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Ultrasound-guided thrombin injection in the management of pseudoaneurysm after percutaneous arterial access

Tomasz Jargiełło¹, Jan Sobstyl¹, Łukasz Światłowski¹, Maryla Kuczyńska¹, Ewa Kuklik¹, Michał Sojka¹, Anna Drelich-Zbroja¹, Maciej Pech², Maciej Powerski²

¹ Department of Interventional Radiology and Neuroradiology, Medical University of Lublin, Lublin, Poland

² Department of Radiology and Nuclear Medicine, Otto von Guericke University, Magdeburg, Germany

Correspondence: Jan Sobstyl, MD, Department of Interventional Radiology and Neuroradiology, Medical University of Lublin, Jaczewskiego 8, 20-954 Lublin, Poland
tel.: +48 81 724 41 54, +48 663 728 258, fax: +48 81 724 48 00,
e-mail: jan.sobstyl@gmail.com

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Abstract

Aim: The purpose of this paper was to evaluate the efficacy of ultrasound-guided percutaneous thrombin injection as a treatment method for arterial access site pseudoaneurysm. **Materials and methods:** A total of 148 patients with iatrogenic arterial access site pseudoaneurysms were treated in the Department of Interventional Radiology and Neuroradiology, Medical University of Lublin. Of those, 142 pseudoaneurysms were located in the common femoral artery, 3 in the brachial artery and the remaining 3 in the radial artery. The study included 77 woman and 71 men (mean age 64.5 ± 14 years). Patients were qualified for percutaneous thrombin injection after Doppler examination during which pseudoaneurysm size and morphology were assessed as well as the presence of arteriovenous fistula was excluded. **Results:** In the reported study, 94.8% (128/135) of patients were successfully treated during the initial thrombin injection. Additional 400 IU dose of thrombin after 24 hours was effective in 5 out of 7 patients with recanalization during the follow-up. A total of 98.5% (133/135) of patients were successfully treated with a percutaneous ultrasound-guided thrombin injection. **Conclusions:** The 10-year experience presented in this study as well as literature reports prove that percutaneous ultrasound-guided thrombin injection is an effective and safe treatment method for iatrogenic arterial access site pseudoaneurysm.

Introduction

Minimally invasive percutaneous endovascular treatment, especially in the area of interventional cardiology and interventional radiology, is increasingly popular. The most common cardiac procedures are coronarography or coronaroplasty and stenting, while the most common peripheral interventions include balloon angioplasty and stenting procedures. Also, embolization is becoming increasingly popular. Endovascular treatment offers many advantages, such as shorter hospitalization time, reduced burden for

patients due to its minimally invasive nature and the use of local anesthesia in most cases. Nevertheless, these procedures also involve the risk of complications, with vascular access site complications being the most common ones⁽¹⁾.

Vascular access in the aforementioned interventions and diagnostic procedures is usually performed with femoral, axillary, brachial or radial punctures. Vascular puncture site complications are as follows (in descending order of frequency): puncture site hematoma, pseudoaneurysm (PA) and arteriovenous fistula. For hematomas, observa-

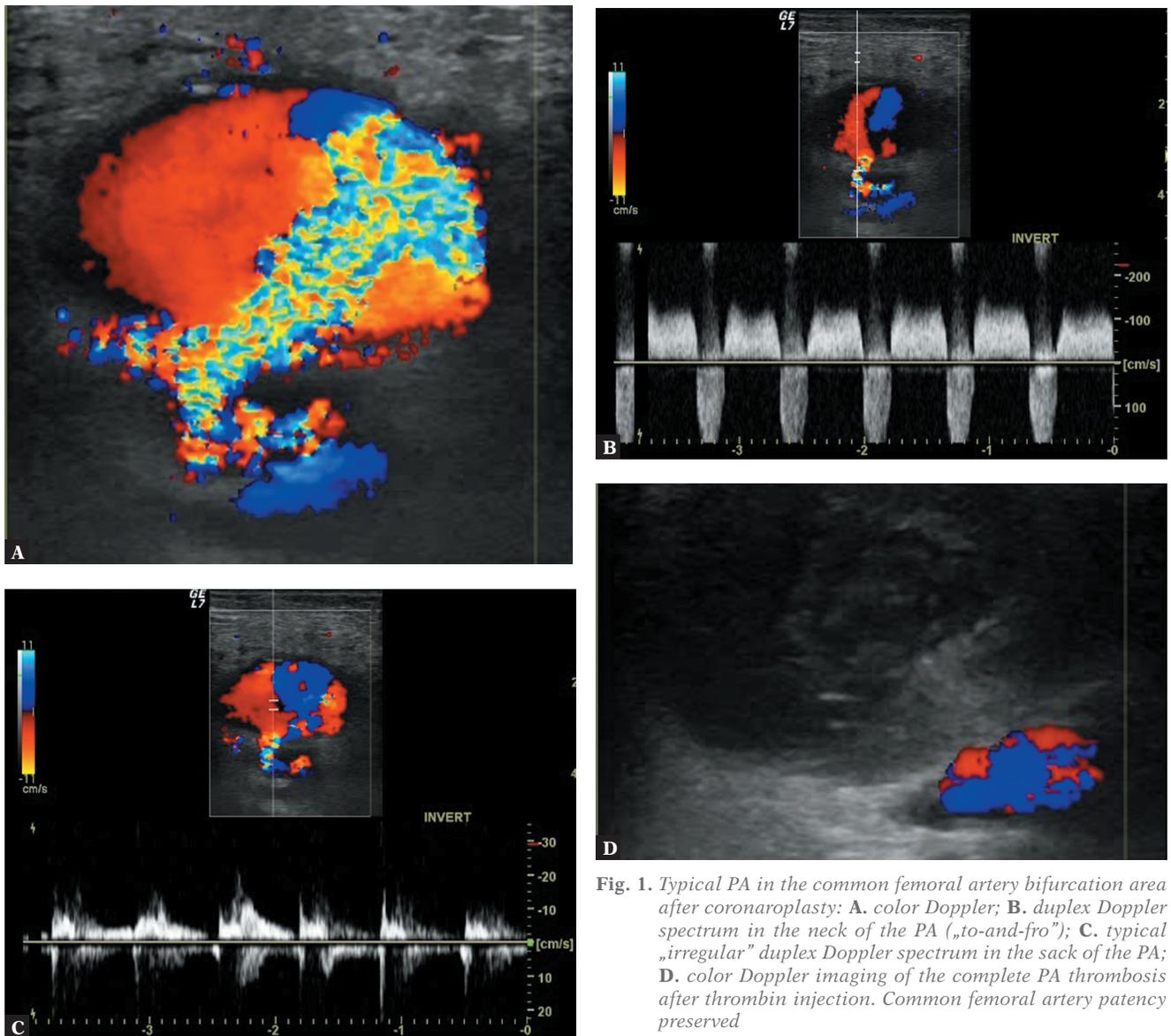


Fig. 1. Typical PA in the common femoral artery bifurcation area after coronaroplasty: **A.** color Doppler; **B.** duplex Doppler spectrum in the neck of the PA („to-and-fro”); **C.** typical „irregular” duplex Doppler spectrum in the sack of the PA; **D.** color Doppler imaging of the complete PA thrombosis after thrombin injection. Common femoral artery patency preserved

tion is usually recommended, while arteriovenous fistulas are normally treated with an open surgery. Many various PA treatment techniques are described in the literature, such as ultrasound-guided (US-guided) compression, percutaneous US-guided thrombin injection, percutaneous US-guided collagen injection, compression by injection of saline around the neck of the PA, percutaneous fluoroscopically guided n-butyl cyanoacrylate (NBCA) injection, PA neck occlusion with closure devices, coiling or surgical arterial suture⁽²⁻⁶⁾. Our paper presents the results of 10 years' experience with US-guided thrombin injection.

Aim of the study

The aim of this article was to evaluate the efficacy of the US-guided percutaneous thrombin injection as an arterial access site pseudoaneurysm (PA) treatment method.

Materials and methods

Written informed consent was obtained from patients participating in this study. Between April 2007 and March 2017, 148 patients with iatrogenic PAs at arterial access site were treated in the Department of Interventional Radiology and Neuroradiology, Medical University of Lublin. Of those, 142 PAs were located in the common femoral artery, 3 PAs in the brachial artery, and the remaining 3 were situated in the radial artery. A total of 77 woman and 71 men were included in the study (mean age 64.5 ± 14 years). The majority of patients (136, 92%) underwent previous coronarography and/or coronaroplasty, whereas only 12 (8%) patients had peripheral interventions – percutaneous transluminal angioplasty or embolization procedures (Fig. 1). Among cardiac patients, femoral artery PAs were reported in 130, brachial in 3 and radial artery PAs in 3 patients. All IR patients had femoral artery PAs.

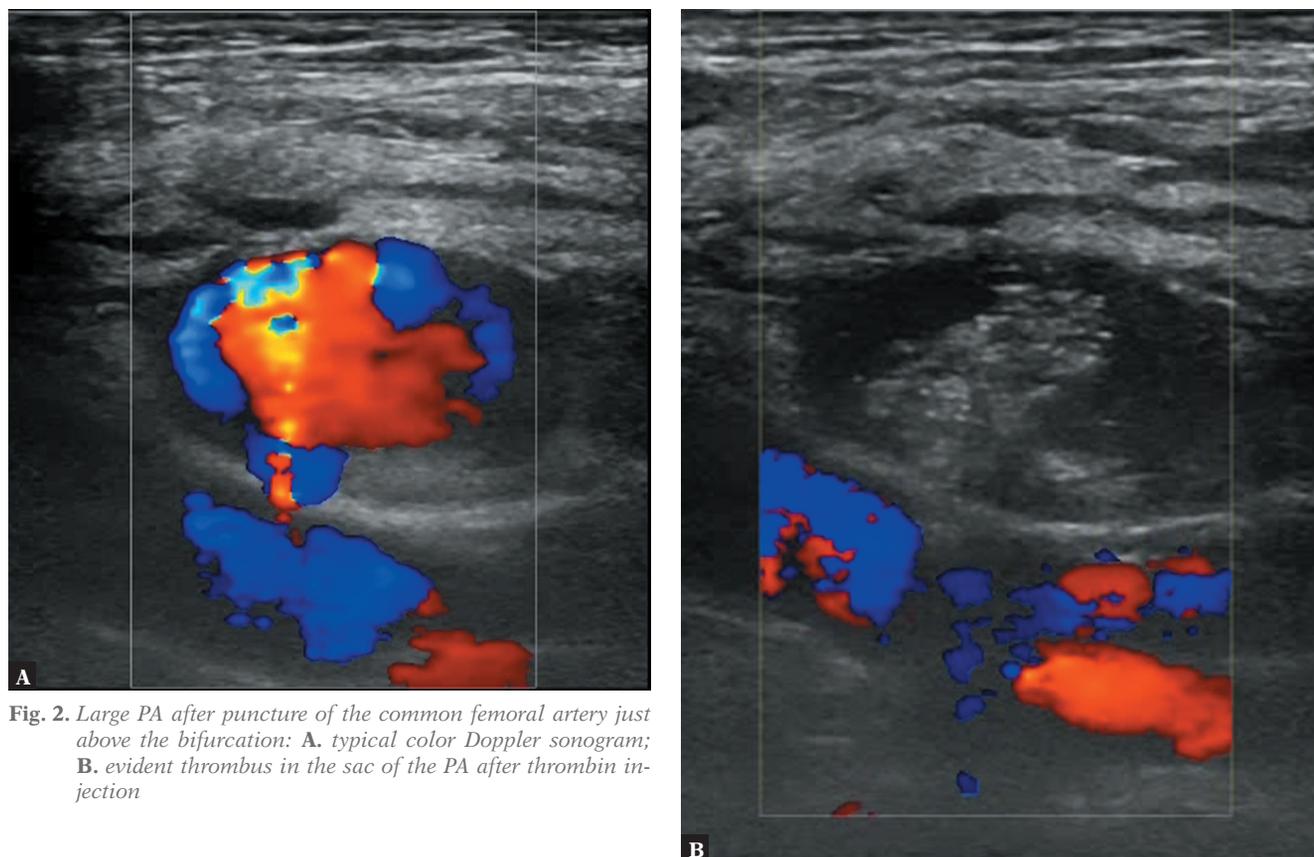


Fig. 2. Large PA after puncture of the common femoral artery just above the bifurcation: **A.** typical color Doppler sonogram; **B.** evident thrombus in the sac of the PA after thrombin injection

Patients were qualified for percutaneous thrombin injection after Doppler US examination during which PA size and morphology were assessed as well as the presence of arteriovenous fistula was excluded. GE Logiq 5 and GE Logiq 7 with 7–12 MHz linear transducers were ultrasound devices used in this study. Based on the largest diameter, all PAs were classified as small (<10 mm), medium (between 10 and 30 mm) and large (>30 mm). Morphologically, PAs were classified as single-cavity and multiple-cavity pseudoaneurysms. Patients were scheduled for the intervention immediately after or the next day after diagnostic Doppler US examination. Bovine thrombin (BioTrombina 400, Biomed Lublin) was used in all patients. One ampoule contains 400 IU of bovine thrombin in 2 mL of isotonic sodium chloride solution.

The skin above the PA location was disinfected and covered with sterile drape. Under US-guidance, thrombin was injected directly to the pseudoaneurysm sac using a 2 mL syringe with a 0.9 mm needle. The amount of thrombin used in one patient varied from 200 IU to 800 IU. In the case of PA with additional cavities, thrombin was injected to the cavity connected to PA neck. All patients were advised to remain in supine position for up to 12 hours after the procedure. A follow-up Doppler US was performed immediately after thrombin injection and 24 hours after the intervention. If total embolization of PA was observed in follow-up Doppler US after 24 hours, treatment was considered successful. However, if signs of recanalization were present, than the second stage of treatment was performed with another 400 IU dose of thrombin.

Results

Small PAs were diagnosed in 28 (including all 3 radial artery PAs), medium-size PAs in 97, and PAs classified as large in 23 patients (Fig. 2). There were 121 single-cavity PAs, and 26 PAs with additional cavities (Fig. 3). If the treatment was planned for the next day, patients were supported with compression bandage between the diagnostic examination and the day of intervention. On the day of intervention, spontaneous thrombosis of the PA was observed in 13 patients (all with femoral artery PAs). The amount of thrombin used to achieve PA thrombosis depended on aneurysm diameter. Half of 2 mL syringe content (200 IU of bovine thrombin) was injected into all small PAs. If the diameter of the PA was larger than 10 mm, the whole content of 2 mL syringe was injected (400 IU of bovine thrombin). Immediately after the injection, a follow-up Doppler US was performed. Eight patients received another 400 IU (800 IU in total) dose of thrombin due to the lack of effect after the first dose – the follow-up Doppler US in these patients after the second dose of thrombin injection and 24 hours after the procedure confirmed successful treatment. Signs of the recanalization were observed in 7 patients (7/135 – 5.2%) during the 24-hour follow-up. Partial recanalization was observed in 5 and total recanalization in 2 cases. Additional 400 IU dose of thrombin was injected in all these 7 patients, and a follow-up was performed after 24 hours. Five patients were treated successfully and 2 patients were qualified for open surgical treatment (2/135 – 1.5%) due to unsuccessful thrombin injection.

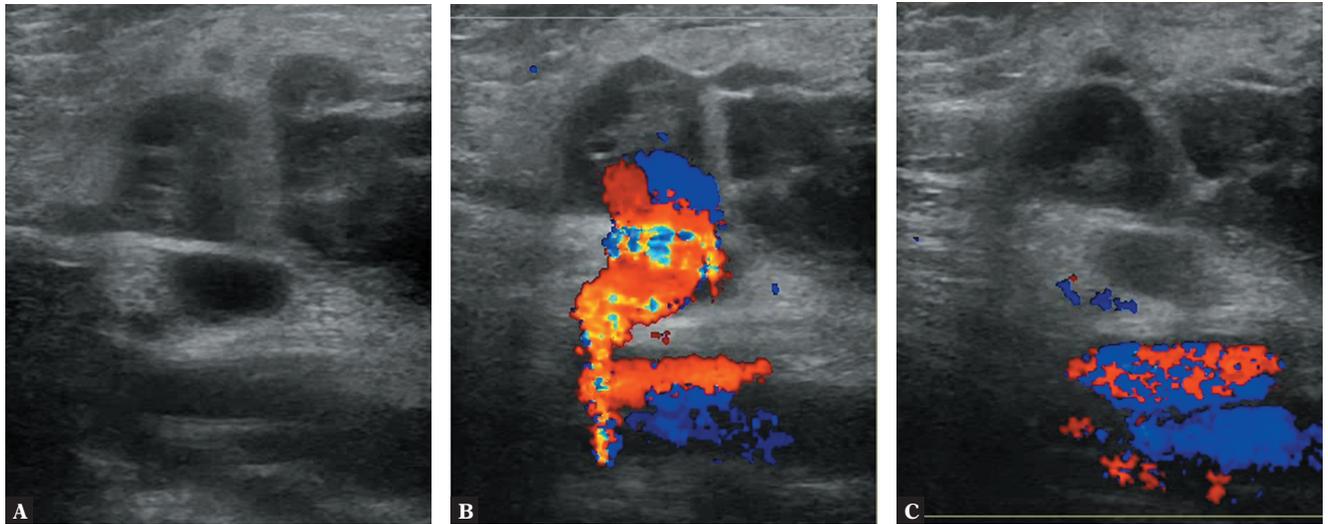


Fig. 3. Multi-cavity PA: **A.** in B-mode imaging; **B.** distal PA's cavities thrombosed in color Doppler imaging **C.** PA after thrombin injection with femoral artery and vein patency preserved

Discussion

For many years open surgery and US-guided compression were common treatment techniques in iatrogenic PAs before the advent of new methods⁽⁷⁾. After its introduction by Liao *et al.* in 1997, the use of thrombin in the management of arterial access site PAs became popular⁽⁸⁾. More comfortable and shorter procedure compared to former methods rendered US-guided percutaneous thrombin injection a beneficial treatment technique for this common complication^(9,10). More articles presenting promising results were published after that time. In 2000, Sackett *et al.* reported successful femoral artery PA embolization in 90% of patients in a 30-day follow-up⁽¹¹⁾. A year later, Calton *et al.* achieved 94% success rates for embolization with a mean duration of follow-up of 9 months⁽¹²⁾. Prospective studies conducted by Olsen *et al.* in 2002 and Schneider *et al.* in 2009 demonstrated 93.9% and 97% success rates, respectively^(13,14). In 2014, a group from USA reported 86% of successfully embolized brachial and radial artery PAs with a mean length of follow-up of 9 months⁽¹⁵⁾.

Our findings correspond to other studies presented in the literature. A total of 94.8% (128/135) of patients were successfully treated during the initial thrombin injection. Additional 400 IU dose of thrombin after 24 hours was effective in 5 out of 7 patients with recanalization during the follow-up. A total of 98.5% (133/135) of patients were successfully treated with a percutaneous US-guided thrombin injection. Although the risk of treatment complications has

been reported in the literature, no unexpected events have been observed in our study. Thrombosis of native or distal arteries and allergic reactions, including anaphylaxis or immune-mediated coagulopathies, can potentially complicate the procedure; however they are rare⁽¹⁶⁻¹⁹⁾. The latter can develop in patients re-exposed to bovine thrombin. The presence of bovine thrombin antibodies was not assessed in our study although it can be found in literature that 5.6% up to 20.7% of patients treated with bovine thrombin may present with IgM or IgG antibodies to bovine thrombin, which can cause a cross-reaction with their human counterparts and lead to severe hemorrhagic events^(20,21). It is also worth mentioning that thrombin used in this study is the only available one.

Conclusions

The 10 years' experience presented in this study as well as literature reports prove that percutaneous US-guided thrombin injection is an effective and safe treatment method for iatrogenic arterial access site PAs.

Conflict of interest

The authors do not report any financial or personal connections with other persons or organizations, which might negatively affect the contents of this publication and/or claim authorship rights to this publication.

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