being applied in the temporal, subclavian, tibial, brachial, and radial arteries, opening new therapeutic options for increasingly used endovascular access routes.

CLINICAL CASE

Male patient, 67 years old, with a history of cardiac catheterization, after which he presented with ecchymosis, a pulsatile mass, and a telesystolic murmur in the left femoral region. With suspicion of femoral pseudoaneurysm, a Doppler ultrasound was performed, showing extraluminal flow of 4 × 6 cm and a neck less than 5 mm *(Figure 1)*, with the yin yang sign *(Figure 2)*, which confirmed the diagnosis. An angio CT was performed to plan treatment, choosing as the first option minimally invasive surgical management with ultrasound guided puncture and injection of human thrombin for closure of the pseudoaneurysm.

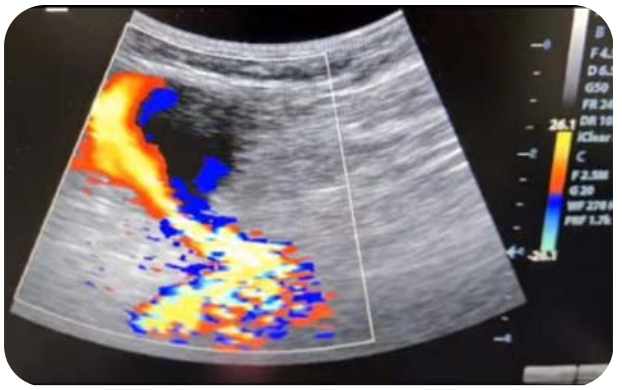

Figure 1. The blood sac formed by the pseudoaneurysm can be observed.

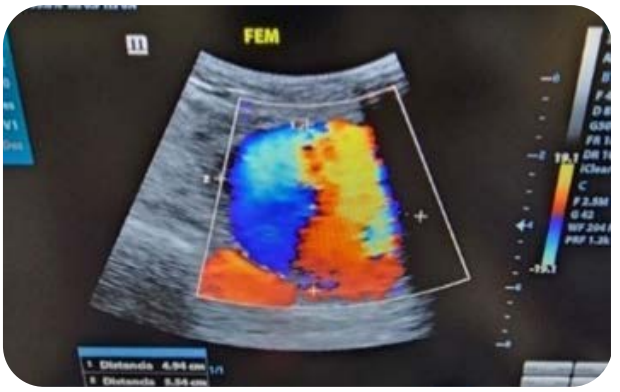

Figure 2. Yin-yang symbol.

The Doppler ultrasound performed on the patient showed the presence of flow inside the aneurysmal sac, turbulence within the pseudoaneurysm, and thrombosis in the wall of the pseudoaneurysm *(Figures 3 A, B and C)*.

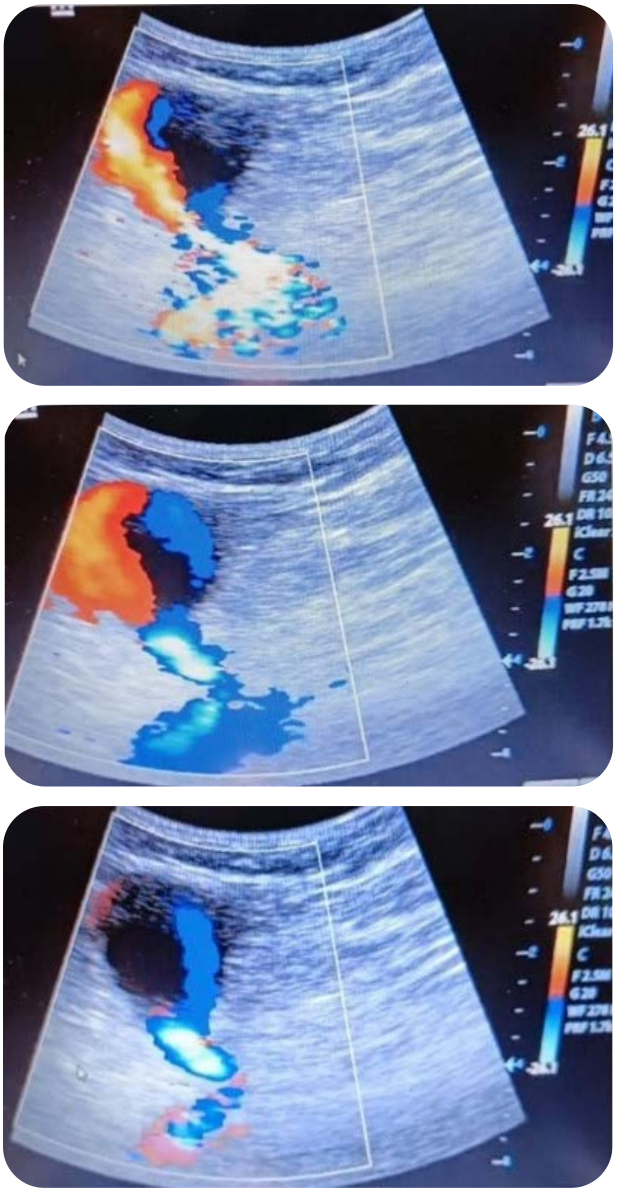

Figure 3. (A, B, C) Doppler ultrasound showing flow inside the aneurysmal sac, turbulence within the pseudoaneurysm and partial thrombosis in the wall.

An ultrasound guided puncture was performed for closure of the aneurysm with human thrombin; we can see the needle entering the artery *(Figure 4)* into the core of the thrombus already formed at the tip of the needle; complete closure of the aneurysm was achieved *(Figure 5)*, causing minimal discomfort and reducing to a minimum both the vital risk and the risk of a new hematoma.

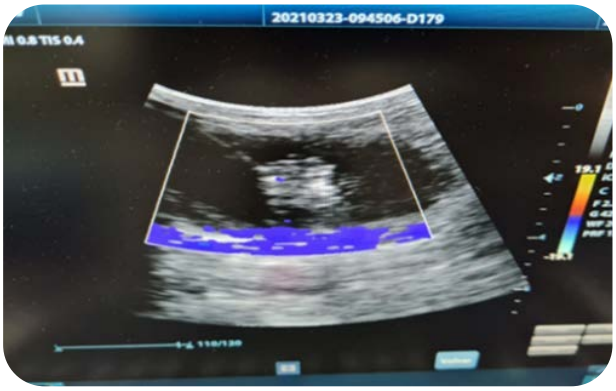

Figure 4. Ultrasound-guided puncture.

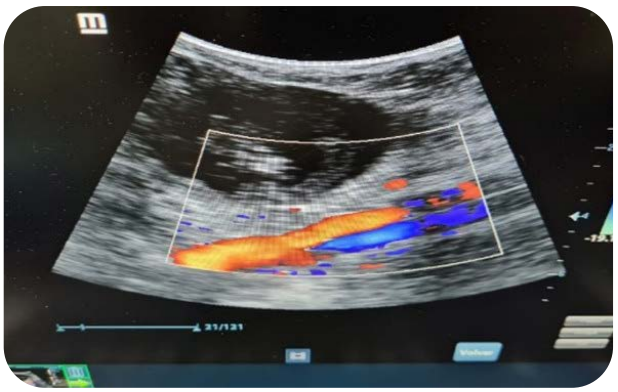

Figure 5. Pseudoaneurysm.

DISCUSSION

Recent studies report that the effectiveness of ultrasound guided puncture with human thrombin has demonstrated 100% efficacy[6]; with a single injection, 88.2% of patients were discharged on the first or second day, without pain or complications. Recurrence is minimal, reaching a maximum of 6%. As a minimally invasive treatment, it reduces not only surgical complications but also significantly lowers costs, since according to published studies, the total cost of thrombin puncture is around 500 USD compared to 980 USD for surgery[6]. The thrombin currently used is human, which can be autologous, eliminating the risk of rejection and other complications associated with the older thrombins derived from pig, horse, or external donors.

In conclusion, ultrasound guided puncture with human thrombin is an effective treatment for pseudoaneurysms, involving minimal invasion, minimal complications, less pain, and it can be performed on an outpatient basis; it has no contraindication due to anticoagulation, only minimal amounts of thrombin are injected, ideally autologous, thereby reducing complications and rejection. It should be noted that no risk of secondary embolism has been reported.

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