The Occurrence of Arterio-venous Fistula during Lower Limb Subintimal Angioplasty: Treatment and Outcome

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Objectives. To describe our experience with iatrogenic arterio-venous fistula (AVF) occurring during lower limb subintimal angioplasty, their management and the final clinical, radiological outcome.

Design. Retrospective review of case series from two centres, from a computerised database over a period of five years.

Material. Twelve patients whose lower limb subintimal angioplasty was complicated by iatrogenic AVF.

Results. The Majority of AVF occurred at the popliteal trifurcation vessels. And the incidence of this complication in our case series was 0.8%. This was managed with a variety of techniques-Coil embolisation, balloon tamponade, alternative dissection and stent placement. In one patient, the fistula was left open intentionally. All twelve patients had a successful angioplasty. The overall technical success rate for AVF ablation was eighty percent.

Conclusions. AVF is a potential complication of angioplasty. The majority can be managed by endovascular means during the angioplasty procedure with good technical success.

Keywords: Subintimal angioplasty; AV fistula.

Introduction

The role of percutaneous angioplasty in the management of peripheral vascular disease has been increasing. In some centres it has become the first line treatment of patients with critical limb ischaemia.1,2

Although considered a relatively safe procedure, with a low rate of major complications and death compared with surgical reconstruction,3 the management of complications during the procedure may be difficult, sometimes resulting in either abandonment or urgent surgery.4

Major complications of subintimal angioplasty include retroperitoneal and scrotal haematoma in 1% of cases in one reported series.5 Minor complications in the same series include groin haematoma, distal embolisation and vessel perforation in 6.5% of cases.5

Perforation and subsequent arterio-venous fistula (AVF) formation is a recognised complication of angioplasty but to the best of our knowledge, no case series of this entity occurring during lower limb angioplasty have been published. We describe our experience of twelve patients in whom AVF occurred during lower limb angioplasty, their management and the final outcome.

Materials and Methods

From the computerised database of the departments of Surgery and Radiology at both hospitals, twelve patients were identified as having had AVF during lower limb subintimal angioplasty during a 5 year period (September 1998 to September 2003), during which 1350 subintimal angioplasty procedures were performed at both centres. Seven of them were women and the mean age was 80 years (range 70 to 90 years). The indication for angioplasty was critical ischaemia in eleven patients (seven with ulceration, four with rest pain and one with non-healing ulcer after previous femoro-popliteal bypass) and short distance (20 yards) claudication in one patient.

All patients had arterial occlusions, ten of them involving the popliteal artery with some occlusions extending into the trifurcation, one occlusion involving the peroneal artery and one involving the superficial
femoral artery. Subintimal angioplasty was performed in all cases by a consultant vascular radiologist in a dedicated angiography suite.

Technical success of the angioplasty was defined as recanalisation with 30% or less stenoses and antegrade blood flow at the end of the procedure. An AVF was deemed to have occurred when contrast emerging from the tip of the catheter demonstrated substantial venous filling during the procedure. Technical success of AVF ablation was defined as absence of venous filling at the completion of the procedure.

Follow up was carried out using duplex scanning in eight patients and angiography in one case in whom critical ischaemia recurred, therefore requiring a repeat angioplasty. One patient had an MRA scan and two patients died post procedure, 10 days and 6 weeks later respectively.

**Results**

The mean length of occlusion of all twelve patients was 19.0 (range 6 cm to 50 cm). Table 1 summarises the site and length of occlusions, the site of the AVF, treatment mode, follow up and outcomes.

Five patients were treated with coil embolisation, three with balloon tamponade, two with alternative dissection, one with an uncovered stent and in one patient the fistula was allowed to remain open intentionally.

In the patients treated with coil embolisation, balloon tamponade was attempted prior to coil embolisation in one of these patients (patient 1). In two of the other four patients, the AVF occurred within a centimetre of the origin of anterior tibial artery and therefore it was not possible to place a balloon catheter across the site of the AVF in order to achieve tamponade.

As a result of the embolisation, the affected artery was occluded in each case but the circulation to the distal segment of the limb was not compromised because at least one of the other calf vessels had undergone successful angioplasty and was therefore patent. For embolisation, 3 mm × 3 cms stainless steel or 5 mm × 3 cms fibred coils were deployed proximal to the site of perforation. (Fig. 1) All five patients treated this way had a technically successful angioplasty, however a completion angiogram in one patient (patient 2) showed the fistula to be patent, a duplex scan 12 months after the procedure showed that the fistula was still patent in this patient. In the other four patients, completion angiogram confirmed total ablation of the fistulae.

One of these patients died (patient 5) six weeks post procedure and hence no follow up was available. All four surviving patients whose AVF were treated with coil embolisation were clinically asymptomatic on follow up, this included the patient in whom the AVF remained patent.

Three patients (Patients 6, 7 and 8) were treated with balloon tamponade alone. (Fig. 2). To achieve tamponade an appropriate sized balloon was placed across the site of the AVF and repeatedly inflated under low pressure (4 atmospheres) for 2 to 3 minutes, until the fistula was seen ablated. In these three patients, angioplasty was technically successful and demonstrated total ablation of the fistulae during follow up.

Clinically, on follow up, two patients were asymptomatic but one patient continued to have an active ulcer.

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<th>Site of AVF</th>
<th>Treatment</th>
<th>Months follow up</th>
<th>Fistula outcome</th>
<th>Angioplasty outcome</th>
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PT: Posterior Tibial; AT: Anterior Tibial; SFA: Superficial Femoral Artery; TPT: Tibio-peroneal Trunk.

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In one patient (patient 9) there was a high flow AVF at the tibio-peroneal trunk, immediately post angioplasty. After tamponade no major difference in flow was observed, so a non-covered 3 mm × 1.5 cm 'Palmaz' stent (Palmaz stent, Johnson & Johnson) was deployed. Completion angiogram showed that the fistula was still patent but flow into the foot through the posterior tibial and peroneal arteries were not compromised. A decision was therefore made to abandon the procedure. A follow up duplex scan 14 months post procedure showed that the fistula was still patent and despite patency of the posterior tibial and peroneal arteries, the foot ulcer was still active.

One patient (patient 10) had a 20 cm occlusion extending the length of the popliteal artery with peroneal artery as the only runoff vessel. During attempted subintimal recanalisation, an AVF occurred at the level of the tibioperoneal trunk. Multiple wire manipulations were attempted to continue the dissection into the peroneal artery, but the wire kept entering the perforation, therefore a new dissection was initiated at mid-popliteal level. Completion angiography after balloon dilatation confirmed AVF ablation. The patient had recurrence of rest pain 5 months after the initial procedure and angiogram showed that the tibioperoneal trunk had occluded with no signs of the fistula. The patient underwent successful repeat angioplasty.

Patient 11 developed an arteriovenous fistula at the mid SFA level which was also bypassed successfully by initiating a new dissection.

The last patient in our series (patient 12) presented with a 'failing' femoropopliteal below knee bypass graft. All run off vessels were occluded on angiogram. Subintimal recanalisation of posterior tibial and peroneal arteries was performed successfully. The completion angiogram showed an AVF at the proximal peroneal artery. It was decided that the AVF should not be ablated in order to encourage high flow and perhaps maintain graft patency. It was felt that the continued patency of the AVF in the peroneal artery would not compromise distal limb flow, as the posterior tibial artery, which had been successfully recanalised, was patent. The patient died 10 days after the procedure due to a myocardial infarction.
With follow up available in ten of the twelve patients, 7 AVF were successfully treated by different methods. On follow up, the popliteal AVF that was left with low flow, sealed a few days after the procedure, therefore accounting for an overall technical success of AVF ablation in 80% of cases. All 12 patients had a primarily successful angioplasty, restoring blood flow into the foot. Clinically, on follow up, seven patients were asymptomatic whereas three still had an active ulcer. In one patient, the reason for non healing of the ulcer was arterial re-occlusion, requiring a repeat angioplasty. In the other two, although arterial patency was confirmed on duplex, they had evidence of venous reflux which suggested a mixed aetiology of the non healing ulcer.

Discussion

Subintimal angioplasty appears to have a slightly higher rate of perforation compared to transluminal angioplasty.6 There may be a number of reasons why this is the case. Subintimal angioplasty is attempted in long occlusions, some of which are calcified,8 and during the procedure some force is necessary on the catheter/wire combination, which increases the risk of perforation7 and possible AVF formation in comparison to the conventional transluminal approach. In addition during subintimal angioplasty, the wall of the dissection channel is relatively thin and this may make perforation more likely when excessive force is used. Interestingly, all except two fistulas originated from the trifurcation vessels. This fact has also been noted by Samson et al.4 and it could well be that the small vessels of the trifurcation are more liable to perforation during subintimal angioplasty. If an AVF has occurred despite a successful crossing and balloon dilatation of the occluded segment, then the best treatment option is to balloon tamponade at the site of the fistula. Should this fail to ablate the AVF, one may decide to abandon the procedure depending on the clinical condition of the patient’s limb, to review management at a later date. Alternatively one may consider deploying a covered stent. Whilst we have no experience of the use of a covered stent in this situation, it is likely to achieve a total ablation of the fistula. There are case reports stating the use of covered stents in management of both above and below knee AV fistulas.9,10 However, the durability of a covered stent in the trifurcation vessels has not been proven yet.

Coil embolisation can be used to treat an AVF where other treatment options are not appropriate or has failed. By embolising the AVF, the feeding vessel may have to be occluded. This option is exercised only when there is at least one patent run off vessel so that the distal circulation is not compromised. Leaving the AVF patent intentionally, may be an option in patients who have a bypass graft, as high flow shunting through the AVF may maintain graft patency.11

In summary, AVF is a potential complication of angioplasty. There is probably a slightly higher incidence of AVF occurring during subintimal angioplasty in comparison to the conventional transluminal technique. The majority of arterio-venous fistulae appear to occur in the trifurcation vessels and most can be managed by endovascular means during the angioplasty procedure. In patients where successful AVF ablation has not been achieved, assessment by duplex scanning during follow up may be useful to help inform future management decisions.

References


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