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## Technical management of traumatic arteriovenous fistula: Tips and tricks

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### ABSTRACT

**INTRODUCTION:** Traumatic Arteriovenous Fistulas (AVFs) are a rare complication of vascular injuries and pose a problem of topographic diagnosis and therapeutic management. Delayed treatment may cause cardiac and trophic complications.

**PRESENTATION OF CASES:** We describe 4 cases of AVFs complicating stab wounds of the lower limb, associated in 2 cases with pseudoaneurysms.

**DISCUSSION:** In two cases we performed a surgical repair, whereas in the other 2 patients we choose an endovascular treatment with wall graft stent placement.

**CONCLUSION:** All traumatic AVFs must be treated to avoid vascular, local and general complications. Using both techniques, we had great results with no complications.

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## 1. Introduction

Traumatic arteriovenous fistulas (AVF) are a rare complication in vascular trauma, especially among civilians; it was more frequently identified in military personnel with blast injuries or gunshot wounds. AVFs are a rare complication of vascular injuries and pose a problem of topographic diagnosis and therapeutic management. These vascular traumatism can be difficult to manage with complex arterial and venous injuries and adaptive changes in the vessels. Delayed treatment may cause cardiac and trophic complications.

Surgical repair has been the treatment of choice for years, especially in urgent management of hemorrhage, but recently endovascular approach with stent-graft placement became a reliable method to treat AVF; it seems to be a safe choice especially with the advances in endovascular techniques.

We report 4 cases of traumatic AVF among which 2 cases were associated to pseudoaneurysm. Furthermore, we report 4 different situations as well as the different elements that have guided our therapeutic choice.

The work has been reported in line with the SCARE criteria and cite the following paper: Agha RA, Borrelli MR, Farwana R, Koshy K, Fowler A, Orgill DP, For the SCARE Group. The SCARE

2018 Statement: Updating Consensus Surgical Case Report (SCARE) Guidelines, International Journal of Surgery 2018;60:132–136.

## 2. Case reports

### 2.1. Case 1

The procedure was performed by the chief of the vascular department.

An 18 year-old male patient with no medical history or drug consumption, was stabbed 4 years ago in his left mid-posterior thigh and now suffering from a chronic venous ulcer on his left leg with varicose veins and swelling (Fig. 1A). Physical examination found that the left lower limb was larger than the right one with oedema, and a strong thrill at the mid thigh with normal palpable pulses. Computerized tomography (CT) angiography demonstrated a large AVF between the superficial femoral artery and the femoral vein, with an important dilatation of the artery proximal to the fistula and the veins proximally and distally (Fig. 1B, C). A selective arteriography showed with precision the fistula located at the mid-thigh (Fig. 1D). A surgical intervention was undertaken, we performed a direct approach, the dissection found a very large fistula (2 cm) with enlarged artery and vein (Fig. 1E), that we repaired with a running sutures. The postoperative course was uneventful and the patient was discharged after 3 days with a prescription of aspirin 160 mg and elastic restraint. At the first month follow-up the patient showed complete recovery.

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**Fig. 1.** A: Image showing swelling, varicosities and leg venous ulcer. B: CT angiography (3D) showing a femoral fistula with very enlarged veins. C: CT angiography showing the dilated veins, Note the dilation of the iliac vein (black arrow). D: arteriography image showing the femoral fistula (direct communication between femoral vessels with venous opacification in the arterial phase). E: per-operative image after dissecting demonstrating the fistula and the vessel defect.

## 2.2. Case 2

The procedure was performed by a PhD.

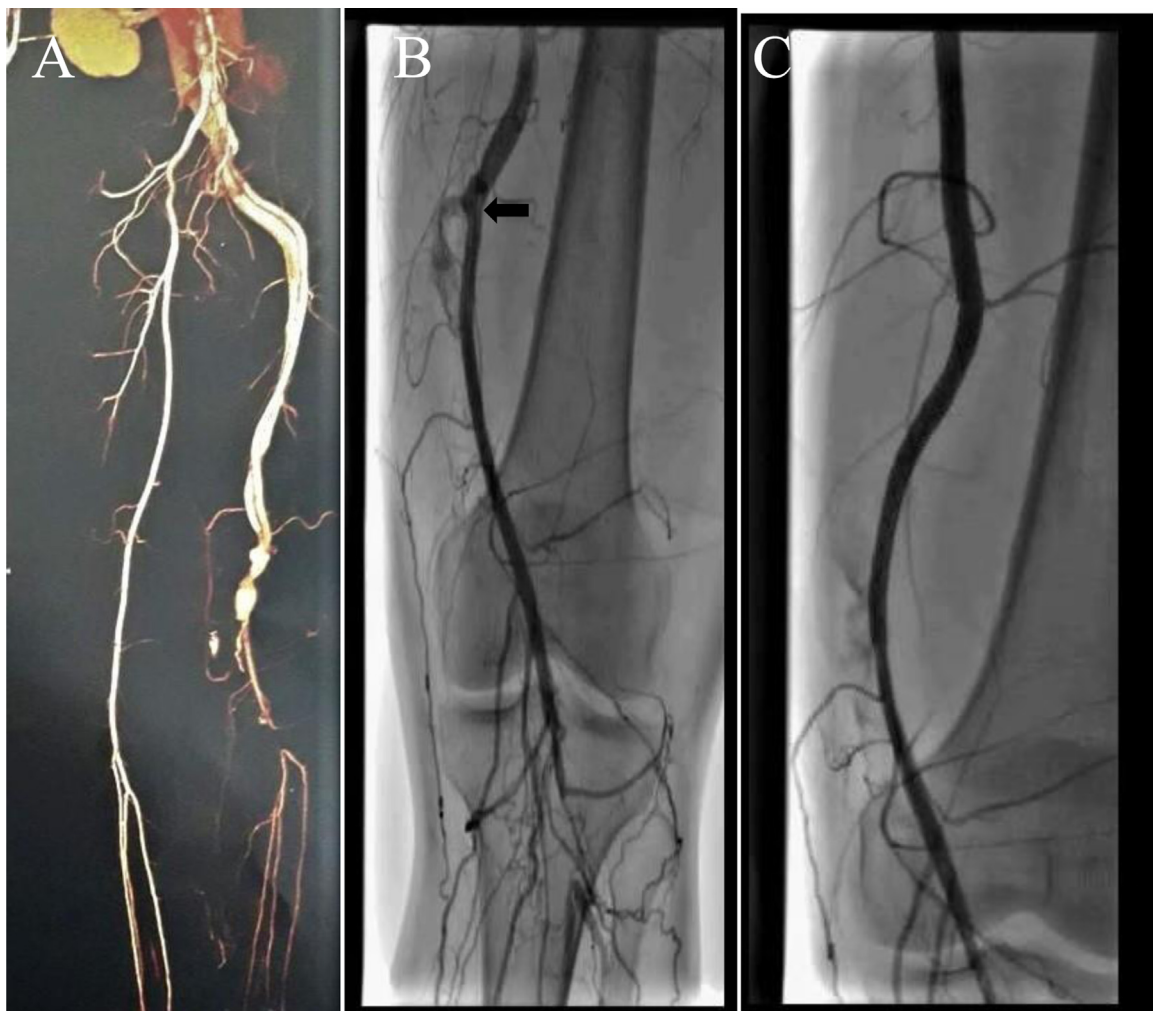
A 47 year-old male with a history of hypertension and no drug consumption, who sustained a stab wound to his left lower-external thigh, the injury was initially explored and sutured in another hospital, he was readmitted 72 h after the trauma due to pain and swelling at his lower left limb, clinical examination found a cold lower extremity with no distal pulses and a thrill at the thigh. CT angiography showed a femoro-femoral AVF with a chronic popliteal artery occlusion (Fig. 2A). The patient was admitted to the operating room where we performed a selective angiography that helped locating the AVF and evaluating the popliteal occlusion (Fig. 2B), an 8 mm × 40 mm stent graft was deployed to cover the AVF and the occlusion was treated by balloon angioplasty successfully (Fig. 2C). The patient was discharged the next day with no

reported complications, and was put under anti-platelet therapy: clopidogrel 75 mg daily for 3 months. The patient had a Doppler ultrasound at 2 weeks, which revealed a patent stent graft without evidence of stenosis or any deep venous thrombosis, distal pulses were palpable.

## 2.3. Case 3

The procedure was performed by a PhD.

A 27 year-old male, with no medical history or drug consumption, who was stabbed 2 months ago in his left lower-anterior thigh, complaining from swelling and pain in his left limb, a pulsatile mass at his thigh (Fig. 3A) and exertional dyspnea. Clinical examination found a pulsatile mass located at the upper part of the popliteal fossa, with palpable pulses and a continuous thrill with signs of heart failure. CT angiography showed the popliteal



**Fig. 2.** A: CT angiography (3D) showing a femoral fistula with a short popliteal occlusion. B: arteriography image showing the femoro-femoral fistula black arrow and the popliteal occlusion. C: arteriography image showing the results after angioplasty of the popliteal artery and the placement of the stent-graft covering the fistula.

pseudoaneurysm ( $10 \times 6$  cm) (Fig. 3B) associated to the AVF with very dilated artery (17 mm) and veins (Fig. 3C). We treated the patient by endovascular technique first (Fig. 3E, F), placing a stent graft, Cheatham Platinum (CP) Stent System ( $18$  mm  $\times$   $45$  mm) and we performed a mini-invasive surgery to remove the compressive pseudoaneurysm (Fig. 3D). The patient was discharged few days later with no complications and was put under anti-platelet therapy: clopidogrel 75 mg daily for 3 months. The one-month follow-up with Doppler ultrasound showed a permeable stent.

#### 2.4. Case 4

The procedure was performed by a junior resident with 4 years of specialised training

A 21 year-old male with no medical history or drug consumption, who was stabbed in his right lower-internal thigh 3 weeks ago, admitted at the hospital for swelling and sharp pain at his thigh complicated with skin erosion surrounding the wound. Clinical examination found a pulsatile masse with a continuous thrill and inflammatory signs at the skin that showed early signs of impending rupture (Fig. 4A). CT angiography revealed a pseudoaneurysm of the superficial femoral artery with a femoro-femoral AVF (Fig. 4B). The patient was admitted urgently to the operating room where we performed a surgical repair of the artery, after removing the pseudoaneurysm, with a venous graft and we repaired the vein with running sutures (Fig. 4C, D). The postoperative course was unevent-

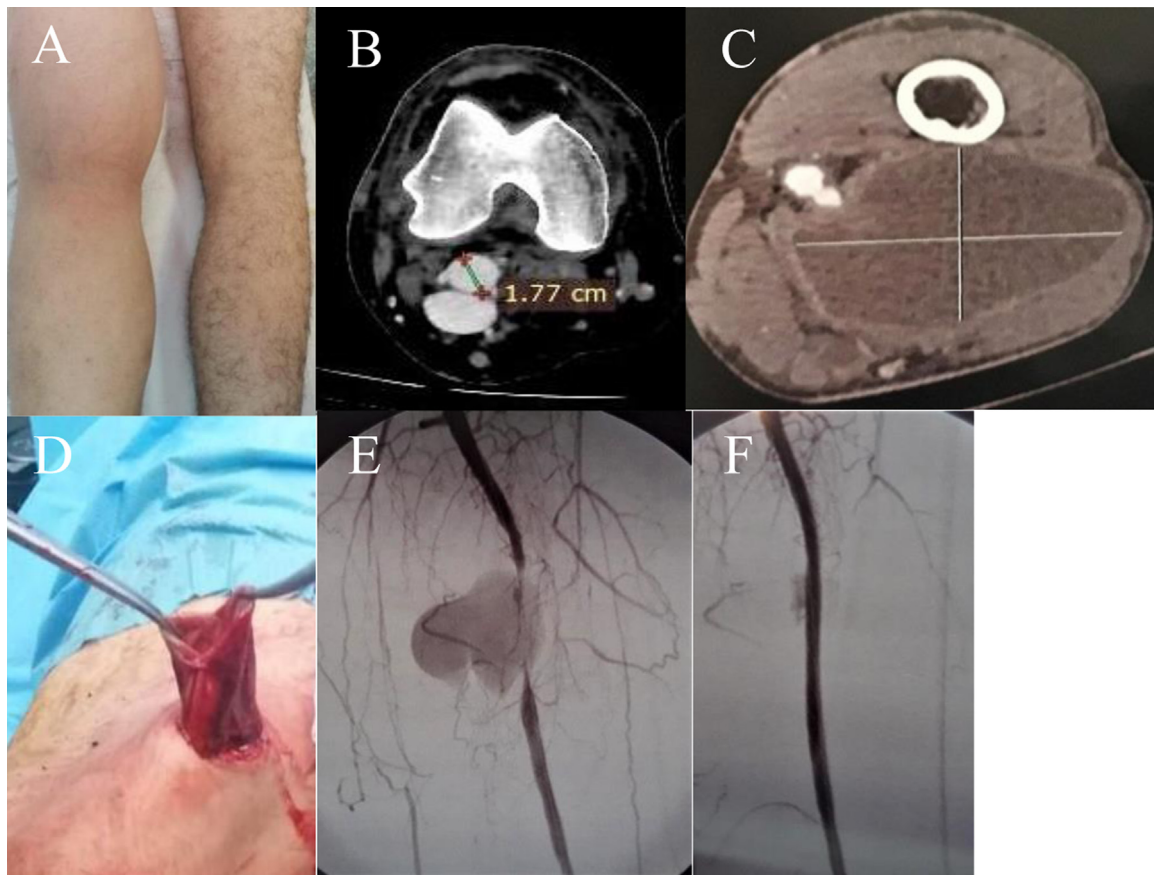
ful and the patient was discharged after 4 days with a prescription of aspirin 160 mg and elastic restraint. At the first month follow-up the patient showed complete recovery.

### 3. Discussion

First described in 1761 by William Haunter, traumatic AVF depends on the mechanism and the localization of the vascular injury and varies between military personnel and civilians. Penetrating trauma due to gunshot wounds (GSW) or stab wounds (SW) account for the majority (61.7%) of civilian. Robbs et al. reported 210 civilian traumatic AVFs, SWs accounted for 63%, whereas GSWs accounted for 26% and blunt trauma for 1% [1].

In our context traumatic AVFs are mostly seen in young adults and are due to stab wounds, which is the case of our patients. When they go unnoticed these AVFs evolve on a chronic mode resulting in various complications such as limb oedema and swelling, deep venous insufficiency, varicose veins and venous ulcer, the increase of preload and ultimately cardiomegaly and heart failure [1].

The interval between the injury and the diagnosis of the AVF is estimated to be from 10 days to 33 years in the literature [2], in our 4 cases this interval was 4 years, 2 months, 3 weeks, and 72 h respectively. The longer this interval is, the more the changes in vessels structure are important, they involve elongation tortuosity and dilatation of both the vein and the artery proximal to the AVF, and



**Fig. 3.** A: Image showing limb swelling and the tumefaction due to the pseudoaneurysm. B: CT angiography showing the pseudoaneurysm. C: CT angiography showing the dilated femoral vessels. D: Arteriography image showing the pseudoaneurysm. E: Arteriography image showing the results after stent-graft placement covering the fistula. F: per-operative image showing the pseudoaneurysm resection by a mini-invasive surgery after endovascular.

in other cases a pseudoaneurysm is associated causing compression of the adjacent anatomic structures especially nerves, with a high risk of rupture due to skin erosion [3].

The clinical diagnosis is made following the symptoms and complications described above. Clinical examination finds the classic sign of an AVF: continuous thrill, with a pulsatile masse in case of an associated pseudoaneurysm.

Doppler ultrasound can be very useful for diagnosis, but CT angiography allows more precise mapping of vascular lesions and adjacent structures, especially in a combination of AVF and pseudoaneurysm [4,5].

Selective angiography has the advantage over other investigation techniques because it can be combined with therapeutic intervention, and it helps to identify the precise localisation of AVF. It shows early venous filling and lack of opacification of the distal arteries, which is the typical aspect of an AVF [1,6,7].

AVF treatment can be managed by ultrasound guided compression and monitoring with bandage compression in case of recent and small iatrogenic AVFs [1]. But surgical or endovascular repair are usually performed to treat AVFs, in fact, both techniques can be combined when a pseudoaneurysm is associated.

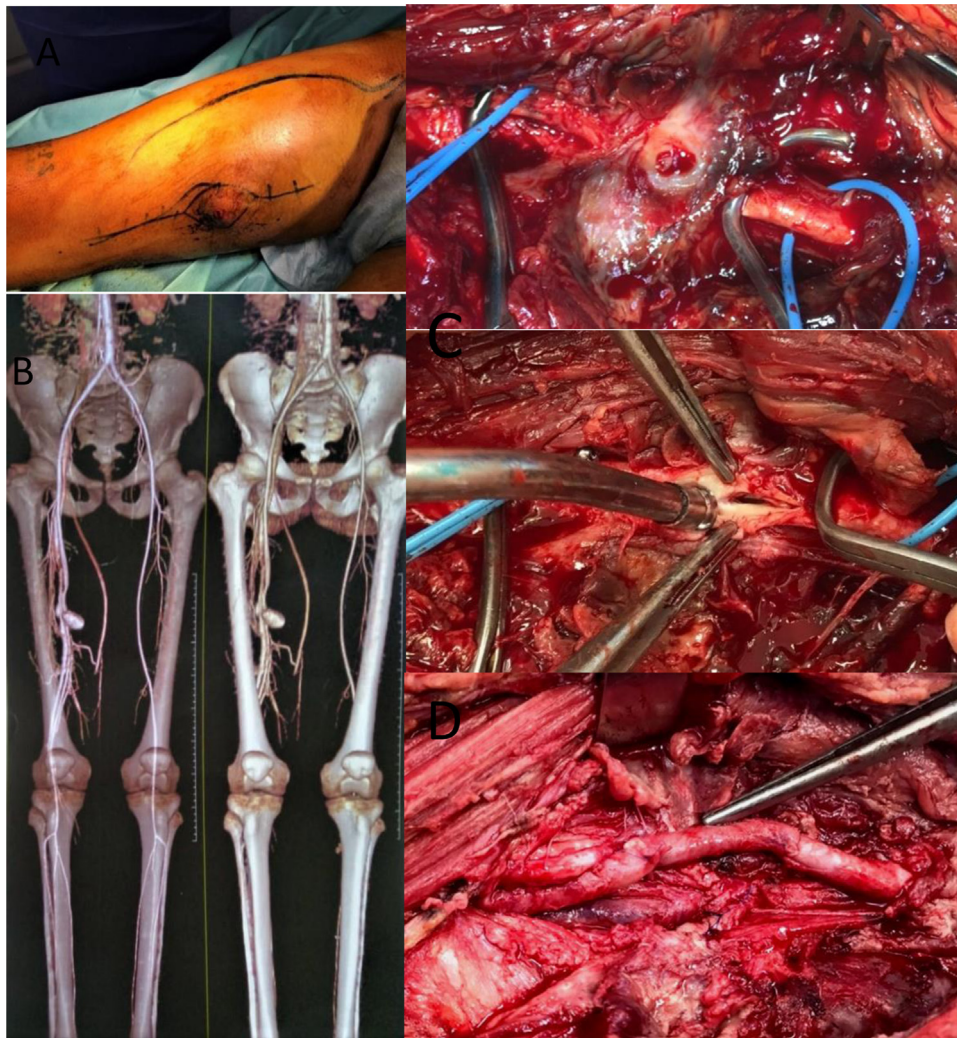
Surgical repair has been the treatment of choice for years, especially in young and healthy adults [7], in urgent management of hemorrhage where it offers a better exposure and control of vessels, allowing repairing the arteriovenous defect with an autogenous or prosthetic patch or interposition graft [1]. But this therapeutic approach is highly associated with peri and postoperative complications such as iatrogenic nerve injuries or vascular rupture considering the hostile environment of the post traumatic fistula

that can also be accompanied with a pseudoaneurysm, in addition to considerable perioperative mortality [8].

Embolization can also be recommended but it can be difficult to realize because of the short neck of the fistula [2].

Recently, endovascular approach with stent-graft placement became a reliable method to treat AVF; it seems to be a safe choice especially with the advances in endovascular techniques and the introduction of shorter length stent-grafts with bigger diameters that are more suitable with large AVF [1]. White and al reported a study of traumatic arterial injuries treated with wall graft endoprosthesis, the patency rates were comparable to open surgery [9].

We treated two of our patients surgically because in the first case, the femoral vein and artery were very dilated, but in the case 4, surgical intervention was the best choice because of the high risk of rupture of the associated pseudoaneurysm. In the other two cases we chose an endovascular approach, in case 2 the AVF was discovered after 72 h and there was no important dilatation in the vessels, so a stent-graft was placed to cover the fistula successfully and at the same time we treated a popliteal occlusion, in the case 3, the patient was showing signs of heart failure so endovascular repair seemed to be a more adequate choice to avoid complications, the increased dimensions of the superficial femoral artery proximally and distally to the AVF (17 mm) excluded the use of the available peripheral stent-grafts. So, we decided to use a Cheatham platinum stent, which was considered as the most suitable for the case. Graft deployment was relatively easy and we managed to cover the fistula and the pseudoaneurysm, then followed by a mini-invasive surgery to remove the pseudoaneurysm and reduce the compression effect, the combination of these two techniques helped shorten



**Fig. 4.** A: Pre-operative image showing skin erosion caused by the pseudoaneurysm and the swelling at the right thigh. B: CT angiography (3D) showing the pseudoaneurysm and the femoral AVF. C: per-operative images after evacuating the pseudoaneurysm showing the femoral AVF. D: per-operative image showing the results after repairing the superficial artery with a venous graft and the femoral vein.

both operative time and hospital stay considering the risks with this patient.

The follow-up of our patients, controlled by Doppler ultrasound, showed no signs of complications, and a comparable satisfying long term results with both techniques.

#### 4. Conclusion

Once diagnosed, all traumatic AVFs must be treated to avoid vascular, local and general complications [10]. Actually there are no prospective randomized controlled trials to compare the effectiveness of surgical and endovascular repair. The surgical repair is still an efficient and durable option that has been practiced for years. While endovascular techniques seem to be a promising alternative that can be safer with low morbidity rates, especially for unstable patients. In some cases, the combination of both treatments can offer excellent results.

The work has been reported in line with the SCARE 2018 criteria [11].

#### Declaration of Competing Interest

The authors report no declarations of interest.

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#### Ethical approval

Exempt from ethnical approval in my institution.

#### Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

#### Author contribution

BOUNSSIR Ayoub: Conception, Methodology, Software, Data curation, Writing - Original draft preparation.

TAGHI Houda: Writing, Data collection

SEDKI Nabil: Critical revision, Approval of the manuscript.

BAKKALI Tarik: Data curation, Analysis.

LEKEHAL Brahim: Critical revision, Approval of the manuscript.

**Registration of research studies**

N/A.

**Guarantor**

BOUNSSIR Ayoub.

**Provenance and peer review**

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