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Surgical Repair of a Post-traumatic Arteriovenous Fistula Complicated by Stent-Graft Misplacement

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Abstract

An arteriovenous fistula (AVF) is an abnormal connection between an artery and a vein which may result from a traumatic injury or occur as a congenital abnormality. It may be asymptomatic or may present with a variety of symptoms. Surgical or endovascular treatment can be preferred. We present a case of unsuccessful percutaneous treatment of a femoral AVF due to misplacement of the stent-grafts, necessitating surgical correction.

Key words: Arteriovenous fistula—Complication—Endovascular treatment—Surgical treatment—Stent-graft—Trauma

An arteriovenous fistula (AVF) may be an incidental finding in an asymptomatic patient or it may manifest with pain, edema, varicosities and even heart failure [1]. The difficulties in detecting post-traumatic vascular injuries are greater than appreciated. Delay in diagnosis will compromise management and potentially may lead to amputation [2]. Treatment of AVFs can be performed either surgically or percutaneously. Although percutaneous treatment is generally preferred, in some circumstances surgical repair may become mandatory.

We present a case of surgical repair of a post-traumatic arteriovenous fistula complicated by stent-graft misplacement.

Case Report

A 23-year-old man was referred to our hospital in March 2003 with chronic progressive swelling of the right leg and claudication after walking 150–200 m. His history revealed that he had been admitted to a medical center immediately after penetrating trauma (stab wound) on the lateral side of his right thigh in October 2002. Percutaneous treatment had been performed in the same week with the diagnosis of traumatic AVF between the superficial femoral artery (SFA) and the superficial femoral vein (SFV) associated with a pseudoaneurysm. After the procedure, antibiotic therapy had been given for 2 weeks due to fever, tenderness and swelling of the right calf. He was discharged after the therapy and was advised 2 more weeks of bed rest and leg elevation. After the first month, swelling of the right calf with the other complaints had regressed partially. He was then told to return 5 months later. After a few weeks, swelling of the calf had become more prominent and progressive claudication had started.

When he came to our hospital, there was visible engorgement of the right leg veins, more prominent in the calf region, subcutaneous capillary prominence, a 3 cm difference in circumference between right and left calf, and a palpable thrill at the stab-wound level. The distal pulses were not palpable. To determine the presence of any stenosis, thrombosis or occlusion, a color Doppler ultrasound (US) examination of the lower extremities was performed. This revealed an increased low-resistance flow pattern in the common femoral artery and in the SFA, a patent stent in the SFA and turbulent flow at the distal end of the stent. In addition there was significantly increased arterialized flow in the SFV and greater saphenous veins, distension of the popliteal vein (PV) and crural veins (CrVs), and many subcutaneous venous-type collaterals. There was no color filling or spectral pattern in the popliteal artery (PA). In the crural arteries (CrAs) a very slow monophasic ischemic flow pattern, resembling weak collateral circulation, was detected. To delineate the exact anatomy digital subtraction angiography (DSA) was performed. This revealed passage of contrast from the SFA to SFV through two overlapping stent-grafts (Fig. 1A). It was also noted that the PV and CrVs were all dilated and tortuous (Fig. 1B), and that there was no passage of contrast to the PA and CrAs below the level of the stents.

These findings suggested that the stent-grafts were misplaced between the SFA and SFV, which made the symptoms eventually become more prominent instead of diminishing after the percutaneous procedure. Retrospective evaluation of the angiograms revealed that the proximal end of the first stent was located in the SFA while the distal end was in the SFV lumen (Fig. 2). It was also seen that a second stent-graft, overlapping the first one, had been placed in the SFV, which confirmed that the position of the distal end of the first stent in the SFV had been overlooked. Before the operation to restore the normal anatomy, all the findings were also discussed with the radiologist who had performed the procedure at the first center. It was learned that the fact that the distal end of the first stent-graft (8×50 mm, Wallgraft-Endoprosthesis, Boston Scientific, USA) was in the SFV was not recognized at the time and an identical second stent-graft was deployed overlapping the first one in the belief that the first stent-graft did not cover the fistula. After the re-evaluation and confirmation of the misplacement of the stent-grafts, surgery was planned to restore the normal anatomy.

During the operation, to avoid excessive hemorrhage due to the extensive network of dilated and engorged veins, an occlusive balloon catheter was advanced through the left common femoral artery to the proximal part of the right SFA, where it was inflated from just before the vascular incision was made until the end of the arterial reconstruction. Reconstruction of the SFA and the SFV walls with polytetrafluoroethylene (PTFE) patches was achieved by cutting the rigid stent-grafts. Restoration of both the arterial and the venous blood flow was achieved. The proximal part of the stents were left in the SFA and the distal part left in the SFV. After the reconstruction of the normal anatomy, the arterial balloon was withdrawn and a peroperative control DSA was performed. This revealed the restoration of a normal popliteal and crural arterial circulation and no

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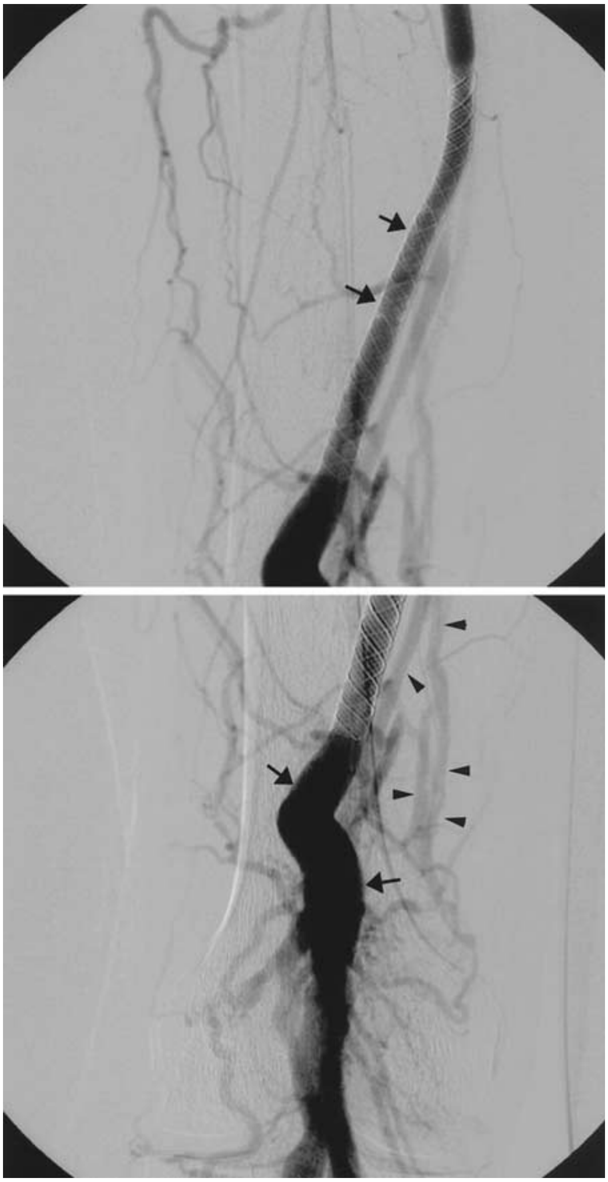

Fig. 1. Digital subtraction angiography revealed **A** passage of contrast through two overlapping stents (arrows) connecting the SFA and SFV, and **B** a dilated popliteal vein (arrows) and venous fillings (arrowheads).

passage of contrast to the SFV (Fig. 3). Total blood loss was not more than 500 ml and the overall duration of the procedure was approximately $1\frac{1}{2}$ hr.

Postoperatively, 125 mg/day of acetylsalicylic acid and low-dose coumadin were started. On the first day, a color Doppler US examination revealed patent arterial and venous flow, and there was no thrombosis. The patient was discharged without any problems on the fifth day. At follow-up on the seventh day the edema in his leg was significantly diminished, there was no complaint of claudication and color Doppler US showed patent arterial and venous flow. The 1, 6 and 9 month follow-up controls revealed no complaint or swelling of the right leg. Color Doppler US examinations showed patent arterial and venous flow.

Discussion

Since the first report of transfemoral treatment of abdominal aortic aneurysm by Parodi et al. in 1991 [3], many clinical experiences have been reported concerning the use of the stent-

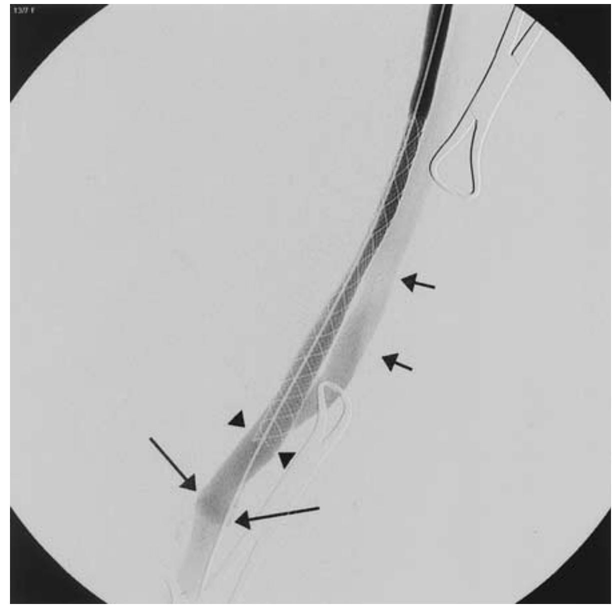

Fig. 2. Initial angiography shows the proximal part of the first stent in the SFA lumen while the distal end (arrowheads) is in the SFV lumen. Note the distal end of the stent is located just proximal to a venous valve (long arrows) that causes a contrast density difference between the proximal and distal parts of the valve. Venous filling in the SFV is also seen (short arrows).

grafts in many types of vascular lesion such as pseudoaneurysms, arteriovenous fistulas, arterial ruptures and perforations [4–10]. There are two main Dacron-like synthetic polymeric materials used in stent-grafts: expanded polytetrafluoroethylene (ePTFE) and polyethylene terephthalate (PET). Although successful use of stent-grafts in the treatment of peripheral disease and aneurysms has been reported [11, 12], there are some reports of a high rate of thrombosis [13]. There are also some reports of neointimal growth and inflammatory response to graft materials causing significant luminal narrowing. PET causes a greater inflammatory response and neointimal growth than ePTFE, and therefore luminal narrowing, especially in small and medium-sized vessels 5–10 mm in diameter [14, 15]. In our case two PET-covered stent-grafts were used, which carry the possibility of restenosis in the SFA. This should be taken into consideration in choosing a stent-graft.

Endovascular treatment is a less invasive treatment modality and does not have the disadvantages of open surgery. The main aim of using this technique is to avoid the possible mortality and morbidity issues associated with the standard and widespread use of the surgical alternative. Surgery has more risks, including general anesthesia and surgical complications, which can be avoided in endovascular treatment. These complications include hemorrhage, infection and cutaneous scarring. In addition, in cases of AVF the surgeon often finds a tangle of vessels that makes it difficult to identify the fistula track. On the other hand, although the technical success rate is reported to be between 80% and 100%, endovascular therapeutic approaches have their own complications [4, 6, 10–6, 10]. Stent occlusion is the most important one, with a reported incidence of 17% [8]. Stent deformation and kinking, and the loss of branch vessels after placement, are also reported [16, 17]. In our case, the attempt at endovascular closure of the

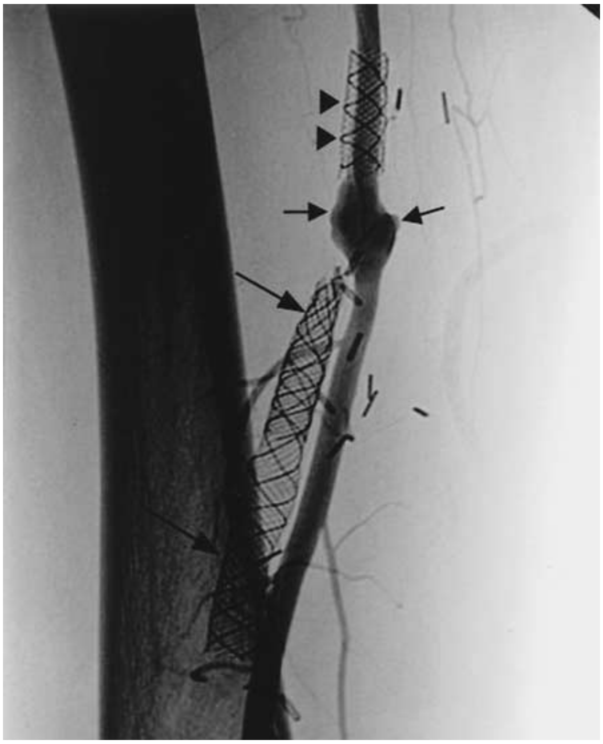

Fig. 3. Control angiogram shows the proximal part of the first stent in the SFA (arrowheads), the reconstructed region of the vessels' walls with PTFE patches (short arrows), and the stent parts in the venous system (long arrows).

AVF between the SFA and SFV due to a stab wound was unsuccessful, which made surgical correction mandatory. The cause was the misplacement of the stent-grafts between the SFA and SFV, causing the AVF to become more prominent. Although many complications of endovascular therapies have been reported, to our knowledge misplacement of stent-grafts between artery and vein in AVF treatment has not been reported previously. In such procedures, location of the fistula and the patency of the distal vascular system should be checked carefully before stent deployment. A double-lumen catheter may be used for this procedure. After advancing the double-lumen catheter distal to the lesion site over the guidewire, distal vascular patency can be controlled by contrast injection through the second lumen. The precise location of the fistula can be determined by injecting contrast medium while withdrawing the catheter slowly. Passage of contrast to the venous system could clearly be seen at the fistula level because of the pressure gradient between the artery and the vein. An alternative method would be to advance a single occlusion or PTA balloon below the fistula over a 0.018 inch guidewire and to inject contrast parallel to the guidewire via a Tuohy-Borst. After determination of the distal vascular patency and the location of the fistula level, without moving the guidewire, the stent-graft could be deployed at the lesion site. In this case, although the distal vascular system and guidewire position seem to have been checked before stent implantation, it had been overlooked so that the procedure had resulted in misplacement, necessitating surgical treatment. In this case arterial and venous blood flow were restored, after reconstruction of the SFA and SFV walls with PTFE patches, by cutting the rigid stent-grafts. Although maintenance of the arterial blood flow is important for salvage of the extremity, maintenance of a patent venous drainage is also important with regard to long-term outcome.

In conclusion, endovascular procedures are less invasive and have many advantages over surgery. However, unpredictable complications do occur which make surgery mandatory. To avoid such complications, the procedures must be performed very carefully in experienced hands.

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