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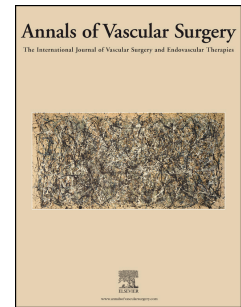
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Endovascular treatment with primary stenting of acutely thrombosed popliteal artery aneurysms

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Abstract**Purpose**

Only anecdotal cases concerning primary stenting of thrombosed popliteal artery aneurysm (PAA) without a preoperative intra-arterial thrombolysis are reported. We report our series of six patients treated with this technique.

Case report

Six male patients, aged between 63 and 88, came to our attention in the last 10 years for acute limb ischemia due to thrombosis of a PAA. In all the cases immediate digital subtraction angiography (DSA) was performed, the occlusion was crossed with an angiographic guidewire and, once an adequate distal landing zone was identified in the distal popliteal artery, a primary stenting was performed. Technical success was achieved in all the cases. One perioperative thrombosis leading to major amputation occurred, and the patient died 4 days later. The mean follow-up of the remaining 5 patients was 28.6 months, with a primary patency rate of 60% and a secondary patency rate of 80%.

Conclusions

Urgent primary stenting of acutely thrombosed PAAs is feasible and can represent an alternative solution to classical surgical approaches

Endovascular treatment with primary stenting of acutely thrombosed popliteal artery aneurysms

Introduction

Popliteal artery aneurysms (PAAs) represent the second most frequent location of arterial aneurysms¹. Thrombosis of PAAs is often associated with acute limb ischaemia (ALI) as the disease can be silent until this complication occurs. Current treatment still represents a challenge and requires immediate open surgical repair. Even with satisfactory long-term patency and limb salvage rates, ranging from 42% to 59%², it still results in poor early outcome due to perioperative complications. Only anecdotal cases concerning primary stenting of thrombosed PAAs without a pre-operative intra-arterial thrombolysis are reported.³⁻⁶ We describe our series of six patients treated with this technique for acutely thrombosed PAAs. All the patients gave their consent to the scientific use of clinical data.

Cases report

Six male patients, aged between 63 and 88, were admitted to the Emergency Department in the last 10 years for the presence of viable to threatened ALI-related symptoms⁷. In all the cases ischemic symptoms dated from less than 72 hours. In all of the patients duplex ultrasound showed the presence of a thrombosed PAA. A suitable landing zone in the distal popliteal artery (length ≥ 2 cm, diameter ≥ 4 mm and ≤ 8 mm) and at least one vessel patent to the foot were considered as pre-operative criteria for immediate revascularization with primary stenting (fig. 1). In all cases, percutaneous intra-operative angiograms confirmed the occlusion of the popliteal artery. After intravenous infusion of 5000 international units (IU) of sodium heparin, an attempt to cross the occlusion with a hydrophilic guidewire supported by an angiographic catheter was performed (fig. 2). This approach was successful in all patients. Hemobahn or Viabahn stent grafts (W.L. Gore and Associates, Flagstaff, AZ, USA) were then implanted (Fig. 3). Postoperative treatment consisted of

standard dual antiplatelet therapy for at least 6 months. The follow up program consisted of duplex ultrasound assessment at 1, 6 and 12 months and yearly thereafter.

The first patient, aged 63, with chronic obstructive pulmonary disease (COPD) and previously diagnosed asymptomatic bilateral PAAs, reported sudden pain to the right foot while in follow-up protocol. Pre-operative duplex scanning showed a right thrombosed PAA (maximum diameter 24 mm) and 2 outflow vessels. Patency was restored using a Hemobahn stent-graft (10 cm). The patient was discharged on the 4th postoperative day. The 60 months post-operative duplex scan showed the patency of the stent graft. The patient died at 77 months due to acute myocardial infarction.

The second patient, aged 79, with coronary artery disease (CAD), arterial hypertension, COPD and a concomitant abdominal aortic aneurysm (AAA), which contraindicated the use of pre-operative thrombolysis, was hospitalised for ALI. Duplex scanning revealed a thrombosed distal superficial femoral artery aneurysm (maximum diameter 21 mm) and 3 run-off vessels. The aneurysm was successfully excluded with a Hemobahn stent-graft (10 cm). In the first postoperative day an emergent open repair for sudden rupture of the AAA was successfully performed. After 48 hours in the Intensive Care Unit, occlusion of the popliteal graft occurred, leading to irreversible ischaemia requiring above-the-knee amputation. The patient died 4 days later due to multi-organ failure.

The third patient, aged 88, with COPD, hyperlipidaemia, hypertension and a previous surgical repair for AAA, was admitted for right ALI. Duplex scanning revealed a thrombosed PAA (maximum diameter 33 mm) with an ectatic superficial femoral artery and 3 outflow vessels. Three Viabahn stent-grafts (total coverage 29 cm) were successfully implanted and the patient was discharged on the 3rd postoperative day. After 15 months, mild to moderate claudication occurred and the patient underwent duplex scanning showing the occlusion of the endobypass. Considering benign clinical presentation and the age of the patient no further intervention was planned.

The fourth patient, aged 86, with severe COPD and and arterial hypertension, presented with sudden severe claudication (less than 10 meters of walking distance) and initial rest pain. Duplex scanning showed a giant PAA (maximum diameter 50 mm) and only 1 run-off vessel. He was treated with three Viabahn stent-grafts (total coverage 30 cm) and was discharged on the 4th postoperative day. At 3 months, critical limb ischemia due to stent graft occlusion occurred and the patient underwent successful intra-arterial thrombolysis. After reintervention the graft was still patent at 34 months.

The fifth patient, aged 70, with COPD and hypertension, was admitted due to sudden onset of left lower limb rest pain associated with pallor and hypothermia. Pre-operative duplex scanning showed a thrombosed PAA (maximum diameter 33 mm) and 3 outflow vessels. The patient underwent the implant of one Viabahn stent-graft (15 cm) and was discharged on the 2nd postoperative day (fig. 1-3). The graft was patent at 3 months.

The sixth patient, aged 73, suffering by CAD, hypertension, diabetes and COPD, presented with sudden onset of right lower limb rest pain associated with pallor and hypothermia. He was affected by a thoraco-abdominal aneurysm and bilateral PAAs with complete thrombosis on the right side (maximum diameter 34 mm) and 3 outflow vessels. The patient was treated with one Viabahn stent-graft (15c m) and was discharged on the 3rd postoperative day. The graft was still patent at 30 months. The patient died at 31 months due to congestive heart failure.

In summary, overall technical success was achieved in all cases. Peri-operative thrombosis rate was 16.6%, whilst peri-operative limb salvage was 83.4%. One patient died perioperatively, whilst the mean follow-up of the remaining 5 patients was 28.6 months, with a primary patency rate of 60% and a secondary patency rate of 80%.

Discussion

Many authors in recent years have reported satisfactory early and midterm results with the use of endografts in the exclusion of uncomplicated PAAs. In urgent circumstances, the introduction of pre-operative thrombolysis allowed successful elective intervention to be performed in many cases after restoring patency of the popliteal and tibial vessels, with both a surgical or endovascular approach^{8,9}. However, thrombolysis is associated with increased risks of bleeding and distal thromboembolism and may be unsuccessful in up to 30% of patients¹⁰. Furthermore, only a few cases report primary endovascular approach to thrombosed PAAs without pre-operative thrombolysis, and the majority of them are included in single centres series without a clear definition of indications.^{3,11} In our series, we assessed the feasibility of primary stenting technique in selected patients. An accurate pre-operative duplex ultrasound selection of patients is crucial for the technical success as an appropriate distal landing zone and the patency of at least one below-the-knee vessel are mandatory. In three of our cases, it was possible to visualize three outflow vessels after successful crossing of the occlusion; considering that all our patients had recent acute limb ischemia, one can suppose that patients with good run-off status and acute popliteal thrombosis have less collaterals and can develop a limb ischemia independently from the preoperative status of run-off. An adequate endovascular expertise is needed to minimise distal embolisation due to manipulation, which never occurred in our patients. The complete coverage of the thrombus was obtained in all cases, reducing the risk of postoperative embolisation, which could result in threatening of the limb. The only peri-operative occlusion was related to general hemodynamic instability following AAA rupture rather than technical issues. Follow-up results were satisfactory, with two late thromboses: one successfully treated with intra-arterial fibrinolysis, the other conservatively monitored due to benign clinical presentation in a high risk patient. Starting from such promising results, we are changing our treatment strategy, attempting a primary endovascular treatment in selected high-risk patients whenever pre-operative duplex scanning confirms the above mentioned criteria. On the other hand, when the outflow status is poor and/or

157 the patient is at low surgical risk, we still perform intra-arterial thrombolysis in patients with mild to
158 moderate ischaemia or open surgery in patients with severe ischaemia.

159 **Conclusions**

160 Primary stenting of acutely thrombosed PAAs is feasible and can represent an alternative solution
161 to classical surgical approaches. However, this approach should not be considered the main
162 therapeutic option for complicated PAAs, but only in selected patients with specific anatomical
163 requirements.

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Fig. 1



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197 Fig.2

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201 Fig. 3

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205 Fig. 1: preoperative angiogram showing the thrombosed aneurysm with patent distal popliteal artery
206 and tibial vessels (case 5)

207 Fig. 2: the occlusion is crossed with a guidewire and the covered-stent is ready to be deployed

208 Fig. 3: completion angiography after stent deployment and ballooning. White arrows show
209 proximal and distal tips of the covered stent

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