A hybrid approach for vascular control and repair of an expanding iatrogenic femoral artery pseudoaneurysm

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ABSTRACT

Surgical repair of iatrogenic femoral pseudoaneurysms in the setting of distorted anatomy, multiple prior interventions, and ongoing hemorrhage requires extensive proximal and distal dissection for control. Furthermore, profunda femoral and other arterial branch control may not always be feasible and can lead to considerable blood loss at the time of surgical exploration. We present a simple, safe, and effective hybrid approach for inflow, outflow, and branch control for treatment of a proximally located, actively expanding, iatrogenic common femoral artery pseudoaneurysm recalcitrant to multiple sessions of percutaneous thrombin injection. (J Vasc Surg Cases and Innovative Techniques 2020;6:460-3.)

Keywords: Femoral pseudoaneurysm; Hybrid approach; Balloon control; Postcatheterization pseudoaneurysm

Femoral artery pseudoaneurysms are the most common access site complication after cardiac and peripheral angiographic procedures, with an incidence ranging from 0.05% to 2.00% and 2% to 6% after diagnostic and interventional procedures respectively.[1] Although small pseudoaneurysms (<2 cm) often thrombose spontaneously, sac expansion, symptoms, and surrounding hematoma confer a risk of rupture and warrant intervention.[2-5] In pseudoaneurysms with suitable anatomy, nonsurgical treatment options are first line and include ultrasound-guided compression, percutaneous thrombin injection, and embolization with coils and/or adhesives.[6-8] Surgical treatment should be reserved for more complicated cases, such as those refractory to percutaneous techniques with active expansion and ongoing blood loss, presence of superimposed infection, skin necrosis, and limb-threatening ischemia.[6] In severely distorted anatomies safe and effective inflow, outflow, and branch control may not always be easily accomplished, leading to potential for considerable intraoperative blood loss and other associated morbidities.

Herein, we present a simple and effective hybrid technique for prompt inflow, outflow, and profunda femoris control before surgical exploration and repair of an actively expanding, proximally located, recurrent common femoral artery (CFA) pseudoaneurysm. This readily available technique minimizes blood loss, avoids surgical exploration in the face of active hemorrhage, expedites culprit vessel identification, avoids the need for remote percutaneous arterial puncture, and can decrease overall operative time. The patient's next of kin consented to publication of this report.

CASE REPORT

Presentation. The patient is a 75-year-old man with carotid stenosis and diabetes, on rivaroxaban and clopidogrel, who underwent right transfemoral carotid stenting complicated by a 1.6 × 2.3 cm right CFA puncture site pseudoaneurysm. This was successfully treated with percutaneous thrombin injection. Two months later, the pseudoaneurysm rapidly expanded and the patient represented with recurrence of pain and pulsatile groin mass. Imaging showed the pseudoaneurysm had recurred to 5 cm. Thrombin injection was once again attempted, though without success. Computed tomography angiography demonstrated a 9.4 × 6.4 cm pseudoaneurysm. Proximally, the associated hematoma extended proximal to the inguinal ligament. Distally, it encompassed the femoral bifurcation, partially compressing and distorting, but not involving, the profunda and superficial femoral arteries (Fig 1 *A* and *B*).

Surgical technique. Preoperative ultrasound examination confirmed extensively distorted anatomy with extension of the pseudoaneurysm and hematoma proximal to the inguinal ligament, obviating proximal surgical control without entering the active pseudoaneurysm sac (Fig 1, *C* and *E*). The proximal aspect of the superficial femoral artery (SFA) was identified as it emerged from the distal-most aspect of the bleeding pseudoaneurysm sac (Fig 1, *D*). We made a longitudinal incision over the previously marked SFA, distal to the pseudoaneurysm site, and mobilized and retracted the sartorius muscle laterally to expose and encircle the SFA. Via retrograde micropuncture technique, we introduced a 5F sheath under direct visualization (Fig 2, *A*) and advanced a 0.035" Glide-Advantage wire (Terumo Interventional

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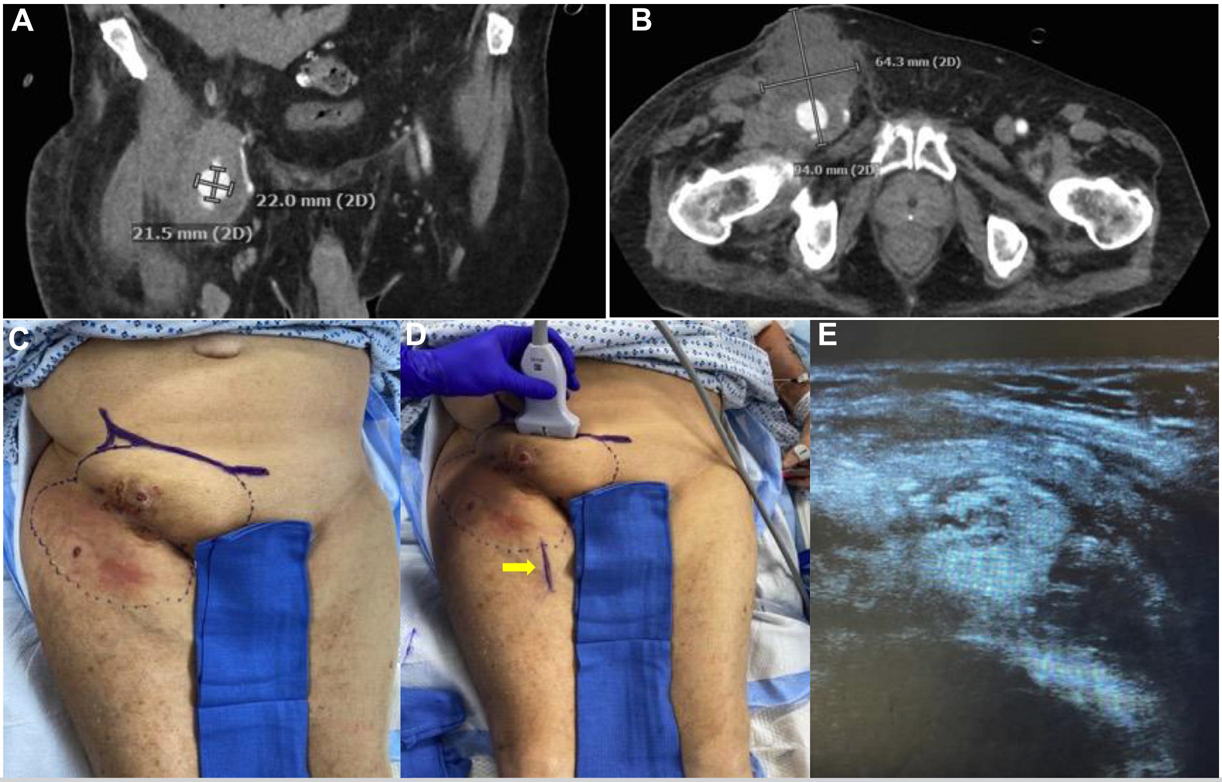

Fig 1. Preoperative imaging. **A,** Coronal view of right common femoral artery (CFA) pseudoaneurysm with patent vessel measuring 22.0 × 21.5 mm on computed tomography angiography. **B,** Axial view of right CFA pseudoaneurysm measuring a 94.0 × 64.3 mm. **C,** Preoperative image of right groin mass. **D,** Preoperative ultrasound imaging of pseudoaneurysm and vasculature; yellow arrow denotes the ultrasound mapped course of the right superficial femoral artery (SFA). **E,** Preoperative ultrasound image of CFA pseudoaneurysm in relation to the inguinal ligament.

Systems, Somerset, NJ) under fluoroscopic guidance into the proximal right common iliac artery. We then systemically heparinized the patient. Retrograde angiography demonstrated precisely the base of the large pseudoaneurysm just proximal to the femoral bifurcation (Fig 2, *B*). We advanced a 7 × 100 mm Mustang balloon (Boston Scientific, Burlington, Mass) to the site of the lesion and insufflated it to nominal pressure, controlling the inflow, outflow, and all branch vessels (Fig 2, *C*).

With the balloon insufflated, we extended the SFA incision proximally to the level of the inguinal ligament and incised the pseudoaneurysm capsule. We manually evacuated a copious amount of hematoma and thrombotic debris along with a small amount of bright red blood. Given the extensively distorted local anatomy, the presence of a long, insufflated balloon allowed for prompt identification of the affected portion of the CFA with manual palpation. Surgical dissection was carried out directly onto this portion of the artery, which exposed the culprit iatrogenic arteriotomy and the underlying balloon (Fig 3, *A*). Vessel loops were applied proximal and distal to the site of injury. Longitudinal and circumferential surgical exploration of the CFA revealed no further sites of arterial injury or any evidence of superimposed infection. Cultures were obtained from the perivascular space only, without inclusion of the arterial wall, as there was no evidence of infection. We then deflated the balloon and with vessel loop control, proceeded with primary repair of the arteriotomy with 5-0 Prolene sutures (Fig 3, *B*). The primary repair was adequate; the artery seemed to be healthy and did not require debridement. A palpable pulse was appreciated and verified with handheld Doppler interrogation of the CFA and its branches. The guidewire and sheath were removed and SFA arteriotomy was repaired with a 5-0 Prolene suture (Fig 3, *C*). Pulse lavage of the surgical wound was performed and the exposed artery covered with a single layer of overlying soft tissue. Topical excellagen collagen matrix (Olaregen Therapeutix, New York, NY) was applied to accelerate wound healing followed by application of a wound VAC (Fig 3, *D*). Operative time from skin incision to closing totaled 45 minutes and the estimated blood loss was 100 mL of evacuated hematoma, with minimal surgical bleeding. An additional session of exploration and washout was performed to ensure wound healing and adequate hemostasis at which time additional cultures were collected and collagen matrix reapplied. All cultures were negative, with one containing a contaminant.

Postoperative course. The patient had no perioperative surgical complications and was discharged to a skilled nursing facility on postoperative day 21. At the time of discharge, his right groin incision site was partially closed with healthy granulation tissue (Fig 3, *D*).

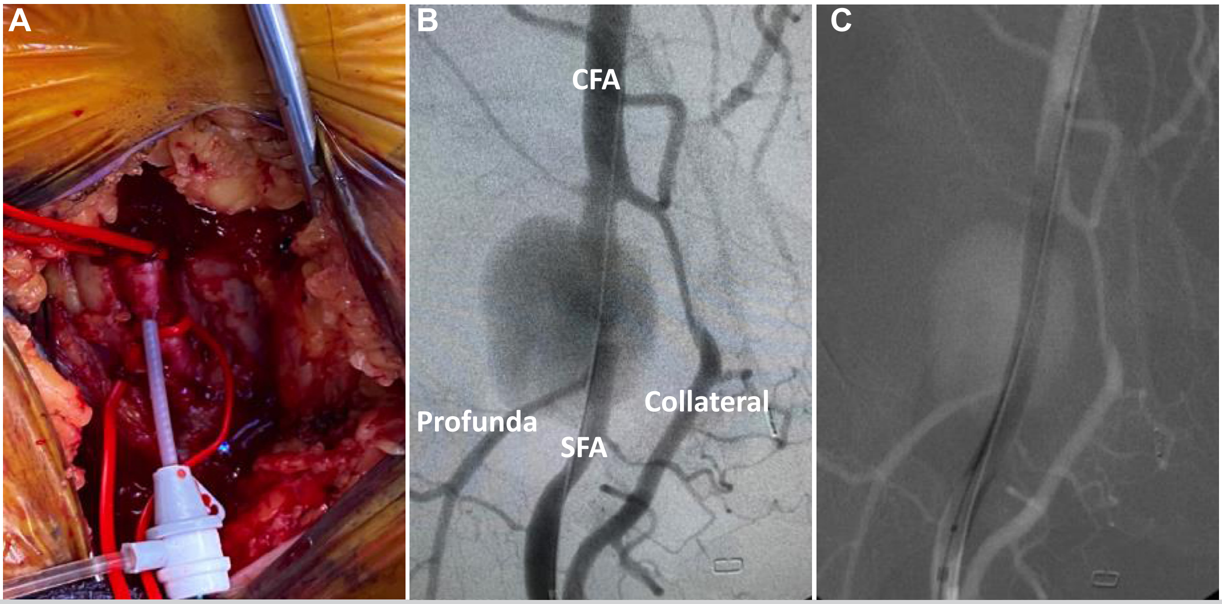

Fig 2. Intraoperative imaging. **A,** Dissection and cannulation of the superficial femoral artery (*SFA*). **B,** Intraoperative angiogram demonstrating common femoral artery (*CFA*) pseudoaneurysm with active extravasation, partially compressing the profunda and SFA. **C,** Angiogram during balloon inflation showing complete occlusion of CFA, superficial femoral and profunda arteries.

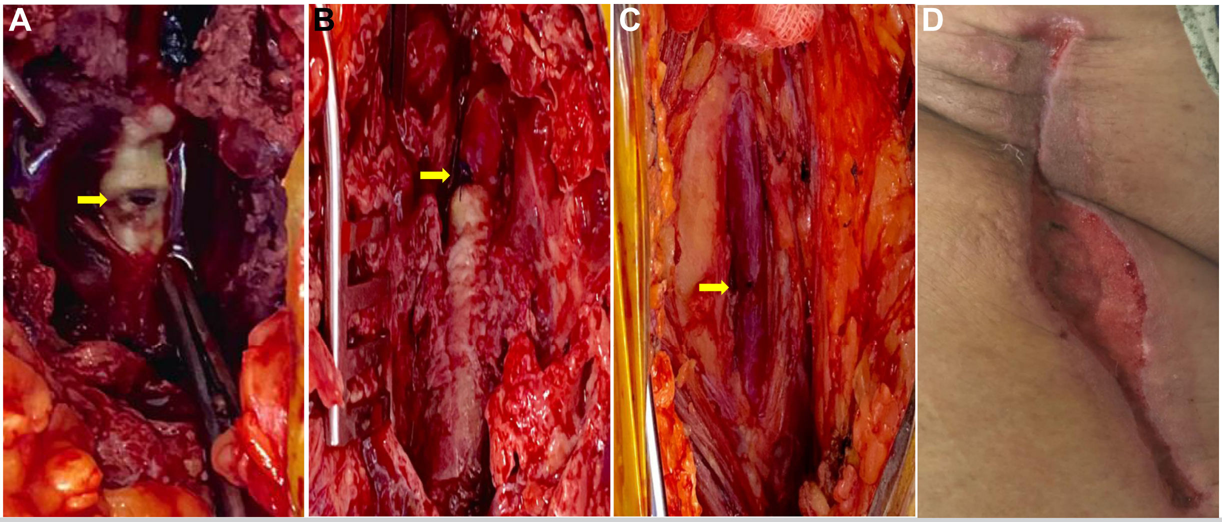

Fig 3. Intraoperative surgical technique. **A,** Complete dissection of common femoral artery (CFA), including aneurysm sac after balloon control of inflow and outflow; yellow arrow illustrates CFA puncture site before repair. **B,** CFA after primary repair; yellow arrow denotes repaired puncture site. **C,** Superficial femoral artery (SFA) at the conclusion of the case; yellow arrow denotes repaired arteriotomy site. **D,** Right groin incision at the time of discharge after 21 days of negative pressure wound therapy.

DISCUSSION

This report demonstrates a successful single incision hybrid approach for prompt simultaneous proximal, distal, and profunda femoris control of a large, expanding, refractory iatrogenic CFA pseudoaneurysm in the context of severely distorted groin anatomy secondary to prior thrombin injections and ongoing hemorrhage. Traditionally, the large size and prior groin interventions of this pseudoaneurysm would have required flank incision and retroperitoneal dissection to attain proximal control of the iliac vessels. This, along with distal surgical control of the SFA, would have provided adequate inflow and outflow vascular control, but back bleeding from the profunda femoral artery and other arterial branches would have remained unaddressed. Placement of a long (100 mm length in this case) balloon with ample shoulders and luminal apposition distal and proximal to the lesion is key in optimizing control and minimizing exacerbating injury locally at the site of the culprit arteriotomy. Furthermore, the usefulness of a readily palpable, long balloon and its ability to lead to prompt identification and exposure of the inured vessel cannot be overemphasized. This helps to minimize unnecessary dissection, decrease overall operative time, and can potentially avoid adjacent nerve or vein injury. If more extensive vascular blowout had been encountered requiring major local surgical vascular reconstruction, this technique would have allowed us to safely dissect and surgically expose and control all inflow, outflow, and branch vessels in a controlled, bloodless operative field. By placing the balloon via surgical exposure of an adjacent outflow vessel, further remote percutaneous access was avoided, thereby minimizing risk of further access site complications.

Although balloon occlusion of arterial flow is a widely accepted method of vascular control, its use at the time of pseudoaneurysm repair has not been widely reported. Several case reports have demonstrated the successful use of percutaneous balloon aided drug delivery to femoral pseudoaneurysms, as well as hybrid approaches to the repair of ruptured femoral pseudoaneurysms.[9-12] In addition, balloon control of a ruptured anastomotic pseudoaneurysm and proximal control at the time of pseudoaneurysm repair have been described.[13,14] Nonetheless, many of the aforementioned techniques relied on contralateral groin access and partial inflow/outflow control only, in addition to use of stents, which carry limited usefulness in infected fields. The hybrid technique described here allows for single incision control of the CFA, SFA, and profunda, and allows for primary pseudoaneurysm repair, obviating the need for extensive dissection, contralateral groin access, or use of prosthetic material for repair.

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