Area reduction of perforation with a small-size sheath technique for iatrogenic femoral artery pseudoaneurysm with a large perforation

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ABSTRACT

Open surgery for femoral artery pseudoaneurysms is invasive, and complications can be detrimental. Several cases of treatment of iatrogenic femoral artery pseudoaneurysms using percutaneous suture-mediated closure devices have been reported. However, it is difficult to properly deploy the foot of the device to the arterial wall when the perforation area is large. We developed a technique using a double guidewire to partially occupy the perforation with a small-size sheath, which reduces the area of the perforation. This AREPAS (area reduction of perforation with a small-sized sheath) technique might allow for minimally invasive closure of perforations even in patients with large perforation areas. (J Vasc Surg Cases Innov Tech 2023;9:101235.)

Keywords: Closure device; Femoral artery; Percutaneous; Pseudoaneurysm

An iatrogenic femoral artery pseudoaneurysm (IFAP) is an occasional complication of endovascular therapy. However, open surgery is invasive, and complications can be detrimental. Recent studies have reported perforation closure using percutaneous suture-mediated closure (SMC) devices with satisfactory results.[1-3] This minimally invasive method can be effective for patients receiving anticoagulant therapy and can be used even when the neck of the pseudoaneurysm is wide and short. However, perforation closure with a percutaneous SMC device is difficult when the perforation is large. To address this challenge, we developed the area reduction of perforation with a small-size sheath (AREPAS) technique, a technique in which a double guidewire is used to partially occupy the perforation with a sheath to reduce the area of the perforation. We describe the case of a patient with an IFAP treated using the AREPAS technique. The patient provided written informed consent for the report of his case details and imaging studies.

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CASE REPORT

A 41-year-old man went into hypovolemic shock and cardiopulmonary arrest during an endoscopic procedure at our hospital. During resuscitation, a 7F sheath was introduced into the left femoral artery for resuscitative endovascular balloon occlusion of the aorta. After the return of spontaneous circulation, the 7F sheath was removed the next day. However, despite manual compression and the use of a compression bandage, swelling of the groin increased, leading to severe ecchymosis and pulsatile hematoma. A contrast-enhanced computed tomography scan taken 3 days later showed a pseudoaneurysm originating from the left superficial femoral artery, 3.6 mm distal to the femoral bifurcation. The patient was referred to our department at this point. The pseudoaneurysm itself was 32 mm in diameter, its neck was 2.9 mm in length and 7.0 mm in diameter (Fig 1). We could not achieve hemostasis with additional compression; thus, surgical treatment was deemed necessary. Initially, we planned to close the arterial perforation using a percutaneous SMC device, and, if hemostasis could not be achieved, a cutdown repair would be performed on site.

Procedure details.

1. Under general anesthesia, the pseudoaneurysm was punctured under ultrasound guidance with a 4F mini-access kit (Merit S-MAK; Merit Medical). An 0.018-in. guidewire was easily advanced over the perforation into the common femoral artery (Fig 2, *A*), and a 4F coaxial introducer was placed. Angiography confirmed the adequate position of the introducer, which was replaced with a 7F sheath over a 0.035-in. guidewire. Ultrasound showed blood flow from the periphery of the sheath into the pseudoaneurysm.

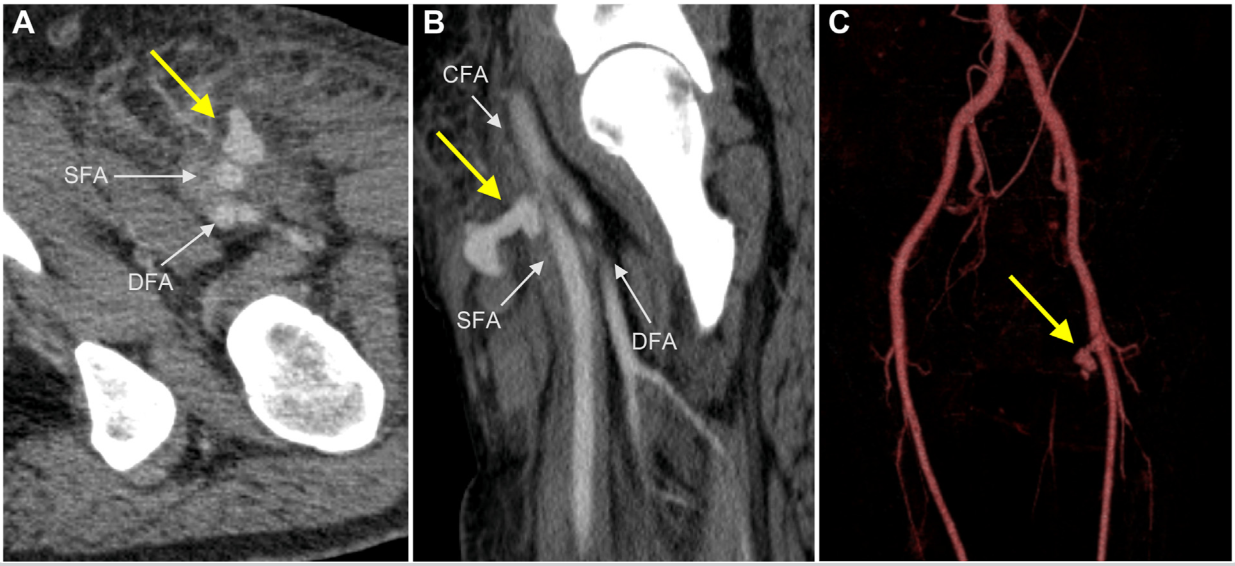

Fig 1. Axial **(A)** and sagittal **(B)** preoperative contrast-enhanced computed tomography views showing the 32-mm diameter pseudoaneurysm (*yellow arrow*). **C,** Three-dimensional computed tomography angiogram showing the pseudoaneurysm (*yellow arrow*) originating from the left superficial femoral artery (*SFA*). *CFA,* Common femoral artery; *DFA,* deep femoral artery.

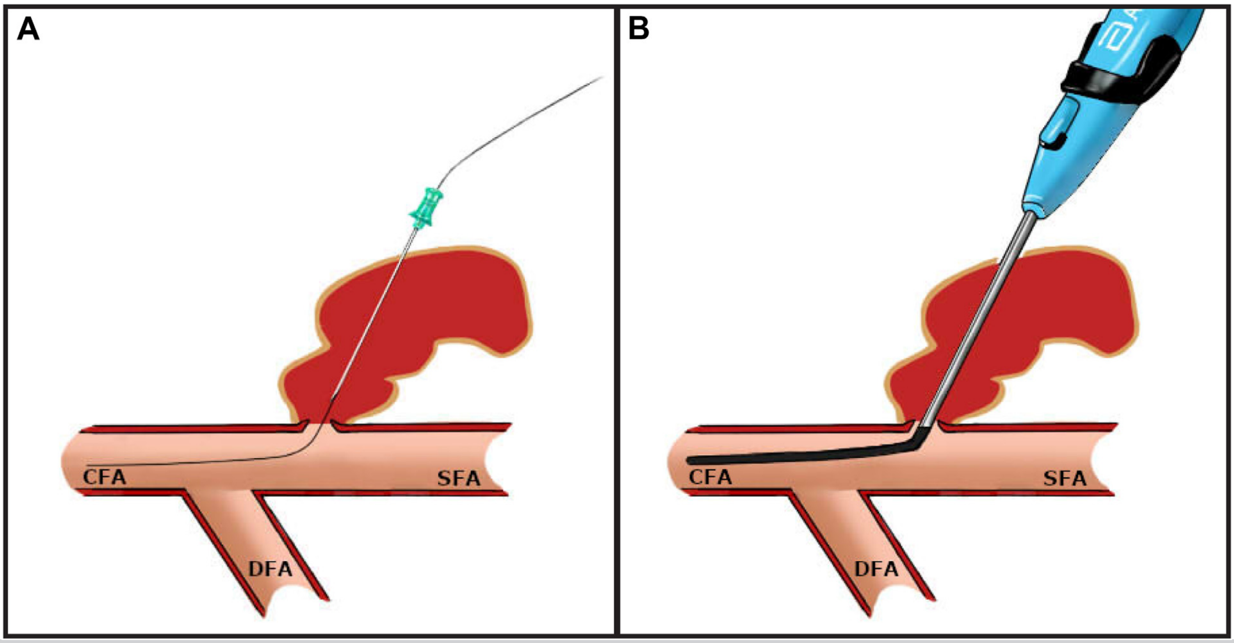

Fig 2. Schema illustrating percutaneous perforation closure of an iatrogenic femoral artery pseudoaneurysm with a suture-mediated closure (SMC) device. **A,** The pseudoaneurysm was punctured with a 4F mini-access kit, and a guidewire was advanced over the perforation into the common femoral artery (*CFA*). **B,** A percutaneous SMC device was inserted into the perforation of the pseudoaneurysm. *DFA,* Deep femoral artery; *SFA,* superficial femoral artery.

The 7F sheath was not large enough to wedge the arterial perforation. Thus, the 7F sheath was removed, and an SMC device (Perclose ProStyle; Abbott Cardiovascular) was inserted (Fig 2, *B*). Because the perforation was too large for the foot to adequately deploy to the anterior wall of the artery, the system was pulled back into the pseudoaneurysm.

2. A 0.035-in. guidewire was reinserted, and a 9F short sheath was placed to minimize hemostasis. Another 0.035-in. guidewire was inserted through the sheath

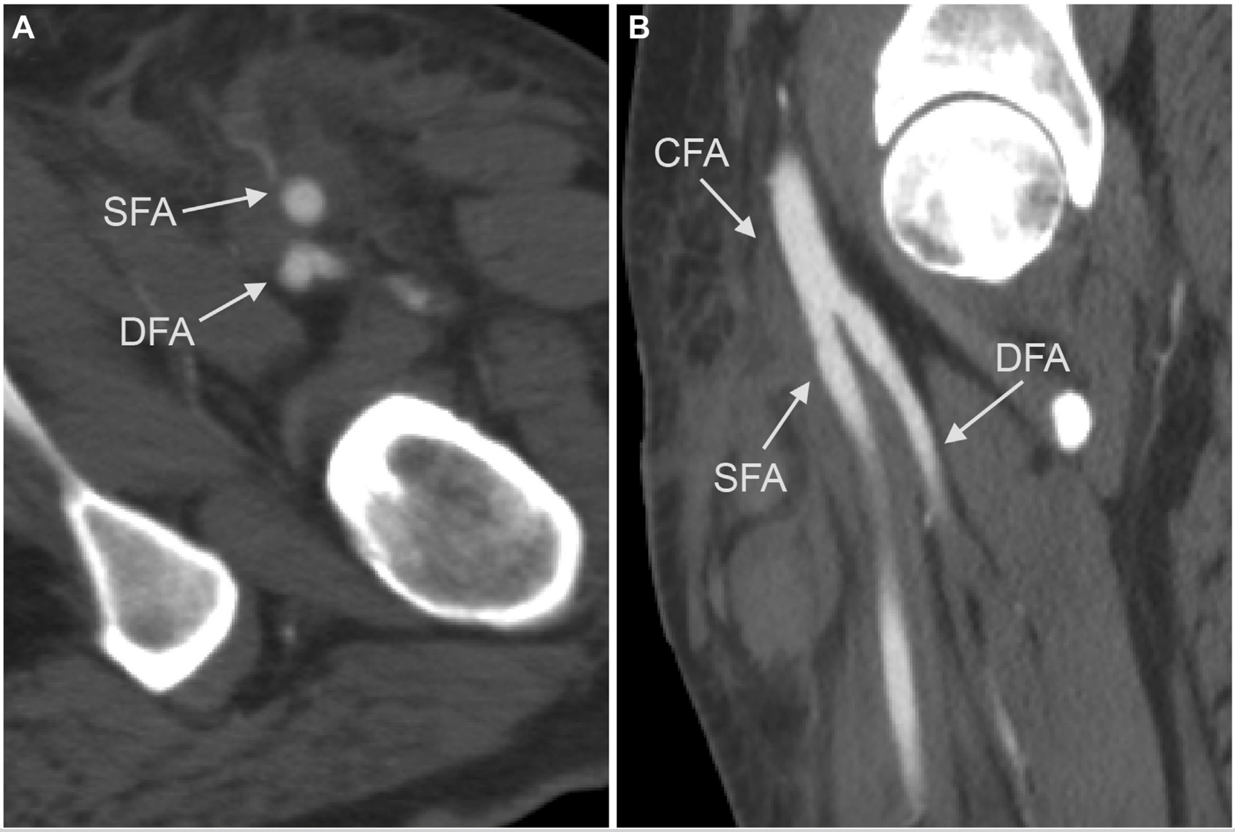

Fig 3. Axial **(A)** and sagittal **(B)** postoperative contrast-enhanced computed tomography views showing successful closure of the pseudoaneurysm. *CFA*, Common femoral artery; *DFA*, deep femoral artery; *SFA*, superficial femoral artery.

to make it a double wire, and the 9F sheath was removed. A 7F sheath was inserted through one of the wires and positioned to the patient's right side. An SMC device was introduced using the other wire on the left side of the 7F sheath.

3. The suture was adequately deployed, and, with the suture lightly tightened, the 7F sheath was replaced with a second SMC device. Both sutures were tightened, and hemostasis was achieved and confirmed via ultrasound by the absence of intracavitary flow (Supplementary Video, online only).

The procedural time was 28 minutes, with a blood loss of 30 mL. Most of the bleeding occurred when exchanging the sheath and device, which can occur during any endovascular procedure. The postoperative course was uneventful, and contrast-enhanced computed tomography performed on the fourth postoperative day confirmed adequate hemostasis and shrinkage of the sac (Fig 3, *A and B*).

DISCUSSION

An IFAP is a detrimental complication of catheter procedures for diagnostic and therapeutic purposes. Nonsurgical options such as ultrasound-guided compression or thrombin injection are often used as an initial treatment.[4] However, for some patients, these treatments will be inapplicable or unsuccessful. Compression is minimally effective with continued anticoagulation therapy, a large pseudoaneurysm size, and for pseudoaneurysms with short and/or wide necks.[5-8] A thrombin injection can be effective but carries a high risk of thrombosis in cases in which the pseudoaneurysm has a short and wide neck[9,10] and a risk of severe allergy.[11,12] However, open surgery carries the risk of blood loss requiring transfusion and wound infection. Patients undergoing surgical treatment have higher infection rates (20.3%) and wound dehiscence rates (12.7%), higher postoperative mortality, and longer hospital stays.[13] In our patient, hemostasis could not be achieved with compression, and the risk of thrombotic complications was high with a thrombin injection (which is off-label use in Japan), because the neck of the pseudoaneurysm was wide and short. Furthermore, stent graft placement carried the risk of deep femoral artery occlusion. Because surgical treatment was unavoidable, we performed percutaneous closure of the arterial perforation with a percutaneous SMC device using the AREPAS technique.

Fig 4 shows an overview of our AREPAS technique. It can be challenging to properly deploy the foot of the

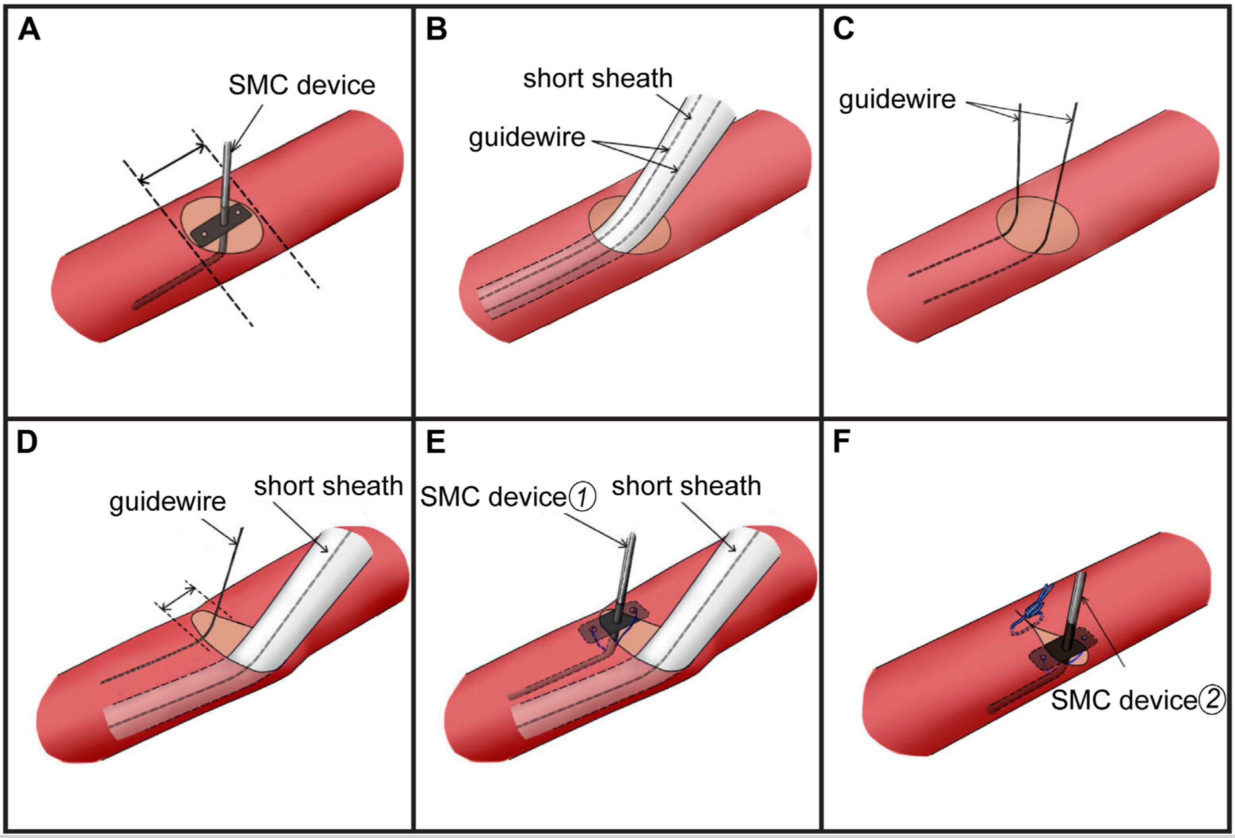

Fig 4. Schema illustrating the area reduction of perforation with a small-size sheath (AREPAS) technique. **A,** A suture-mediated closure (SMC) device could not be deployed because of the large perforation. **B,** A sheath is first place over a guidewire, and a second guidewire is inserted to fashion a double wire. **C,** After removal of the initial sheath, two guidewires remain in the perforation. **D,** A sheath is inserted through one of the wires and positioned on the patient's right side to relatively reduce the size of the perforation. **E,** An SMC device is introduced through the other guidewire, and the suture is deployed. **F,** The sheath is removed, and a second SMC device is introduced.

percutaneous SMC device to the arterial wall when the perforation is large (Fig 4, *A*). If this is the case, a sheath is first placed over a guidewire, and a second guidewire is inserted to fashion a double wire (Fig 4, *B*). After removal of the initial sheath (Fig 4, *C*), a small-size sheath is inserted through one of the wires and positioned to the patient's right side (Fig 4, *D*). The sheath occupying the perforation allows another guidewire to be positioned at the edge of the perforation where the distance between the two walls is shorter. In addition, the sheath can be used to pull the arterial wall of the perforation laterally, causing the perforation to stretch and reduce the distance between the two walls of the artery. An SMC device is then introduced using the other wire on the left side of the sheath (Fig 4, *E*). The suture is deployed, and, with the suture lightly tightened, the sheath is replaced with a second SMC device (Fig 4, *F*). Finally, both sutures are tightened to close the perforation.

The AREPAS technique we report can theoretically be used for the salvage of large-bore sheath access without antecedent suture deployment such as in emergent endovascular aneurysm repair for ruptured aortic aneurysms. A third suture can also be added if the second suture using the AREPAS technique is not enough for complete hemostasis. However, this technique could have limitations regarding the onset of pseudoaneurysm formation. For the present patient, the sheath was inserted for only 1 day, and the surgery was performed 3 days after sheath removal. If the sheath had been in place for a longer period, or if more time had passed after removal of the sheath, the perforation and tract could have hardened. This can lead to misfiring of the SMC device; hence, caution is required.

CONCLUSIONS

We treated a case of an IFAP using a minimally invasive method with the AREPAS technique. The AREPAS technique can facilitate percutaneous treatment of IFAPs with a large perforation, thereby avoiding open surgery and its potential risk of detrimental complications.

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