Double Trouble: Pseudoaneurysm on Pseudoaneurysm

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INTRODUCTION

Pseudoaneurysms (PAs) are a well-documented and serious complication of percutaneous endovascular repairs. However, what is not well documented is the formation of one PA superimposed on top of another. In this report, we describe the development of an iatrogenic femoral artery PA with an additional PA extending from the first following the endovascular repair of an infrarenal abdominal aortic ulcer.

CASE PRESENTATION

The patient was a 57-year-old woman who presented with right groin pain and rapidly expanding bruising. The patient had recently undergone percutaneous endovascular repair of an infrarenal abdominal aortic ulcer that measured 0.9 cm in depth with a 0.9-cm base. Percutaneous access was performed under fluoroscopic guidance. An 8-gauge needle was inserted using a single anterior common femoral artery wall stick on the right. An 8-Fr sheath was placed, followed by a dilatation catheter with a 14 × 40 × 80 cm balloon and an 11 × 39 mm balloon expandable endoprosthesis (stent). Stent apposition was appropriate. The access site was manually closed. The sheath was capped and left in the groin because of the patient's continued anticoagulation. When the patient's activated clotting time was in a suitable range, the sheath was removed. Overall, the patient tolerated the procedure well and was discharged home. They returned 1 week later with pain and swelling at the catheter site. Arterial duplex ultrasound of the right groin was performed because of concern for PA formation in the right common femoral artery. Arterial ultrasound identified a primary PA measuring 0.9 × 1.6 cm with a 0.2-cm-wide neck and an even larger secondary PA measuring 1.4 × 2.3 cm with a 0.3-cm-wide neck extending from the primary PA (Figure 1, Videos 1-3).

The patient was admitted to the hospital for PA reduction. Real-time ultrasound guidance was used to identify both PAs. Less than 1 mL thrombin was injected into the primary PA until it was completely thrombosed (Figure 2). Success of the procedure was confirmed with repeat ultrasound the following day, which showed no blood flow in either PA, indicating complete thrombosis (Figure 3). The patient was later discharged from the hospital with instructions to follow up in 1 week.

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DISCUSSION

The formation of a PA begins with a patent disruption of the first two layers of the vessel wall, the tunica intima and tunica media. The turbulent blood that extravasates outside the tunica media exerts pressure on the outermost wall, the tunica adventitia, creating a dilation in the vessel. Because the outpouching is bound by only the outermost layer as opposed to all three, it is deemed to be "false" and is therefore referred to as a PA.[1] A secondary PA may occur if an additional disruption occurs in the adventitia. As blood leaves the primary PA, the surrounding soft tissue becomes irritated and promotes fibrous tissue development around the extravasation site. If the newly formed capsule composed of fibrin and platelets successfully contains the bleed, it is deemed to be a secondary PA.[2]

Even though PAs are well documented, they are still fairly rare, occurring in <1% of all interventional procedures and in <4% of all femoral access catheterizations.[3] Although rare, they should remain in the differential diagnosis if a patient presents with a painful pulsatile mass at the site of a recent percutaneous access site. On auscultation, a bruit may be heard, which occurs secondary to turbulent blood flow within the vessel dilation. If these findings are present, arterial duplex ultrasound should be ordered, as it is the reference standard and modality of choice for diagnosis, with respective 94% and 97% sensitivity and specificity.[4] Color flow Doppler ultrasound can often identify a characteristic manifestation known as the "yin-yang" sign (Figure 1B) within the body of the PA. Pulsed-wave Doppler may show a "to-and-fro" pattern (Video 1) that can be visualized in the neck.[4] These phenomena are caused by the inflow of blood during systole and outflow of blood during diastole.[5]

Our patient presented with symptoms suggestive of a PA, so arterial duplex ultrasound was ordered. Unexpectedly, the imaging showed the formation of what appeared to be two PAs stacked on top of each other. We believe that the patient had a primary PA that developed at the time the sheath was removed. A few days after the original procedure, the primary PA likely spontaneously ruptured, leading to the formation of the secondary PA. There are no criteria to distinguish a single lobulated PA vs a secondary PA that develops off of a primary PA. However, we postulate that this case represents two separate PAs because of the following findings.

Ultrasound demonstrated both the "yin-yang" sign and "to-and-fro" pattern within each of the proposed PAs. The consecutive timing of blood flow from the femoral artery to the primary PA and then into the secondary PA was also supportive. Finally, the capsule of the primary PA was more echogenic, suggesting that the primary PA was older and more organized.

Risk factors for developing PAs after endovascular procedures include anticoagulant or antiplatelet use, the use of a larger sheath diameter (>6 Fr), creating a puncture site below the common femoral artery, and emergency procedures.[6] Patient risk factors include platelet count < 200,000 cells/mm^3, obesity, female sex, hypertension, arterial calcification, and age > 75 years.[6] Several of these factors

VIDEO HIGHLIGHTS

Video 1: Vascular ultrasound of the right common femoral artery using a broadband linear-array transducer, oblique short-axis display with color flow Doppler, demonstrates bidirectional blood flow and the "yin-yang" sign in both the primary and secondary PAs.

Video 2: Vascular ultrasound of the right common femoral artery using a broadband linear-array transducer, slightly more oblique short-axis display with color flow Doppler, demonstrates the bidirectional blood flow and the "yin-yang" sign in both the primary and secondary PAs from a slightly altered perspective.

Video 3: Vascular ultrasound of the right common femoral artery using a broadband linear-array transducer, oblique short-axis display, demonstrates the pulsatile primary and secondary PAs and intraluminal thrombus.

View the video content online at www.cvcasejournal.com.

applied to the patient in this report, including antiplatelet use, the use of an 8-Fr catheter during the initial procedure, a body mass index of 32.9 kg/m^2, female sex, and a history of hypertension. Many of these components could have contributed to the development of the PAs. Most of these lesions are benign and self-resolving,[7] especially if they measure <3.0 cm and are not complicated by hemodynamic instability, subcutaneous damage, or infection.[8] Enlarging PAs may exhibit pressure on the skin with pain that ultimately results in skin ischemia, necrosis, and hemorrhage.[2]

Contrast-enhanced computed tomographic angiography may help define the relation to surrounding structures, though it is often unnecessary in straightforward cases.[2] Failure to treat may lead to rupture, hemodynamic compromise, or thrombus embolization. Previously, femoral artery PAs caused by endovascular access were treated exclusively by surgical means, but in the past several decades, the paradigm has shifted to less invasive measures. Options for management now include observation, ultrasound-guided compression, ultrasound-guided thrombin injection, and surgical repair. Ultimately the characteristics of the false aneurysm guide the treatment choice.[2] Femoral artery aneurysms <3.0 cm in diameter may undergo spontaneous thrombosis and regression with observation. Those that are larger typically do not spontaneously thrombose, but this is not an absolute rule.[2]

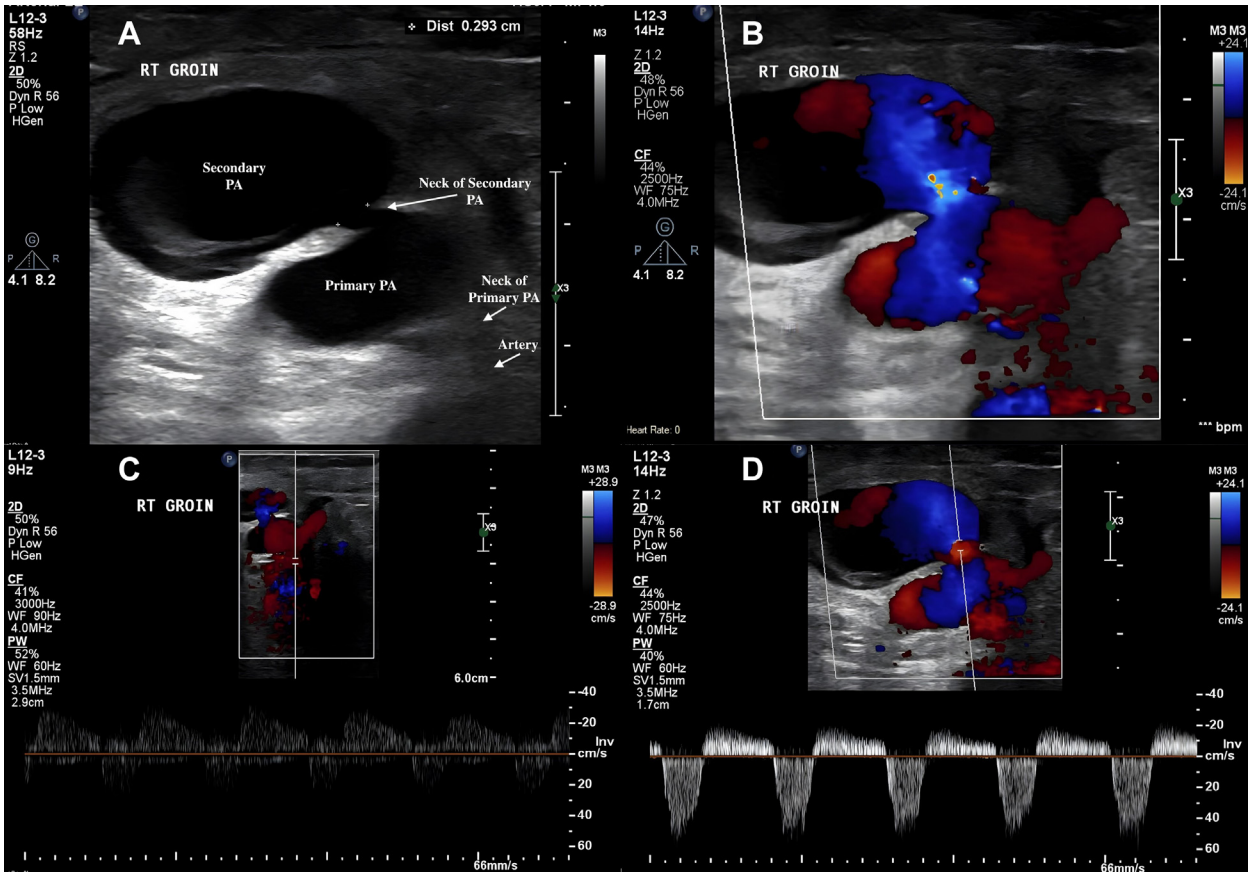

Figure 1 Vascular ultrasound of the right common femoral artery using a broadband linear-array transducer, oblique short-axis display without **(A)** and with **(B)** color flow Doppler, demonstrates bidirectional blood flow and the "yin-yang" sign in both the primary and secondary PAs. Pulsed-wave spectral Doppler displays from the neck of the primary PA **(C)** and the secondary PA **(D)** confirm the "to-and-fro" flow pattern.

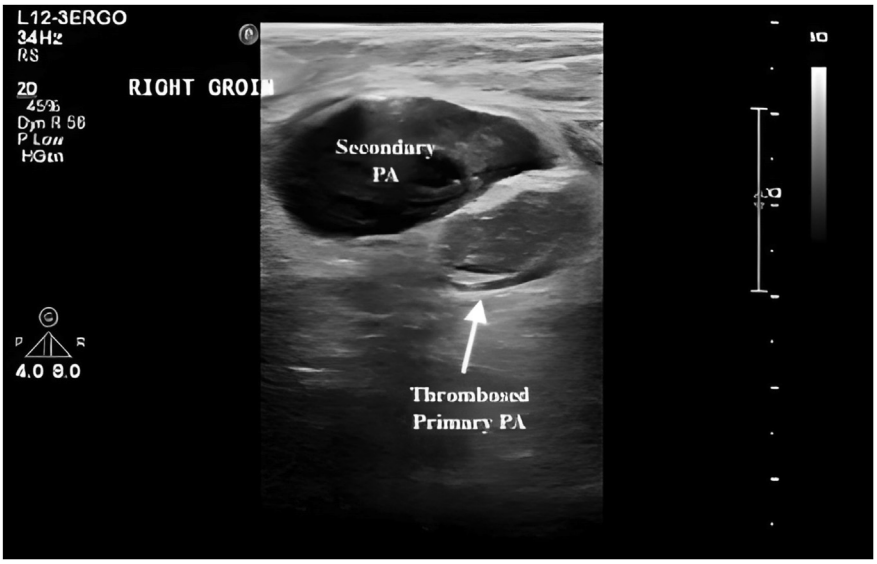

Figure 2 Vascular ultrasound of the right common femoral artery using a broadband linear-array transducer, oblique short-axis display, demonstrates the change in the appearance of the two PAs after thrombin injection into primary PA.

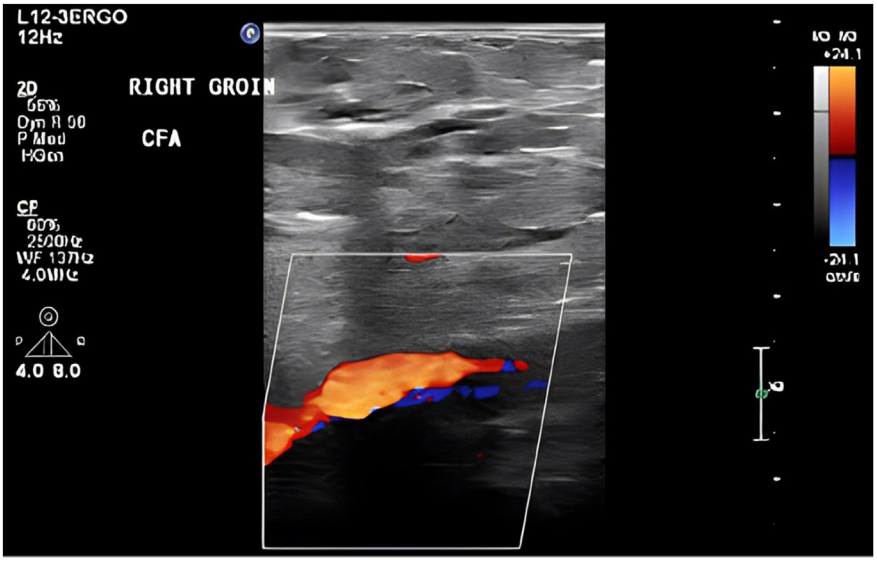

Figure 3 Vascular ultrasound of the right common femoral artery using a broadband linear-array transducer, long-axis display with color flow Doppler, performed the day after the thrombin injection, demonstrates complete thrombosis of the primary PA without any evidence of flow in either PA.

Ultrasound-guided thrombin injection is a well-established, minimally invasive method for treating accessible PAs.[2] Studies have reported high success rates of 97% with a single injection of thrombin for femoral artery PAs, even if the patient is on anticoagulation and/or antiplatelet agents.[9] In the case of our patient, the course followed the trends established by previous studies, with complete resolution of both PAs after injection of <1.0 mL thrombin.

Risks of the procedure include embolization. Aneurysms with shorter neck lengths are correlated with a higher risk for embolic events, and those with necks of <0.2 cm have the highest risk. Luckily, complications are quite rare and occur in only approximately 2% of cases. This procedure is not recommended for PAs <1.0 cm, because of the theoretical risk for arterial embolization, though these can safely undergo ultrasound-guided compression.[2] Surgical management of femoral PA is reserved for patients in whom at least one duplex-guided compression or thrombin injection is unsuccessful or for those who develop PAs at the site of anastomosis following a vascular grafting procedure.[10]

CONCLUSION

Although secondary PAs are not as frequently documented as primary PAs, they should remain in the differential diagnosis for patients presenting with hematomas following percutaneous intervention. This is important because a secondary PA carries an increased risk for rupture due to the absence of an additional vessel wall. Fortunately, diagnosis and management are identical, so identification is the most crucial step.

ETHICS STATEMENT

The authors declare that the work described has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for experiments involving humans.

CONSENT STATEMENT

Complete written informed consent was obtained from the patient (or appropriate parent, guardian, or power of attorney) for the publication of this study and accompanying images.

FUNDING STATEMENT

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DISCLOSURE STATEMENT

The authors report no conflict of interest.

SUPPLEMENTARY DATA

Supplementary data related to this article can be found at https://doi.org/10.1016/j.case.2024.05.010.

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