Management of Popliteal Artery Aneurysms

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Case Presentation
Case Presentation

55 yo male presented with

- **Left popliteal fossa and calf pain for 4 days**
- **Difficulty walking**
- No history of trauma
- No claudication
Case Presentation

**PMH/Social**
- HTN
- Right adrenal adenoma with hyperaldosteronism
- DM
- Hypercholesterolemia
- Smoker (2 P/D)
- Social drinking

**PSH**
- Varicocoelectomy
- Knee arthroscopy
- Heel spur
Physical exam

Pertinent for:

**Left pulsating popliteal mass, 3X3cm, warm foot w/o evidence of acute ischemic changes and good capillary refill bilaterally**

**DP/PT pulses non palpable/biphasic doppler signals bilaterally**
Case Presentation

- **LABS**: no pertinent findings; WNL

- **LE Duplex**: Left popliteal artery aneurysm partially thrombosed 4.5x4.8 cm

- **CTA of Aorta with Distal Runoff**
Case Presentation
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- **CTA of Abdominal Aorta w/ Runoffs**
  - Right popliteal artery aneurysm with thrombus 2 cm
  - **Left popliteal artery aneurysm 5x6 cm** with thrombus but remains patent
  - Left tibioperoneal trunk patent
  - **Left PT patent to mid calf**
  - Left Peroneal a. patent
  - Left ATa. occluded
Case Presentation

- Initial plan:
  - Admission for anticoagulation
  - Vein mapping
  - Semi-elective intervention
  - Angiogram
- However,
  - Increase in symptoms during night

OR in morning
Case Presentation

PROCEDURE- Left Common Femoral to Below Knee Popliteal Bypass w/ Ringed PTFE Graft and Popliteal Aneurysm Ligation

FINDINGS-

- Severe inf. reaction, perianeurysmal
- Venous hypertension
- Heavily calcified popliteal artery
- Periadventitial adventia (a. & v.)
- Dense venous collateral
Case Presentation

- **POD1-8**
  - Improved swelling
  - Decreased pain
  - Ambulation/PT
  - Anticoagulation- Lovenox/coumadin
  - Palpable pulses
  - No neurologic findings or complaints
Case Presentation

- **POD9**
  - C/O pain and numbness of the left leg and foot
  - Weakness of the foot/drop foot
  - Warm extremity
  - Non palpable pulses/biphasic dopplerable signals
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- Working diagnosis: graft occlusion v/s expansion of PAA and nerve compression
- Heparin drip
- CTA of lower extremity
Case Presentation
Case Presentation
Case Presentation
Case Presentation
Case Presentation

- **CTA LE**
  Widely patent graft

  **9 cm PAA with intra-aneurysmal flow**

  Patent trifurcation
**PROCEDURE**- Left PAA exclusion, revision of bypass graft and intraoperative angiogram

- Proximal control of the aneurysm above the knee
- Angiogram through graft showed retrograde filling of aneurysm
- Control/ligation of aneurysm below knee
- Improvement of distal pulses and flow through graft
- Completion angiogram- no filling of aneurysm, patent Peroneal a. reconstituting the DPA
Case Presentation

- **POD1-3 (POD10-13)**
  - Extubated POD1
  - Mild improvement in symptoms (3/5 improvement in dorsiflexion and eversion/inversion of foot) **However, persistent weakness and numbness**
  - Maintained anticoagulation
  - PT/Rehab
  - Antibiotic coverage

- **POD4-** OR for thrombus evacuation
Case Presentation

PROCEDURE- Exploration of left popliteal fossa and PA aneurysmectomy and debridement via a posterior approach

FINDINGS-
- Stretched tibial nerve over the sac
- PAA controlled and excised - gelatinous material that shelled out easily; little thrombus
- Obliteration of sac
- JP drain in fossa
Case Presentation

PATHOLOGY

All specimens - organizing thrombus, part of vessel wall
Coccoid bacteria
Cultures - Staph epidermidis

MYCOTIC ANEURYSM
Postoperative course

Slowly improving neuro symptoms
Rehab and physical therapy
Long term antibiotics
Long term anticoagulation and antiPt

Discharge on POD15 (POD19/POD29)
Management of Popliteal Artery Aneurysms
DEFINITION

- Normal PA diameter - 0.5-1.1 cm
  - Varies with gender
  - Varies with segment of PA

- Aneurysm = 1.5x normal diameter of adjacent PA segment
EPIDEMIOLOGY

- **95-100% male**
- Second most common aneurysms, 70% of aneurysms of LE
- However rare - 1-7.4/100000
- Bilateral 50-54%
- PAA + AAA 40%
- Bilateral PAA + AAA up to 70%
- AAA + PAA up to 8%
- Risk of other aneurysms over 10 yrs- 50%
CLINICAL FINDINGS

- Asymptomatic mass: 38-40% will develop symptoms at a rate of 14%/yr (2)
- Intermittent claudication (chronic ischemia): 25%-40% (1,2)
- Pressure related (pain, DVT, swelling): 5-10% (2)
- Rupture: 0-7% (1)
- Acute ischemia: 21-35%; thrombosis or embolisation (1)
Physical Exam - Unreliable

Duplex US - more reliable; determines size, presence of thrombus and patency of outflow vessels

Anatomical studies - needed when decision to operate is made

> Angiography
> CTA
> MRA
NATURAL HISTORY of asymptomatic aneurysms

- **SIZE**
  - Asymptomatic: 2 cm or less
  - Symptomatic: 3 cm or more (3 for ischemia and 3.45 for compression)
  - Rate of growth: 3 mm/y (2,3)

- **DISTORTION**
  - Asymptomatic: 0°
  - Acute thrombosis: 60°
  - Compression: 45° (2,3)
NATURAL HISTORY of asymptomatic aneurysms

- **Size/ Distortion**
  
  Size + distortion = best PPV and NPV for complications
  
  \[
  \text{Size} > 3 \text{cm} + \text{Distortion} > 45^\circ \quad (3)
  \]

- **Runoff**
  
  Absent distal pulses = higher rate of complications \((1,2,3)\)
When to Operate?

- Elective intervention may have higher patency and limb salvage rates but difference is not significant.

- Observation may be a viable option in PAA < 3 cm with little or no distortion and no intramural thrombus (2,3).
WHEN TO OPERATE?

- **INDICATIONS**
  - Thrombosis
  - Symptomatic
  - Size greater than 3 cm (2,3)
ELECTIVE SURGICAL TREATMENT: OPEN REPAIR

- **Medial approach**
  
  small fusiform aneurysms
  conventional bypass and ligation

- **Posterior approach**
  
  large saccular aneurysms
  symptoms of compression
  interposition grafting
MEDIAL APPROACH

- Saphenous vein exposure
- Exposure of above knee and below knee pop a. through same incision
- Large aneurysm → difficult exposure
- Tunnel from above-knee to below-knee pop space between heads of gastrocnemius
- Bypass- end to side, reversed/non reversed, in-situ if CFA to distal a.
MEDIAL APPROACH

- Sartorius muscle
- Gastrocnemius muscle
- Popliteal artery
- Popliteal vein
- Posterior tibial nerve
Aneurysm ligation- proximal and distal ligation as close to the aneurysm as possible to decrease the risks of expansion.

Aneurysm should be open and back-bleeding branches ligated- difficult with medial approach.
POSTERIOR APPROACH

- Prone position
- Lazy S incision across the popliteal fossa
- Can be extended over lesser saphenous vein if adequate for bypass
POSTERIOR APPROACH

- Exposure - between semimembranosus and semitendinosus and biceps muscles
- **Attention!!** tibial and peroneal nerves
- Open aneurysm sac
- Ligate backbleeders
- Bypass or interposition graft
Acute Ischemia

No

Threatened Limb?

Yes

Heparin drip
Angiogram

Occluded aneurysm
Patent Distals

Yes

Bypass

No

Thrombolysis

Yes

Bypass

No

Angio Surgery

Patent distals

Thromboembolectomy +/- intraop thrombolysis

Emergency Surgical Treatment
25-45% of acutely ischemic patients will have thrombosis of the PAA with either no runoffs or compromised runoffs unsuitable to bypass

Catheter-directed intra-arterial thrombolysis with TPA or urokinase

Mechanical thrombectomy may be used
THROMBOLYSIS

- Re-image at 6-24 hours
- If improvement → prepare for surgery
- Total clearance is not necessary for bypass
- If no improvement beyond 24h → high risk of amputation
- Do not continue beyond 24h
RESULTS of THROMBOLYSIS

- Improves outflow before bypass in 29-45% of acute ischemia patients
- Reduces amputation rate from 96 to 69%
RESULTS of THROMBOLYSIS

- Galland - increased number of complications other than bleeding - Acute deterioration of the limb during thrombolysis
- Destabilization and embolization of a large thrombus
- Intraoperative thrombolysis (1,2)
OUTCOMES OF OPEN SURGICAL REPAIR

Approach

Posterior and medial approaches seem to have equally good results.
## OUTCOMES OF OPEN SURGICAL REPAIR/APPROACH

![Graph showing comparison between Dorsal and Medial approaches in surgical repair of 58 PAAs.](image)

### Dorsal versus Medial approach in surgical repair of 58 PAAs

<table>
<thead>
<tr>
<th></th>
<th>Patency (%)</th>
<th>Stenosis (%)</th>
<th>Obstruction (%)</th>
<th>Aneurysm (%)</th>
<th>Amputation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dorsal</td>
<td>76%</td>
<td>7%</td>
<td>10%</td>
<td>3%</td>
<td>0</td>
</tr>
<tr>
<td>Medial</td>
<td>52%</td>
<td>21%</td>
<td>24%</td>
<td>3%</td>
<td>10%</td>
</tr>
</tbody>
</table>

- *P = .056*
- *NS*¹
- *NS*²

- *P = .237*

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OUTCOMES OF OPEN SURGICAL REPAIR/APPROACH

Fig 1. Kaplan-Meier life-table analysis of primary patency after surgical repair of popliteal artery aneurysms through a medial (thick line) or posterior approach (thin line) (log-rank, \( P = 4187 \)).

OUTCOMES OF OPEN SURGICAL REPAIR

- **Saphenous vein vs graft**
  - Patency of saphenous vein superior to graft overall - 94% vs 63%
  - Regardless of approach
  - Most significant in patients with acute ischemia
OUTCOMES OF OPEN SURGICAL REPAIR

Pulli et al. (6)

159 PAA between 1984 and 2004
42% asymptomatic
1/3rd 3 runoffs, 1/3rd 2 runoffs 1/3rd 1 or 0 runoffs

follow up - clinical + sono at 1, 6 and 12 months then yearly thereafter
# OUTCOMES OF OPEN SURGICAL REPAIR

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>30-day amputation rate</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asymptomatic</td>
<td>1/67 (1.4%)</td>
<td>.05</td>
</tr>
<tr>
<td>Symptomatic</td>
<td>6/92 (6.5%)</td>
<td></td>
</tr>
</tbody>
</table>

30 day Amputation Rate
## OUTCOMES OF OPEN SURGICAL REPAIR

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>Symptomatic</th>
<th>Asymptomatic</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Survival</td>
<td>87%</td>
<td>81.4%</td>
<td>NS</td>
</tr>
<tr>
<td>limb salvage</td>
<td>80.4%</td>
<td>93.4%</td>
<td>0.03</td>
</tr>
<tr>
<td>primary patency</td>
<td>51.6%</td>
<td>86.5%</td>
<td>0.001</td>
</tr>
<tr>
<td>secondary patency</td>
<td>79.6%</td>
<td>89.4%</td>
<td>NS</td>
</tr>
</tbody>
</table>

Estimated 60 Months Outcomes
OUTCOMES OF OPEN SURGICAL REPAIR

60 months limb salvage rate in symptomatic limbs (claudication vs acute ischemia)
OUTCOMES OF OPEN SURGICAL REPAIR

Factors associated with outcome on multivariate analysis (6)

Clinical presentation

Runoff Status (5 yr patency 72% w/ 2 or more runoffs vs 47.4% w/ worse runoffs)

Site of distal anastomosis (popliteal vs tibial a.)
POST EXCLUSION ANEURYSM EXPANSION

Mehta et al.

26 PAAs between 1995 and 2001
Mean F/U 38 months
Duplex, CTA, MRA to document aneurysm size (7)
POST EXCLUSION ANEURYSM EXPANSION

- Results (7)
  - 38% - persistent flow from geniculate arteries
  - 23% - increased max sac diameter
  - 12% - rupture w/ 4% limb loss

All PAAs had near systemic pressure

- Pathophysiology similar to type II endoleaks
  - Geniculate a. transmit syst. pressure to the PAA causing its growth (7)
Conclusions (7)

**Routine use of posterior approach whenever possible** with ligation of collateral vessels and endoaneurysmorrhaphy esp. for large saccular aneurysms with compressive symptoms

Medial approach should be reserved for extensive fusiform PAAs and still the collateral vessels should be ligated.
ENDOVASCULAR POPLITEAL ANEURYSM REPAIR (EPAR)

- Long term results unknown
- Short term results
  - patency rates lower than open repair
  - higher rates of reintervention

Reserved for patients at high surgical risks and appropriate anatomy
ENDOVASCULAR POPLITEAL ANEURYSM REPAIR (EPAR)

**Contraindications**

- Accessa. should accommodate 9-11Fr introducers
- Thrombosed aneurysms
- Occluded SFA
- Distal embolization (may be worsened by deployment)
- Very diffuse aneurysms extending above the adductor hiatus or involving the entire below knee popliteal a. or SFA should be treated surgically
Steps in Deployment of an Endograft for a Popliteal Aneurysm

1. Pretreat with clopidogrel.
2. Perform contralateral femoral puncture with delivery of an appropriately sized sheath over the bifurcation into the superior femoral artery.
3. Heparinize to an activated clotting time of greater than 250 seconds.
4. Cross the aneurysm into the distal popliteal artery or tibial vessels with a 0.035- or 0.018-inch wire, depending on the instructions for use of the device. Create a road map angiogram.
5. Deploy the graft from the distal to the proximal landing zone and overlap with additional grafts as needed. Postdilate the entirety of the graft to “iron out” any kinks or stenoses.
6. Perform a completion angiogram to evaluate for endoleak and preservation of runoff without embolization. In addition, an angiogram with the knee in extreme flexion should be performed to identify potential areas of kinking. A fluorographic save image to serve as a baseline for structural integrity of the graft is helpful.
7. Prescribe clopidogrel postoperatively indefinitely.
Tips

Grafts should be oversized by 10-20%.
If more than 1 stent is required a 3 cm overlap at least should be done.

Follow up

Duplex at 3 months intervals the first year then Q6 months thereafter.
Results

Weighted average for primary and secondary patency rates at 1.5 yr- 65% and 76%.

- Decreased length of stay and recovery.
- Increased rates of thrombosis and repeat interventions.
Antonello et al. (8)

Prospective randomized trial
30 PAAs between 1999 and 2003
15 patients OR/15 patients ET
Hemobahn graft - self expanding nitinol stent w/ internal linining of PTFE
size 2cm or more
Technical details (8)

Embolization of geniculate branches when present

Intraoperative study in flexion - if stenosis >50% → conversion

Follow-up (8)

› Duplex and ABI with flexion upon discharge
› Same at 1 and 3 months and Q6 months after
› Forced leg flexion CTA at 6 and 12 mo then Qyear
# Early Procedural Results (8)

<table>
<thead>
<tr>
<th></th>
<th>Group A (OR)</th>
<th>Group B (ET)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Graft/endograft occlusion</strong></td>
<td>0%</td>
<td>6.7%</td>
<td>NS</td>
</tr>
<tr>
<td><strong>Primary Patency</strong></td>
<td>100%</td>
<td>93.3%</td>
<td>NS</td>
</tr>
<tr>
<td><strong>Assisted Patency</strong></td>
<td>100%</td>
<td>100%</td>
<td>NS</td>
</tr>
<tr>
<td><strong>Limb Salvage Rate</strong></td>
<td>100%</td>
<td>100%</td>
<td>NS</td>
</tr>
<tr>
<td><strong>Endoleaks</strong></td>
<td>0%</td>
<td>0%</td>
<td>NS</td>
</tr>
<tr>
<td><strong>Mean Operative Time</strong></td>
<td>195.3mn</td>
<td>75.4mn</td>
<td>&lt;.01</td>
</tr>
<tr>
<td><strong>Mean Hospital Stay</strong></td>
<td>7.7 days</td>
<td>4.3 days</td>
<td>&lt;.01</td>
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</table>
Primary Patency Rates at 1 year and 4 years (8)

<table>
<thead>
<tr>
<th></th>
<th>GROUP A (OR)</th>
<th>GROUP B (ET)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 months</td>
<td>100%</td>
<td>86.7%</td>
<td>NS</td>
</tr>
<tr>
<td>primary patency</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>48 months</td>
<td>81.8%</td>
<td>80%</td>
<td>NS</td>
</tr>
<tr>
<td>primary patency</td>
<td></td>
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</tr>
</tbody>
</table>
There was no endoleaks.

No evidence of kinking of the graft during the follow up period (45 months) as evidenced by CTA with forced flexions and ABIs with flexion and at rest.

**Conclusion**

- ET seems to be safe and as good as open repair.
- Study limitation and no long term follow up.
REFERENCES

1- Cronenwett: Rutherford’s Vascular surgery, 71th ed. Saunders 2010


REFERENCES


6- **Pulli R, Dorigo W, Troisi N et al.** Surgical management of popliteal artery aneurysms: which factors affect outcomes? *J Vasc Surg* 2006; **43**: 481-487

7- **Mehta M, Champagne B, Darling C et al.** Outcome of popliteal artery aneurysms after exclusion and bypass: significance of residual patent branches mimicking type II endoleak