



Management of Traumatic Recurrent Arteriovenous Fistula of the Lower Extremity: Open Versus Endoscopic Repair

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Abstract

Background: Traumatic Arteriovenous Fistula (TAVF) and traumatic artery aneurysms are the late complications of vascular injuries. Complications arise from neglected or undetected cases of TAVF, hence the need to promptly diagnose and manage them.

Aims/Objective: this is to highlight the principles and challenges of managing traumatic recurrent AVF of the lower extremity in a low income setting like ours. We present a 43-year-old man with traumatic recurrent AVF of the lower extremity, associated with chronic venous disease and ankle ulcer dating 17 years, who underwent successful treatment *via* open repair, in our facility, through the combined efforts of multidisciplinary team involving vascular and plastic surgeons as well as physiotherapist.

Introduction

Arteriovenous Fistula (AVF) is a direct connection between an artery and vein at a point proximal to the capillary. The causes of this abnormality are threefold and include congenital, therapeutic and traumatic (iatrogenic and accidental). It is related to arteriovenous malformations but the distinguishing characteristic between the two is the presence of vascular nidus or nest or epicenter that connects the artery and vein (arteriovenous malformations). It can involve consequential or non-consequential vessels. It may involve central or peripheral vessels.

AVF was first described as an entity in medicine by William Hunter in 1752, followed by first attempt at surgical correction by Breschet in 1837. He tried to eliminate the fistula by ligation of the proximal or feeder artery [1]. Various factors do play a role in the etiology of AVF, the incidence of which is difficult to determine because of the possibility of delay in diagnosis for years [2,3]. Absence of spontaneous regression within two weeks is an indication for surgical or endovascular treatment [4].

It is one of the most fascinating and misdiagnosed complications of vascular injuries, whether military or civilian [5].

Surgery may involve excision or quadruple ligation if the vessels involved are inconsequential. When the affected vessels are consequential, treatment may involve direct primary repair or anatomical reconstruction using autogenous vein graft, synthetic interposition graft or bypass [6].

AVF causes venous hypertension, arterializations of the vein wall, varicose veins and venous ulcer including local gigantism or limb overgrowth. Large AVF causes high output cardiac failure which may manifest as dyspnea and peripheral leg edema. Aneurysmal degeneration of the involved artery and venous segments (structural changes) from hemodynamic stress may occur. Total peripheral resistance is lowered distal to the fistula. Subacute Bacterial Endocarditis (SBE) at the site of the fistula and venous insufficiency including peripheral ischemia may occur as complications [6-8].

Case Presentation

A 43-year-old commercial bus driver presented to our service with two months history prior, of fifteen years history of recurrent right leg swelling. His problem, when it started was insidious in onset. The swelling initially started in the foot and later deteriorated to involve the leg and the thigh. There was associated varicose veins and circumferential ankle ulcer. There was associated pain, worsened by activities like standing and walking and relieved by analgesics. There was a preceding history of gunshot injury to the right lower limb two months prior to the onset of symptoms. He

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Figure 1: Thigh circumferences (30 cm from anterior superior iliac spine): (R) is 59 cm while (L) is 54.5 cm. Leg circumferences (15 cm from tibial tuberosity): (R) is 42.5 cm while (L) is 38 cm.

initially presented to a peripheral hospital where he was evaluated and diagnosed as a case of traumatic arteriovenous fistula, after digital subtraction angiography. Repair of the AVF was done and patient had an un-ventual recovery. However, three months after, the symptoms relapsed, necessitating patient presentation to our service, for expert management.

Examination revealed a middle-aged man in no obvious distress, afebrile, severely pale, anicteric, acyanosed, not dehydrated, nil peripheral edema of the contralateral limb. Musculoskeletal evaluation showed right lower limb that was swollen up to the mid-thigh with hyperpigmentation and engorged tortuous veins noted around the upper two third (2/3) of the leg. The oedema was non-pitting. There as tender circumferential ulcer at the ankle, with sloping edge and floor oozing seropurulent, foul-smelling discharge. All peripheral arterial pulsations and skin sensations were intact. There was significant thrill felt over the mid-thigh extending to the femoral triangle. The bruit was positive over the sites of the thrill. However, bruit was more pronounced at the mid-thigh. There was no abnormality in the contralateral limb (Figure 1).

In the cardiovascular system examination pulse rate was found to be 89 pulsations per minute, full volume and regular rhythm. All the peripheral pulses were present and synchronous. Blood pressure was 110/60 mmHg. There was no raised jugular venous pressure. Apex beat was on the 5th left intercostals space, midclavicular line. Heart Sound, S1&S2, were heard and no murmur.

Respiratory system examination showed that respiratory rate was 20 cycles per minute and SPO₂ on room air was 98%. Auscultations revealed vesicular breath sound and no added sound.

There were no significant findings in the abdominal and urogenital examinations respectively.

Confirmatory Investigations (Doppler ultrasound) done was not helpful as it demonstrated as follows: Artery and vein in the distal third of the thigh with suspected right arteriovenous fistula involving the superficial femoral artery with areas of AV fistula in the pelvic cavity (external iliac artery and vein and common femoral artery and vein on the right). There were prominent superficial veins in the right which suggest an inflammatory response rather than venous insufficiency.

However, the computerized tomography scan showed the followings: Early enhancement of the right external iliac vein, common femoral vein and superficial femoral vein with focal berry aneurysmal dilatation is demonstrated.

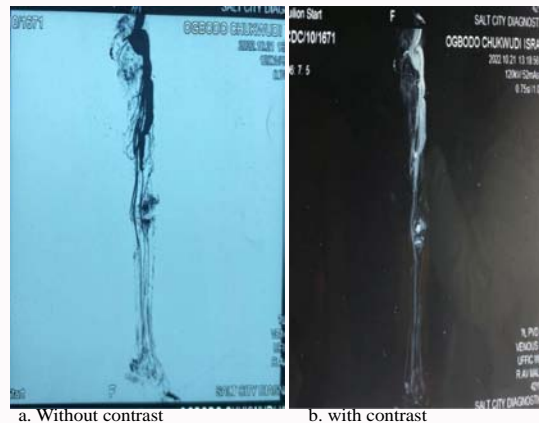


Figure 2: Digital subtraction angiography.

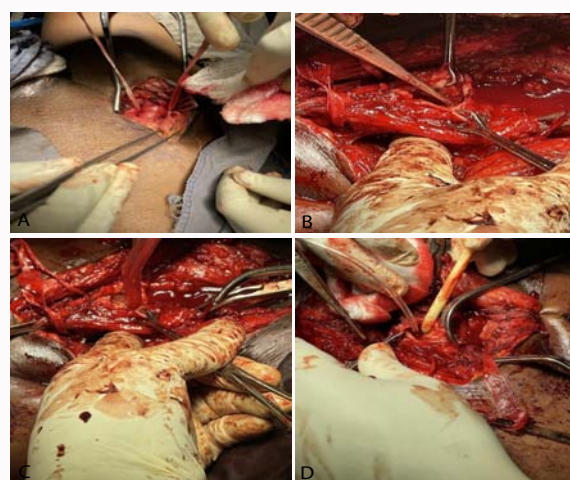


Figure 3: Intra-operative details. A) Longitudinal incision was made in the groin to achieve proximal control of common femoral artery. B) A second longitudinal incision was made in the mid-thigh to achieve distal control and access the fistula. C) Arteriotomy was done and the fistula identified. Surgical field was suctioned to provide clear field. D) Urethral catheter, size 16 was introduced into the fistula and inflated to plug occlude the fistula. A size 16 NG tube was passed into the distal lumen. Fistula was then closed using Prolene 3/0 and arteriotomy repaired with same suture size. Wounds were closed in layers with passive drain *in-situ* around the site of the arteriotomy. The thrill disappeared. Patient received 4 units of blood.

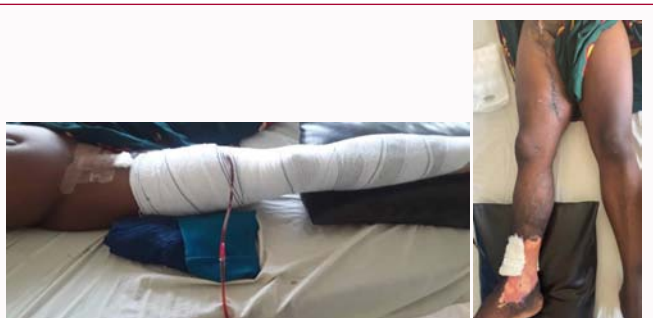
The right common femoral vein, superficial vein and its corresponding arteries appear engorged relative to the contralateral lower limb with abrupt change in the caliber noted at the level of proximal 2/3rd slightly above the knee.

Extensive vascular nidus within the soft tissues of the medial right thigh is noted with the arterial supply arising from the small branches of the femoral artery and profunda femoris.

The left lower limb appears to be normal in its vascular configuration.

There is asymmetry in the size of the lower limb (RT>LT) consistent with right hemihypertrophy (Figure 2a, 2b).

On the bases of the clinical evaluation with the investigations, a working diagnosis of traumatic recurrent right lower limb Arteriovenous Fistula (AVF) complicated with Chronic Venous Disease (CVD) and ankle ulcer was made.



3E (Day 1 postop) 3F (7 days postop)
Figure 3: E) Wound dressing clean and dry. About 120 ml of bloody effluent in the drain container. F) After a week, wound inspection showed superficial proximal wound breakdown at groin region. There was no thrill and no bruit either in the groin or the mid-thigh. Wound drain was removed. Patient was commenced on daily dressing for the proximal wound. Care for the ankle ulcer continued by the plastic unit.



G. (2 Months Postoperative).
Figure 3: G) 2 Months Postoperative

Treatment was multidisciplinary involving vascular and plastic surgeons as well as physiotherapist. Patient was admitted into the ward and treated with parenteral antibiotics and analgesics. He was transfused 2 units of blood (post-transfusion hemoglobin was 11.3 g/dl). Wound care was also commenced by the plastic surgery unit. He later had surgical repair of AV fistula on the 9th of November, 2023.

Intra-operative details

Right lower limb still swollen but has improved substantially. Circumferential right ankle ulcer showed healthy granulation. Thigh circumferences: (30 cm from Anterior superior iliac spine): Right – 56 cm, left – 54.5 cm. Leg circumferences: (15 cm from tibial tuberosity) Right – 40 cm, Left – 38 cm (Figures 3A-3G and Table 1).

Discussion

Vascular injuries caused by civilian or war trauma represent a surgical challenge. These lesions are potentially lethal and can cause death at the scene. One of the most fascinating and misdiagnosed complications of vascular injuries is the Arteriovenous Fistula (AVF), which results from a direct communication between an artery and a vein [9]. They are usually secondary to penetrating trauma and occasionally may be diagnosed many years after the injury. AVF represents significant diagnostic and management challenge. Angiography is necessary to identify the affected vessels as this helps to develop a surgical treatment plan (open/close/combination) [10]. Comprehensive clinical cum investigative review helps to do hemodynamic analysis and enables the choice of either open or close approach.

When AVF presents with complications, multidisciplinary approaches are needed and they may involve vascular and plastic

Table 1: Comparative limb sizes after 2 months postop.

	Preop		Postop	
	Right	Left	Right	Left
Thigh Circumferences (30 cm from ASIS)	59 cm	54.5 cm	56 cm	54.5 cm
LEG Circumferences (15 cm from TIBIAL TUBEROSITY)	42.5 cm	38 cm	40 cm	38 cm

surgeons, hematologist cardiologist, interventional radiologist and physiotherapist. In the index case, vascular and plastic surgeons as well as physiotherapist were involved in the management.

The objectives borne in mind in the management are to close the AVF, maintain the patency of the consequential vessels and exclude or excise the non-consequential vessels as well as decrease or eliminate number of complications such as cardiac failure, venous hypertension and local gigantism among others [11]. In the index case, there was evidence of reduction in local gigantism after repair (Table 1).

The principles of treatment are sequential and include obtaining proximal and distal control, wide exposure over the point where the thrill is palpated highest or the area of the AVF, as outlined by preoperative angiography. Systemic heparinization and arteriotomy for closure of the AVF under clear vision and then the arteriotomy [12]. In the index patient, femoral artery and vein are consequential vessels; the above principles were followed to the later (Figures 3A-3D). Unlike the index case, where the communication site is complex, the artery should be ligated and reconstruction effected using autogenous vein graft or prosthesis. Bypass can also be done [13].

The open approach may be fraught with danger owing to grossly distorted and edematous tissue planes and late presentation of AVF is prone to significant intra-operative bleeding due to the complex vascular anatomy encountered during surgical dissection and repair [14]. In the index case, there was dense adhesion and venous hypertension that led significant intra-operative blood loss. To avoid morbidity and mortality associated with open procedure, emphasis is now on endovascular approach.

In developed centers unlike ours, with equipment and expertise to manage this type of AVF, the objectives are usually to selectively eliminate the AVF *via* endoscopic approach with preservation of normal patency of consequential vessels (femoral artery and vein) and reduce morbidity and mortality encountered in open repair. In addition to this inherent advantage, there is rapid postoperative recovery, reduction in pain and disability. Available options in the endoscopic treatment are the use of covered stents (expandable or non-expandable), coil embolization and balloon occlusion techniques. It is noteworthy that biodegradable and retrievable stents are now available for use in the cutting-edge technology to manage challenging AVFs especially in children [15,16].

On the other hand, the following factors will make open treatment inevitable: Discrepancy between proximal and distal diameters of the vessel, impossibility of catheterization of the vessel, injuries that need exploration, hematoma with compressive symptoms and infected wounds [17,18]. The index case was suited for endovascular treatment, but our center lacked the technical know-how.

Conclusion

Management of large AVF of the lower extremity, with prolonged duration, where consequential vessels are involved, not to talk of recurrent one, complicated with chronic venous disease and ulcer,

is very challenging. However, the adoption of standard principles coupled with expertise of a competent vascular surgeon alongside other multidisciplinary team, there was resolution of symptoms with patient recovering satisfactorily. The absence of endoscopic treatment facility in our facility sometimes, creates avoidable morbidity like severe postoperative pain, delayed recovery and prolonged hospital stay.

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