Acquired Arteriovenous Fistulae: A Study of Three Cases and Review of Literature

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Abstract

William Hunter is credited with the earliest description of an arteriovenous fistula (AVF) when he noticed an abnormal connection between an artery and a vein in two patients who underwent a phlebotomy. After the 19th century with the advent of high-speed projectiles, the incidence of AVF increased. With a better understanding of the underlying pathophysiology, the modalities of diagnosis and treatment have come a long way and even now continue to change. We present below three patients who presented with AVF and were treated with surgery.

Key Words: Acquired, arteriovenous fistula, iatrogenic, open surgical repair, traumatic

Introduction

An abnormal connection between an artery and a vein is known as an arteriovenous fistula (AVF). This leads to shunting of blood between the two vessels, causing a pulsatile flow of blood within the vein. AVF are classified as either congenital or acquired based on etiology, due to an increase in the number of invasive procedures being performed in the setting of critical care the incidence of iatrogenic AVF is increasing. Acute arterial injuries can often be complicated by the development of an AVF. Here, we present three patients who presented with AVF and were managed successfully.

Case Reports

Case 1

A 34-year-old man was brought to casualty with complaints of bleeding from a wound at the right femoral region which he sustained while he was hammering a piece of metal when small shrapnel penetrated his right thigh. On examination, the patient was hemodynamically stable, and system examination was normal. Examination of the right lower limb revealed a 2 cm × 2 cm size entry wound at the upper one-third of the right thigh and a thrill at the right femoral region. His popliteal artery pulsations were feeble, anterior tibial artery, and posterior tibial artery pulsations were absent. His laboratory parameters were normal. An ultrasound study revealed a rent in the posterialmedial wall of the femoral artery causing a communication between the femoral vein and artery and a hematoma which was expanding. The patient was taken to the operation theater and a wound exploration and repair of fistula with an end to end repair of femoral artery and a femoral vein repair was done. The patient was discharged in satisfactory condition and is on regular follow-up with us on an outpatient department (OPD) basis.

Case 2

A 40-year-old man, diagnosed with chronic kidney disease (CKD) was brought to OPD with complaints of a swelling at the left thigh for the past 4 months after he underwent an invasive procedure at another hospital while trying to establish IV access for dialysis. A duplex scan revealed an AVF between the femoral artery and femoral vein. The patient was taken up for surgical repair of the AVF. A pseudoaneurysm was identified along with a sac. The sac was excised and the AVF was dismantled, lateral repair of the femoral vein and ligation of the femoral artery was done followed by a bypass from the common femoral artery to the superficial femoral artery with a reverse saphenous vein graft. The patient was discharged in satisfactory condition and is on regular follow-up with us on an outpatient department (OPD) basis.

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Case 3
A 50-year-old female, known case of CKD on dialysis, who had undergone surgery for a brachiocephalic fistula 5 months prior to admission presented to OPD with complaints of a swelling at the arm, 5 cm above the previous surgery site after she had undergone dialysis at another hospital where a technician had tried inserting a cannula 4 months ago. The swelling was painless and progressively increasing in size. The patient was taken up for exploration. Intraoperatively an AVF was found between the brachial artery and cephalic vein. The AVF was dismantled; a primary repair of the artery and vein was done [Figure 4]. Postoperative period was uneventful. The patient was discharged and is on regular follow-up on an OPD basis.

Discussion
An AVF is an abnormal connection between an artery and a vein. The classification of AVF is based on the etiology. Primarily AVF are traumatic or iatrogenic however a small number may be spontaneous when an aneurysm erodes into an adjacent vein. Congenital AVF occurs in isolation or as a part of a complex arteriovenous (AV) malformation. Congenital AVF in the upper and lower limbs will manifest with the same symptoms such as edema, hypertrophy, cardiac changes, and cardiovascular changes.[1] Endovascular and open surgical techniques have been used individually or in combination for the treatment of the same.[2] Traumatic AVF are those fistulae caused by blunt or penetrating trauma, they are not iatrogenic. Majority of traumatic AVFs are caused by stab injuries while the rest are secondary to gunshot injuries and blunt trauma. While the upper and lower limb AVF have an equal preponderance of 20%, intrathoracic and intra-abdominal AVF account for only 4% of the total.[3] An increase in the number of iatrogenic AVF is attributed to the rising number of interventional procedures being performed, however, the natural history is relatively benign with 38%–81% closing spontaneously.[4] Lower limbs account for majority of the fistulae with the femoral artery accounting for 12%–30% of the AVF while the carotid and subclavian arteries account for 4%–25%.[5] Although two-third of the patients are diagnosed within a week of injury, the rest of the patients are diagnosed later (weeks or months) causing them to have an increased risk of developing complications like arterial and venous dilation proximal to the fistula, leg edema, and ulceration. Serious complications such as fistula rupture, neuropathy, distal embolus, and thrombosis are seen commonly. Long standing fistulas can cause cardiac overload and lead to cardiac failure and endocarditis.[6] Although digital subtraction arteriography (DSA) is considered the gold standard, duplex

![Figure 1](image1.png)
![Figure 2](image2.png)
![Figure 3](image3.png)
![Figure 4](image4.png)
scans, computed tomographic angiography (CTA), and magnetic resonance imaging provide faster and quicker diagnosis.[8] However, Duplex scans have a low sensitivity for correctable defects like intimal flaps compared to conventional angiography or CTA.[9] CTA allows for a rapid, accurate and operator independent information, however the volume of contrast required is a limiting factor. Digital subtraction angiography features for an AVF includes early venous filling and failure of the distal vessels to opacify. An excellent alternative to conventional angiography is the use of DSA with carbon dioxide, especially in those with a history of contrast reactions and chronic renal failure.[10] All post-traumatic fistulas should repaired at the earliest thereby preventing complications such as hemorrhage and pseudoaneurysms.[10] The aim of the treatment is the closure of the AVF, with preservation of patency of the main vessels. Treatment is based on the principle of isolating and disrupting the abnormal communication between the artery and the vein. Options include surgery, endovascular stenting, and embolization. Various factors need to be taken into account before selecting the modality of management like the size and type of AV communication, the region distal to the fistula and the effect of embolization through the AVF. Embolization is preferred when treating a complex AVF with multiple feeding and draining vessels while endovascular stenting is used in regions where access is difficult as in solid organ AVFs.[11] A study by Hughes and Jahnke in 1958 stressed the importance of repairing the vein, especially in the lower limbs. They also noted that it was possible in most cases to repair the laceration in the artery or to perform the end-to-end anastomosis.[12] AVF can be safely treated endovascularly, either by embolization or stent grafting. The aim of treatment is to definitively close the direct communication between the artery and vein. The anatomy and an understanding of the functional outcome demanded will determine the best technique and approach. An incomplete treatment resulting in failure to occlude the site of direct arteriovenous communication will lead to recurrence with a more complex architecture that is more devastating, troublesome, and challenging to treat. It is necessary that the initial treatment is carefully planned and executed for a successful and good result.

Conclusion
A thorough history and clinical examination is of prime importance in any patient present with a swelling at the extremities and also in those patients who present with trauma, the possibility of an AVF must be kept as a differential. Further investigations will provide further information thereby aiding in the management. Treatment options have to be tailored according to the patient. More time should be spent on critically evaluating the patient and the lesion which may help us in treating our patient efficiently and in the best possible way.

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Conflicts of interest
There are no conflicts of interest.

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