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CASE REPORT

Endovascular Management of Infected Femoral Artery Pseudoaneurysms in High-Risk Patients: A Case Series

Mario D'Oria[1] · Giada Sgorlon[1] · Cristiano Calvagna[1] · Francesca Zamolo[1] · Stefano Chiarandini[1] · Roberto Adovasio[1] · Filippo Griselli[1]

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Abstract We report our experience with the urgent treatment of two high-risk patients with infected femoral artery pseudoaneurysms (IFAPs) with the placement of a self-expandable covered stent (SECS). In both cases, there was no perioperative mortality and the aneurysm exclusion was successful without early or late stent thrombosis/stent fracture nor acute or chronic limb ischemia or limb loss. There was no recurrence of local or systemic infection during the follow-up period. Endovascular therapy represents a feasible treatment option for IFAPs in those patients for whom the risk of open surgical repair would be prohibitive, especially under urgent circumstances.

Keywords Femoral artery · Infected aneurysm · Endovascular repair

Introduction

Infected femoral artery pseudoaneurysms (IFAPs) can represent a threat for both limb and life. An infected pseudoaneurysm can occur when infection of the arterial wall causes the development of a new aneurysm or when a preexisting aneurysm becomes secondarily infected. It is common in intravenous drug users (IVDUs), especially when there is associated immunodeficiency (e.g., HIV infection/AIDS, chronic viral hepatitis, immunosuppressive therapy, chemotherapy, and/or radiotherapy for cancer, malnutrition). These patients are usually at high risk for open surgical repair because of multiple comorbidities; moreover, these clinical entities can represent urgent situations when surgical morbidity and mortality are usually higher than under elective circumstances. The treatment of IFAPs is still controversial and challenging. It has been reported in a limited number of case series/reports that a less invasive approach with endovascular exclusion via stent-graft deployment associated with surgical debridement/drainage and antibiotic therapy, provides bleeding control and ensures distal perfusion of the limb without an increased risk of progression and/or recurrence of the infection [1, 5, 9, 10]. We report our experience of two patients with IFAPs treated with the placement of a self-expandable covered stent (SECS) with good results up to 4 and 2 years, respectively.

✉ Mario D'Oria
mario.doria88@outlook.com

[1] Vascular and Endovascular Surgery Unit, University Hospital of Cattinara, Trieste, TS, Italy

Case Series

Case 1

The first patient was a 35-year-old male, IVDU, with chronic viral hepatitis from HCV infection. He was admitted to the emergency department with a 10-day history of pyrexia up to 39.5 °C. The physical exam showed the presence of a painful mass in the left groin. Laboratory investigations showed elevated count of white blood cells and elevated levels of C-reactive protein. A duplex ultrasound (DUS) revealed a pseudoaneurysm of the left common femoral artery (CFA) (Fig. 1) with the lesion confirmed by computed tomography angiography (CTA). On the same day, the patient underwent a digital subtraction angiography (DSA) and a SECS (Viabahn, Gore) was deployed with complete exclusion of the pseudoaneurysm. The next day, open debridement/drainage of the abscess

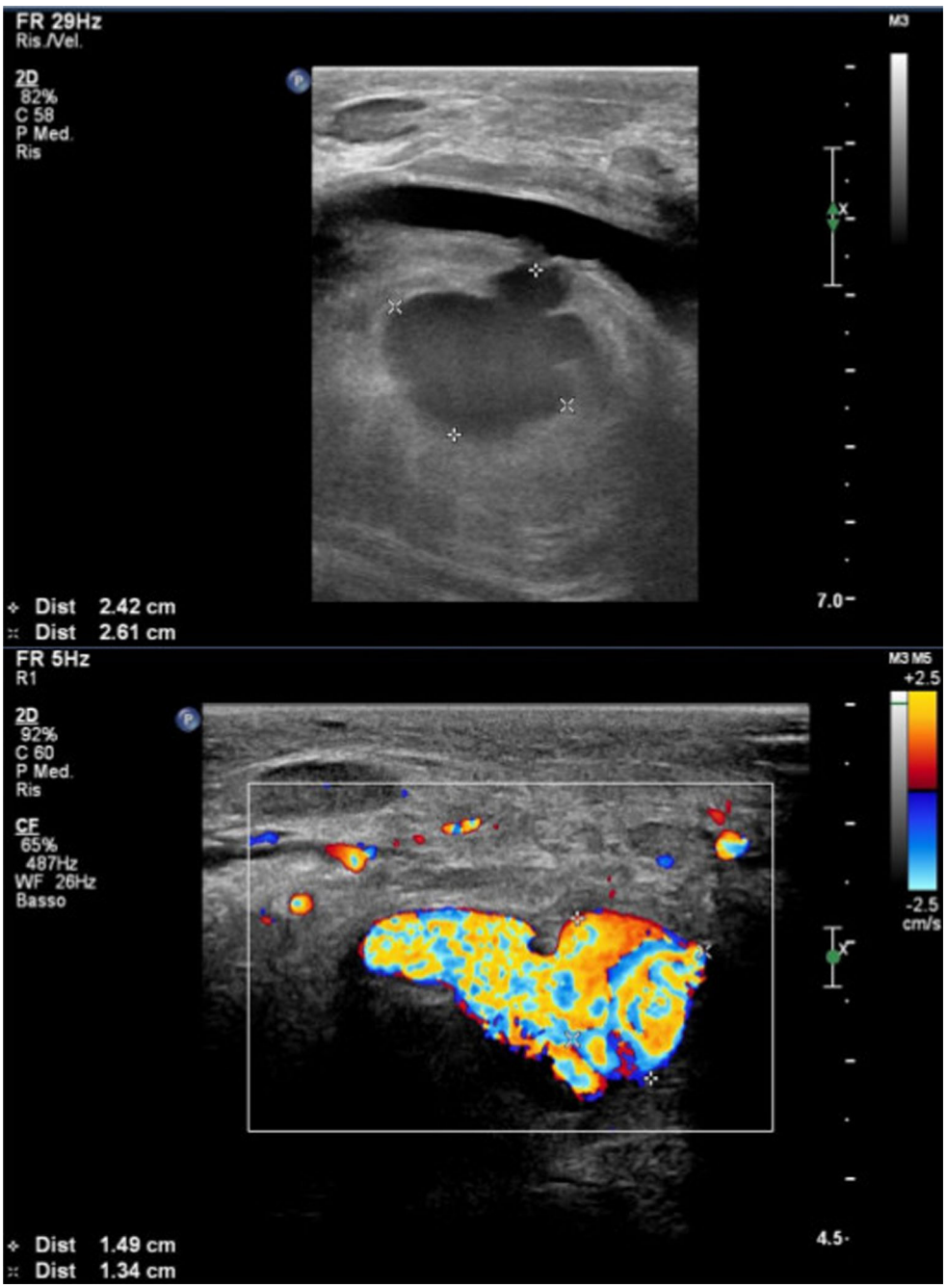

Fig. 1 DUS showing a pseudoaneurysm of the left CFA with evidence of turbulent flow with color-doppler imaging

was performed through incision of the groin. Cultures obtained from the abscess were positive for *Staphylococcus aureus* (while cultures from the blood were negative) and the patient was placed on appropriate antibiotic therapy with intravenous Vancomycin and Rifampicin. He was discharged at home after 4 weeks of hospitalization on oral linezolid for 1 month followed by oral amoxicilline/clavulanate and ciprofloxacin for 6 months. CTA scan at 1 month demonstrated complete resolution of the abscess; clinical and ultrasonographic follow-up at 6 and 12 months showed patency of the stent-graft with preserved distal flow to the limb without any signs of recurrence of the infection. The patient died after 4 years; his death was not related to the pseudoaneurysm.

Case 2

The second patient was a 28-year-old male, IVDU, with HIV infection and chronic viral hepatitis from HCV infection. His past medical history was also significant for a previous mitral valve replacement for infective endocarditis. He presented at the emergency department with

hemodynamic instability, severe anemia, and a pulsatile mass in the left groin draining pus (Fig. 2). A DUS was performed and showed a ruptured pseudoaneurysm of the left CFA actively bleeding associated with a large abscess of the groin, the ultrasonographic findings being confirmed by a CTA (Fig. 3). Due to the patient's unstable clinical conditions, he was immediately transferred to operating room and a DSA was performed. After appropriate confirmation of the lesion's site, the pseudoaneurysm was successfully excluded with the placement of a SECS (Viabahn, Gore) (Fig. 4). Cultures obtained from blood and abscess were positive for *Staphylococcus aureus* and *Staphylococcus epidermidis*. Extensive surgical debridement of all necrotic tissue through a lateral incision of the thigh was performed right after the endovascular procedure and a silastic drain was placed subcutaneously to allow pus drainage and irrigation of the wound with antiseptic solution. The patient was then placed on appropriate antibiotic therapy with intravenous Vancomycin and Daptomycin. Following the operation, the patient's condition improved and a CTA performed two weeks later demonstrated the correct placement of the stent-graft with complete exclusion of the pseudoaneurysm. The patient was discharged to home after 4 weeks of hospitalization on oral linezolid for 1 month followed by oral amoxicilline/clavulanate and ciprofloxacin for 6 months. Regular clinical and ultrasonographic follow-up at 3, 6, 12, and 24 months has been conducted since now. There has been no evidence of any stent-related complication nor of any recurrence of infection.

Fig. 2 Pulsatile mass of the left groin region draining pus

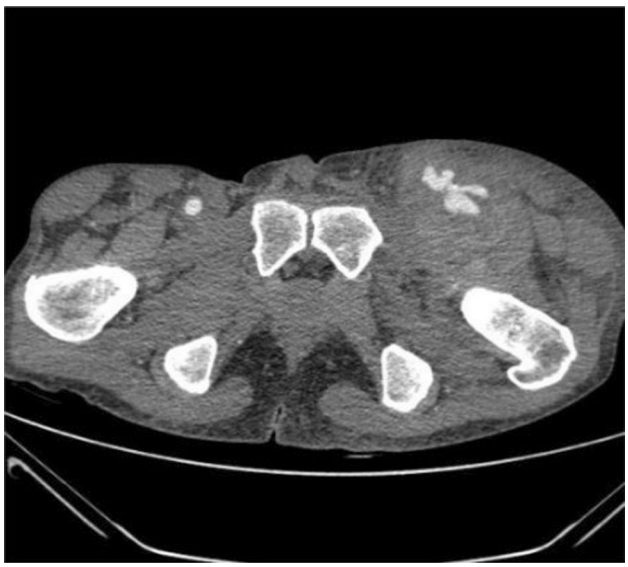

Fig. 3 CTA demonstrating a ruptured pseudoaneurysm of the left CFA actively bleeding associated with a large surrounding abscess of the groin and proximal thigh

Technical Notes

The following technical notes refer to those aspects of the endovascular procedure which are the same in both cases. The angiographic procedure was performed through percutaneous contralateral femoral access. The stent-graft dimensions were chosen such that the nominal diameter was equal to the reference vessel diameter. Vessel size was determined on the basis of preoperative imaging. The stent-graft was placed with appropriate sealing proximally and distally. The endoprosthesis was post-dilated with an angioplasty balloon (Optapro, Cordis) whose dimensions were chosen such that the nominal diameter was inferior to the stent-graft diameter by 1 mm (to reduce damage to the media) and the length did not exceed the stent length. The femoral arterial puncture site was sealed with a vascular closure device (Angioseal, St Jude Medical). The patients were started on dual antiplatelet regimen (clopidogrel 75 mg daily and aspirin 100 mg daily) for two months after the procedure and then were placed on lifelong aspirin 100 mg daily.

Discussion

Traditionally, the therapy of IFAPs relies on radical excision of the infected pseudoaneurysm with ligation of the affected artery with or without revascularization [2, 3]. The need for revascularization depends upon the patient's underlying vascular status and condition of distal

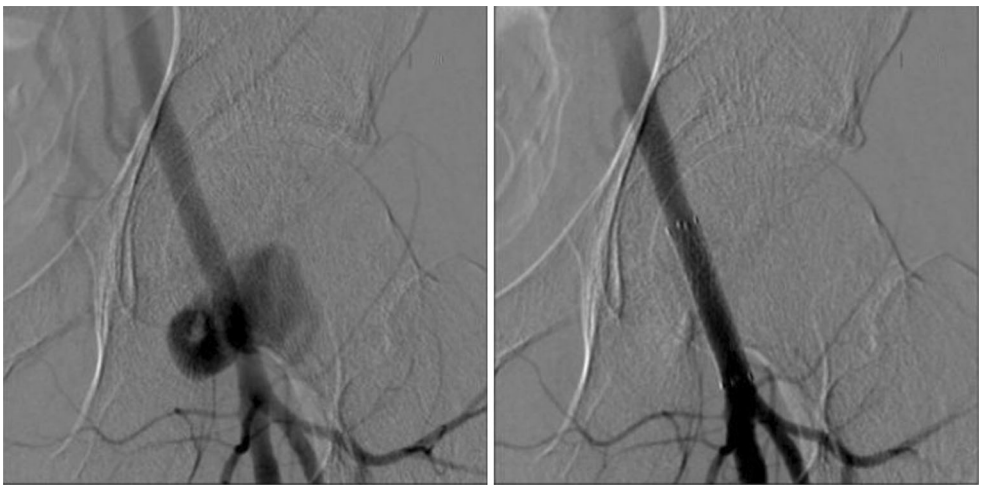

Fig. 4 DSA before (*left*) and after (*right*) the placement of a stent-graft for treatment of a ruptured CFA pseudoaneurysm

perfusion. It is generally accepted that revascularization is not mandatory when adequate collateralization via the profunda femoral artery (PFA) is available. On the other side, immediate reconstruction carries the potential risk of recurrence of the infection or hemorrhage due to breakdown of the anastomoses. Surgical management of infected pseudoaneurysms can be extremely challenging, because of the extensive damage of arterial wall and surrounding tissues derived from the infection. Furthermore, autologous venous conduits could not be available for surgical reconstruction (especially in IVDUs who commonly have a past medical history of deep and superficial vein thrombosis). The mortality with open surgical repair ranges from 0 to 4.5% and can be even higher in emergency arterial reconstructions. The rate of amputation following surgical management of IFAPs is reported to be between 10 and 30%. Thus, surgical reconstruction carries risks for both life and limb [4].

Endovascular surgery may be most suitable for the management of infected femoral pseudoaneurysms in high-risk patients for whom mortality rates with open surgery would be prohibitive, especially in urgent situations. Fu et colleagues [1] report 16 IFAPs in 15 patients treated with stent-graft placement; hemorrhage was the most common reason for seeking medical care and in three cases the patients presented in hemorrhagic shock. At a median follow-up of 13 months (with two patients lost at follow-up), the Authors report two relapsing pseudoaneurysms and one stent-graft thrombosis. In their experience, Klonaris et al [5] describe emergent stent-graft deployment in six patients with ruptured IFAPs; at a median follow-up of 14.1 months (two patients died at 8 and 10 months for major adverse cardiac events), they report patency of all implanted stent-grafts without any endoleak, while no signs of recurrent local or systemic infection were noticed.

Endovascular therapy has the advantage of avoiding surgical maneuvers in an already contaminated field and the risk of further bleeding in hemodynamically unstable patients. For all these reasons, the possibility to exclude IFAPs via stent-graft placement and simultaneously treat the infection (locally with open debridement/drainage and systematically with antibiotic therapy) is fascinating and provides bleeding control and distal perfusion at the same time. Nevertheless, some aspects of endovascular therapy make it not ideal for the management of IFAPs. The need to obtain adequate proximal and distal landing zones may lead to coverage of the ostium of the PFA, which can result in limb ischemia. Moreover, it can be argued that the deployment of a stent-graft in an infected area may lead to a catastrophic closed-space infection. This has not clearly happened in our cases, leading us to hypothesize, as recently suggested by Moulakakis et al. [6], that the bacterial load the endoprosthesis was exposed to was low. This can probably be due to the fact that the minimal defect in the arterial wall, which leads to the development of the pseudoaneurysm, is not enough to provide a graft infection. In addition, the aggressive treatment of the infection can effectively control it by reducing the bacterial burden.

Stenting of the CFA historically represents a controversial issue essentially because its location against the hip joint flexion–extension point makes the stent vulnerable to fracture which in turn may cause in-stent restenosis. This notion might not be true with new generations of SECS, as reported by series in literature showing acceptable short- and mid-term results after primary stenting of the CFA with these kind of endoprosthesis [7, 8]. In our case series, the very distal portion of the CFA and the femoral bifurcation seemed to be not involved by the pathologic process (based on preoperative imaging studies and clinical presentation). Our intention was to use a single stent to

exclude only the origin of the pseudoaneurysm leaving uncovered the distal CFA slightly above the PFA ostium, and in both patients, an acceptable landing zone up to 3–5 mm was available proximally and distally for the stent-graft to be placed. In our cases, which can be classified as acute/subacute, the pseudoaneurysm's neck was narrow and the arterial wall close to the lesion did not seem to be involved by the pathologic process. Given these considerations, we deemed a relatively short landing zone to be adequate for the stent-graft to be deployed. Conversely, when the pseudoaneurysm represent a chronic situation, usually the neck is wide and there is a concomitant deformation of all vascular components adjacent to the primary lesion. In such cases, when a longer sealing zone is not available, endovascular repair would not be appropriate and open surgical repair would represent a better choice.

Traditionally, endovascular exclusion of IFAPs has been considered only as a bridging method toward a further definitive surgical reconstruction after slowdown of the infection. At our center, in patients with symptomatic pseudoaneurysms who are judged "fit for surgery" at the time of presentation, we usually prefer to execute an extra-anatomic bypass (running across healthy tissue planes) with autologous venous conduits, rather than primary endovascular repair. We believe that, in patients at high surgical risk, the endovascular option could represent more than a bridging measure, leaving a major surgical procedure as a bailout solution if relapse of infection/pseudoaneurysm or ischemic complications are noticed during follow-up. An open question remains about which factors need to be considered as prognostic factors in order to determine those cases in which endovascular treatment is most likely to have a poor outcome. In such cases, endovascular stent-graft placement can represent a temporizing measure, until definitive surgical treatment can be performed under more elective circumstances [9, 10].

As for all endovascular procedures, ongoing surveillance is mandatory to achieve satisfactory outcomes. In our experience, the smaller urban area with referral to our hospital has been a key factor in reaching a satisfactory follow-up even in a subset of patients with an often unsatisfying attendance to scheduled controls. Of significant concern, remains the fact that most of these patients could continue their addictive behavior, and the risk of using the conduits for re-puncture calls for a prudent selection of patients.

Conclusions

Our small experience with two cases of IFAPs in high-risk patients successfully managed with stent-graft placement and aggressive treatment of the infection, shows that this algorithm can represent a safe and effective option. In our small series, at mid-term follow-up, we did not observe any major amputation, nor stent-related complications (i.e., in-stent restenosis, stent thrombosis or stent fracture) or recurrence of infection. There were no procedure-related deaths. However, ongoing surveillance is mandatory after endovascular repair of the CFA, given the great mobility of the hip joint and the dynamic modification of the arterial wall.

Compliance with Ethical Standards

Conflict of interest Mario D'Oria, Giada Sgorlon, Cristiano Calvagna, Francesca Zamolo, Stefano Chiarandini, Roberto Adovasio, and Filippo Griselli have no conflict of interest.

Ethical Approval For this type of study, formal consent is not required.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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