Popliteal Artery Aneurysms: A Review

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• No Disclosures
Popliteal Artery Aneurysms
Popliteal Artery Aneurysms

- Most common peripheral artery aneurysm
- Account for more than 70% of all peripheral aneurysms
- On average 4 to 5 cases seen by major vascular center per year
### Table I. Demographic data and risk factors of 289 patients with 358 popliteal artery aneurysms

<table>
<thead>
<tr>
<th>Data</th>
<th>No (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients</td>
<td>289 (100)</td>
</tr>
<tr>
<td>Male</td>
<td>281 (97)</td>
</tr>
<tr>
<td>Female</td>
<td>8 (3)</td>
</tr>
<tr>
<td>Age, mean y (range)</td>
<td>70 (17-88)</td>
</tr>
<tr>
<td>Risk factors*</td>
<td></td>
</tr>
<tr>
<td>Cardiovascular</td>
<td>128 (44)</td>
</tr>
<tr>
<td>Pulmonary</td>
<td>41 (14)</td>
</tr>
<tr>
<td>Renal</td>
<td>3 (1)</td>
</tr>
<tr>
<td>Hypertension</td>
<td>192 (66)</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>46 (16)</td>
</tr>
<tr>
<td>Current smokers</td>
<td>81 (28)</td>
</tr>
</tbody>
</table>

*As defined by Department of Veterans Affairs National Surgical Quality Improvement Program. 25
Fig 1. Prevalence of concomitant aneurysms in 299 patients with popliteal artery aneurysms.
Pathogenesis

- Degenerative

- True aneurysms can result from popliteal artery entrapment syndrome
Clinical Manifestations

- Asymptomatic presentation in 40%
- Limb ischemia is presenting symptom in approximately 55%
  - Thrombosis
  - Distal Embolization
- Rupture in 1-7%
- Local compressive symptoms in 6.5%
Size of aneurysm related to symptoms

- Varga and associates 1994
  - Median diameter of asymptomatic aneurysms was 2cm
  - Median diameter of aneurysms with ischemia was 3cm
Size of aneurysm related to symptoms

- Ravn et al.
  - Out of 623 legs with PAs 96% had greater than 2mm of thrombus
  - No significant difference between amount of thrombus in symptomatic vs. asymptomatic
Diagnosis

- Physical Exam
  - Inaccurate
- Duplex Ultrasound
- CTA
- MRA
Patients with PA aneurysms treated medically

- 35% developed thromboembolic complications during 45-month follow up
- Complications associated with 25% amputation rate
- All complications from aneurysms greater than 2 cm
Natural History

• Patients with PA aneurysms treated medically (Cont.)

  – 36% risk of developing complications at 3 years with palpable pedal pulse

  – 86% risk of developing complications at 3 years with non-palpable pedal pulse
Indication for Intervention

- All symptomatic aneurysms should be repaired
- Asymptomatic aneurysms
  - Size >2cm
  - Mural thrombus
  - Evidence of previous thromboembolism
  - Risk of surgical repair
Treatment

• Proximal and distal ligation with bypass is the “Gold Standard”

• Relevant Variables
  – Availability of saphenous vein
  – Quality of inflow and outflow vessels
  – Presence of additional aneurysms
Posterior Approach

- S shaped incision
- Best for localized popliteal aneurysms
- Best approach for endoaneurysmorrhaphy
Medial Approach

- Wider access to SFA and tibials
- Easier access to greater saphenous vein
- Best for long bypass
Treatment

• Bypass technique with vein through medial approach is most popular

• Advantages
  – Injuries to structures adherent to aneurysm reduced
  – Popliteal vein avoided
  – Gastrocnemius left intact
Treatment

• Disadvantages
  
  – Compressive symptoms not relieved
  
  – Possible continued flow into the aneurysm sac through collaterals
Rupture of Excluded Popliteal Artery Aneurysm: Implications for Type II Endoleaks

A Case Report

Albeir Mousa, MD, Peter L. Faries, MD, FACS, Joshua Bernheim, MD, Rajeev Dayal, MD, Brian DeRubertis, MD, Scott Hollenbeck, MD, Peter Henderson, BA, Elizabeth A. Mahanor, MD, and K. Craig Kent, MD, FACS, New York, NY
Fate of excluded popliteal artery aneurysms

James L. Ebaugh, MD, a Mark D. Morasch, MD, b Jon S. Matsumura, MD, b Mark K. Eskandari, MD, b Wendy S. Meadows, RN, b and William H. Pearce, MD, b Seattle, Wash; and Chicago, Ill


• Reviewed 25 PA aneurysms treated with ligation and bypass

• Reviewed CT scans and duplex scans

• 8 (33%) PA aneurysms increased in size

• 1 required treatment due to symptoms
The medial versus the posterior approach in the repair of popliteal artery aneurysms: A multicenter case-matched study

Rogier H. J. Kropman, MD, a Hjalmar C. van Santvoort, MD, b Joep Teijink, MD, PhD, c Henricus D. W. M. van de Pavoor dt, MD, PhD, a Henricus J. Belgers, MD, c Frans L. Moll, MD, PhD, b and Jean-Paul P. M. de Vries, MD, PhD, a Nieuwegein, Utrecht, and Heerlen, The Netherlands


• Retrospective review of 66 surgically treated PA aneurysms

• 33 treated with medial approach, 33 treated with posterior approach
Results

• Mean follow up 47 months

• No significant difference in patency rates after 4 years (app. 70%)

• 22% of patients had aneurysm growth after medial approach, none after posterior approach
Medial vs. Posterior Approach

- No significant difference in patency rate
- Medial approach safer and technically less demanding
- Decompression of aneurysm possible during medial approach
- Posterior approach most effective in avoiding recurrence
- Patients need to be followed with duplex scanning after medial approach
Emergency Treatment

- Surgical treatment of acute thrombosis and acute distal embolization associated with less successful outcomes

- Ravn et al 2007:
  - Treatment of symptomatic patients has amputation rate of 12% vs. 1.8% for asymptomatic presentation
Emergency Treatment

- Supportive care
- Anticoagulation
- Angiogram or CTA
Emergency Treatment

- Immediate operation with thromboembolectomy
- Pre-operative thrombolysis with subsequent revascularization
Pre-operative Thrombolysis

Table 2. Difference between the delayed surgery group (DSG) and the immediate surgery group (ISG) regarding age, aneurysm size and amputation-rate

<table>
<thead>
<tr>
<th></th>
<th>DSG</th>
<th>ISG</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size (mean)</td>
<td>27 mm</td>
<td>37 mm</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Age (mean)</td>
<td>66.8 year</td>
<td>71.6 year</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Amputation</td>
<td>7 %</td>
<td>27 %</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

The size of the PAA was measured in 144 legs.

Eur J Vasc Endovasc Surg 33, 690–695 (2007)
In many studies limb salvage and graft patency rates have improved with pre-operative thrombolysis.

Most beneficial in patients with mild to moderate acute limb ischemia and poor outflow.
Fig 2. Cumulative patency of 336 grafts after popliteal artery aneurysm repair with great saphenous vein (GSV) or polytetrafluoroethylene (PTFE) grafts.
Fig 3. Cumulative patency of 72 grafts in group 3 (acute presentation) after popliteal artery aneurysm repair with great saphenous vein (GSV) or polytetrafluoroethylene (PTFE) grafts.
Fig 4. Cumulative limb salvage of patients (group 3, acute presentations) after popliteal artery aneurysm repair with great saphenous vein (GSV) or polytetrafluoroethylene (PTFE) grafts.
Endovascular Repair
First Endovascular Repair

CASE REPORT

Transfemoral endoluminal stented graft repair of a popliteal artery aneurysm

Michael L. Marin, MD, Frank J. Veith, MD, Thomas F. Panetta, MD,
Jacob Cynamon, MD, Curtis W. Bakal, MD, William D. Suggs, MD,
Kurt R. Wengerter, MD, Hector D. Baronè, MD, Claudio Schonholz, MD, and
Juan C. Parodi, MD, New York, N.Y., and Buenos Aires, Argentina


Fig. 2. Completion arteriogram obtained after placement of polytetrafluoroethylene graft-stent device shows exclusion of aneurysm and graft patency (arrow, stent). Inset shows detail of stent in distal popliteal artery. TP, Tibioperoneal trunk; AT, anterior tibial artery.
A Systematic Review and Meta-analysis of Endovascular Popliteal Aneurysm Repair Using the Hemobahn/Viabahn Stent-Graft

Shaneel R. Patel, MBBS, BSc (Hons), MRCS¹, Cian O. Hughes, MBChB¹, Keith G. Jones, MD, FRCS¹, Peter J. E. Holt, PhD, FRCS¹, Matt M. Thompson, MD, FRCS¹, Robert J. Hinchcliffe, MD, FRCS¹, and Alan Karthikesalingam, PhD, MSc, MA, MRCS¹
<table>
<thead>
<tr>
<th>Author, Year, Country</th>
<th>Study Design</th>
<th>Study Midpoint</th>
<th>Neck Length Criterion for EVT, mm</th>
<th>Exclusion Criteria for EVT</th>
<th>Age, y&lt;sup&gt;1&lt;/sup&gt; Mean, %</th>
<th>Symptomatic, %</th>
<th>Patients/Limb</th>
<th>Aneurysm Diameter, mm&lt;sup&gt;2&lt;/sup&gt;</th>
<th>Stent-Graft</th>
<th>Mean Follow-up, mo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antonello, Italy, 2007, RCT then cohort vs. open</td>
<td>CS</td>
<td>7/2001</td>
<td>&gt;10</td>
<td>Age &lt;50, poor distal runoff, CI AC/AP, symptomatic presentation</td>
<td>65.7/81</td>
<td>0</td>
<td>21/21</td>
<td>37.3</td>
<td>H + V</td>
<td>47.8</td>
</tr>
<tr>
<td>Curi, 2007, USA</td>
<td>R vs. open</td>
<td>1/2003</td>
<td>≥20</td>
<td>None specified</td>
<td>75/93</td>
<td>13</td>
<td>13/15</td>
<td>25 (median)</td>
<td>V</td>
<td>14</td>
</tr>
<tr>
<td>Etezadi, 2010, USA</td>
<td>CS</td>
<td>10/2006</td>
<td>≥20</td>
<td>None specified</td>
<td>70/94</td>
<td>66.6</td>
<td>18/18</td>
<td>30</td>
<td>V</td>
<td>15</td>
</tr>
<tr>
<td>Garg, 2012, USA</td>
<td>CS</td>
<td>11/2007</td>
<td>≥15</td>
<td>CI AC/AP, patients who frequently flex knee &gt;90°</td>
<td>74/90.5</td>
<td>38</td>
<td>21/26</td>
<td>28.9</td>
<td>V</td>
<td>22</td>
</tr>
<tr>
<td>Huang, 2014, USA</td>
<td>R vs. open</td>
<td>7/2008</td>
<td>≥15</td>
<td>Poor distal runoff, &gt;4-mm difference in proximal and distal landing zone diameters, age &lt;50, symptoms of compression, patients who frequently flex knee &gt;90°</td>
<td>81/100 Elective: 100; emergent: 32; emergent: 10</td>
<td>30</td>
<td>V</td>
<td>31.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jung, 2010, USA</td>
<td>CS</td>
<td>5/2004</td>
<td>≥20</td>
<td>None specified</td>
<td>74.6/93</td>
<td>13</td>
<td>13/15</td>
<td>25</td>
<td>V</td>
<td>54</td>
</tr>
<tr>
<td>Midy, 2010, France</td>
<td>CS</td>
<td>12/2003</td>
<td>≥15</td>
<td>None specified</td>
<td>—</td>
<td>—</td>
<td>—/42</td>
<td>—</td>
<td>—</td>
<td>—</td>
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<tr>
<td>Pulli, 2013, Italy</td>
<td>R vs. open</td>
<td>1/2006</td>
<td>≥20</td>
<td>None specified</td>
<td>74.9</td>
<td>82</td>
<td>—/134</td>
<td>34.7</td>
<td>H + V</td>
<td>35</td>
</tr>
<tr>
<td>Rajasibbeg, 2006, USA</td>
<td>CS</td>
<td>5/2005</td>
<td>≥10</td>
<td>Poor distal runoff, CI AC/AP, ALI</td>
<td>76/100</td>
<td>0</td>
<td>16/23</td>
<td>27</td>
<td>V</td>
<td>7</td>
</tr>
<tr>
<td>Saunders, 2014, UK</td>
<td>CS</td>
<td>11/2008</td>
<td>≥20</td>
<td>Poor distal runoff</td>
<td>76/96</td>
<td>32</td>
<td>26/34</td>
<td>—</td>
<td>H + V</td>
<td>40</td>
</tr>
<tr>
<td>Stone, 2013, UK</td>
<td>R vs. open</td>
<td>6/2006</td>
<td>—</td>
<td>None specified</td>
<td>76.2/95</td>
<td>45.8</td>
<td>20/24</td>
<td>29</td>
<td>V</td>
<td>33.9</td>
</tr>
<tr>
<td>Thomazinha, 2008, Brazil</td>
<td>CS</td>
<td>11/2005</td>
<td>&gt;10</td>
<td>Age &lt;50, poor distal runoff, CI AC/AP, nerve/venous compression, ALI</td>
<td>64/100</td>
<td>27.3</td>
<td>11/11</td>
<td>22.9</td>
<td>H + V</td>
<td>27.4</td>
</tr>
<tr>
<td>Tiellu, 2010, Netherlands</td>
<td>CS</td>
<td>9/2003</td>
<td>≥30</td>
<td>Poor distal runoff</td>
<td>68.6/95</td>
<td>—</td>
<td>65</td>
<td>26.5 (median)</td>
<td>H + V</td>
<td>50</td>
</tr>
</tbody>
</table>

Abbreviations: ALI, acute limb ischemia; CI AC/AP, contraindication to anticoagulation/antiplatelet agents; CS, case series; EVPAR, endovascular popliteal aneurysm repair; H, Hemobahn; R, retrospective; RCT, randomized controlled trial; SF, stent fracture; V: Viabahn.

<sup>1</sup>Mean or median.

<sup>2</sup>Mean unless noted otherwise.
<table>
<thead>
<tr>
<th>Author</th>
<th>Access</th>
<th>Mean Number of Stents</th>
<th>Stent Oversizing</th>
<th>Stent Overlap</th>
<th>DAPT Duration</th>
<th>Follow-up Imaging</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antonello(^{14})</td>
<td>Perc</td>
<td>1.8</td>
<td>≥10%</td>
<td>≥1 cm</td>
<td>1 mo</td>
<td>DUS, ABI, knee radiograph</td>
</tr>
<tr>
<td>Curi(^{15})</td>
<td>Varied</td>
<td>—</td>
<td>10%–15%</td>
<td>2–3 cm</td>
<td>None</td>
<td>—</td>
</tr>
<tr>
<td>Etezadi(^{16})</td>
<td>Varied</td>
<td>1.6</td>
<td>1 mm</td>
<td>2–3 cm</td>
<td>3–6 mo</td>
<td>DUS</td>
</tr>
<tr>
<td>Garg(^{17})</td>
<td>Varied</td>
<td>1.8</td>
<td>10%–15%</td>
<td>≥2 cm</td>
<td>Variable</td>
<td>DUS</td>
</tr>
<tr>
<td>Huang(^{18})</td>
<td>Varied</td>
<td>2.1</td>
<td>1–2 mm</td>
<td>≥4 cm</td>
<td>3 mo/ lifetime</td>
<td>DUS, ABI</td>
</tr>
<tr>
<td>Jung(^{19})</td>
<td>Varied</td>
<td>—</td>
<td>10%–15%</td>
<td>2–3 cm</td>
<td>None</td>
<td>—</td>
</tr>
<tr>
<td>Midy(^{20})</td>
<td>Varied</td>
<td>—</td>
<td>1 mm</td>
<td>≥2 cm</td>
<td>6 weeks or indefinitely</td>
<td>DUS, knee radiograph</td>
</tr>
<tr>
<td>Pulli(^{21})</td>
<td>Varied</td>
<td>2</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>DUS</td>
</tr>
<tr>
<td>Rajasinghe(^{22})</td>
<td>Perc</td>
<td>—</td>
<td>—</td>
<td>≥2 cm</td>
<td>None</td>
<td>DUS</td>
</tr>
<tr>
<td>Saunders(^{23})</td>
<td>Perc</td>
<td>1.9</td>
<td>10%</td>
<td>3 cm</td>
<td>Variable</td>
<td>DUS</td>
</tr>
<tr>
<td>Stone(^{24})</td>
<td>Varied</td>
<td>1.8</td>
<td>—</td>
<td>≥1 cm</td>
<td>—</td>
<td>DUS</td>
</tr>
<tr>
<td>Thomazinho(^{25})</td>
<td>Perc</td>
<td>1.3</td>
<td>20%</td>
<td>2 cm</td>
<td>1 mo</td>
<td>DUS</td>
</tr>
<tr>
<td>Tiellu(^{26})</td>
<td>Open</td>
<td>—</td>
<td>—</td>
<td>≥3 cm</td>
<td>Initially none, protocol changed to 6 weeks midway through study</td>
<td>DUS, knee radiograph</td>
</tr>
<tr>
<td>Trinidad-Hernandez(^{27})</td>
<td>Varied</td>
<td>2.1</td>
<td>1–2 mm</td>
<td>≥2 cm</td>
<td>Variable</td>
<td>DUS, ABI (+ CT at first follow-up)</td>
</tr>
</tbody>
</table>

Abbreviations: ABI, ankle-brachial index; CT, computed tomography; DAPT, dual antiplatelet therapy; DUS, duplex ultrasound; Perc, percutaneous.
Figure 2. (A) Pooled primary patency rates in endovascular popliteal aneurysm repair (EVPAR). [Solid line, pooled estimate of primary patency; dotted lines, 95% confidence intervals (CIs); gray lines, primary patency survival curves from original studies]. (B) Meta-analysis to determine the hazard ratio for loss of primary patency in EVPAR as compared with open repair. (C) Pooled primary patency rates for Viabahn stent-graft alone (solid green line with dots as 95% CI) vs. Viabahn + Hemobahn stent-grafts (blue dashed with interrupted dots/dashes as 95% CI). Gray lines, primary patency survival curves from original studies. (D) Pooled secondary patency rates in EVPAR. (Solid line, pooled estimate of primary patency; dotted lines: 95% CI; gray lines, primary patency survival curves from original studies). The color version of this figure is available online at http://www.jert.org.
-Pooled 5 year primary and secondary patency are 69.4% & 77.4%
-Comparable to open bypass
Recommendations

• Plavix post-operatively

• Accurate measurement of landing zone diameters

• Avoid placing overlap zone at knee bend

• No flexion of knee >90° after discharge
Summary

• Untreated peripheral artery aneurysms have risk of limb loss

• The best treatment results are with elective proximal and distal ligation of aneurysm with vein bypass

• Pre-operative thrombolysis should be considered in cases of acute ischemia
Summary

- Endovascular repair results are improving with improved anti-platelet therapy and devices
- Endovascular therapy can be used with success in the appropriate patient