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Endovascular treatment with primary stenting of acutely thrombosed popliteal artery aneurysms

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1 **Endovascular treatment with primary stenting of acutely thrombosed popliteal artery**
2 **aneurysms**

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37

38 **Abstract**

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40 **Purpose**

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

44 **Case report**

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

53 **Conclusions**

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

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61 **Endovascular treatment with primary stenting of acutely thrombosed popliteal artery** 62 **aneurysms**

63 **Introduction**

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

73 **Cases report**

74 Six male patients, aged between 63 and 88, were admitted to the Emergency Department in the last
75 10 years for the presence of viable to threatened ALI-related symptoms⁷. In all the cases ischemic
76 symptoms dated from less than 72 hours. In all of the patients duplex ultrasound showed the
77 presence of a thrombosed PAA. A suitable landing zone in the distal popliteal artery (length ≥ 2 cm,
78 diameter ≥ 4 mm and ≤ 8 mm) and at least one vessel patent to the foot were considered as pre-
79 operative criteria for immediate revascularization with primary stenting (fig. 1). In all cases,
80 percutaneous intra-operative angiograms confirmed the occlusion of the popliteal artery. After
81 intravenous infusion of 5000 international units (IU) of sodium heparin, an attempt to cross the
82 occlusion with a hydrophilic guidewire supported by an angiographic catheter was performed (fig.
83 2). This approach was successful in all patients. Hemobahn or Viabahn stent grafts (W.L. Gore and
84 Associates, Flagstaff, AZ, USA) were then implanted (Fig. 3). Postoperative treatment consisted of

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

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

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

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

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

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

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

127 In summary, overall technical success was achieved in all cases. Peri-operative thrombosis rate was
128 16.6%, whilst peri-operative limb salvage was 83.4%. One patient died perioperatively, whilst the
129 mean follow-up of the remaining 5 patients was 28.6 months, with a primary patency rate of 60%
130 and a secondary patency rate of 80%.

131 **Discussion**

132 Many authors in recent years have reported satisfactory early and midterm results with the use of
133 endografts in the exclusion of uncomplicated PAAs. In urgent circumstances, the introduction of
134 pre-operative thrombolysis allowed successful elective intervention to be performed in many cases
135 after restoring patency of the popliteal and tibial vessels, with both a surgical or endovascular
136 approach^{8,9}. However, thrombolysis is associated with increased risks of bleeding and distal
137 thromboembolism and may be unsuccessful in up to 30% of patients¹⁰. Furthermore, only a few
138 cases report primary endovascular approach to thrombosed PAAs without pre-operative
139 thrombolysis, and the majority of them are included in single centres series without a clear
140 definition of indications.^{3,11} In our series, we assessed the feasibility of primary stenting technique
141 in selected patients. An accurate pre-operative duplex ultrasound selection of patients is crucial for
142 the technical success as an appropriate distal landing zone and the patency of at least one below-
143 the-knee vessel are mandatory. In three of our cases, it was possible to visualize three outflow
144 vessels after successful crossing of the occlusion; considering that all our patients had recent acute
145 limb ischemia, one can suppose that patients with good run-off status and acute popliteal
146 thrombosis have less collaterals and can develop a limb ischemia independently from the
147 preoperative status of run-off. An adequate endovascular expertise is needed to minimise distal
148 embolisation due to manipulation, which never occurred in our patients. The complete coverage of
149 the thrombus was obtained in all cases, reducing the risk of postoperative embolisation, which
150 could result in threatening of the limb. The only peri-operative occlusion was related to general
151 hemodynamic instability following AAA rupture rather than technical issues. Follow-up results
152 were satisfactory, with two late thromboses: one successfully treated with intra-arterial fibrinolysis,
153 the other conservatively monitored due to benign clinical presentation in a high risk patient. Starting
154 from such promising results, we are changing our treatment strategy, attempting a primary
155 endovascular treatment in selected high-risk patients whenever pre-operative duplex scanning
156 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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