WHO YOU GONNA CALL?
C LOT-BUSTERS!

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ACUTE LIMB ISCHEMIA IS THE ABRUPT CESSATION OF NORMAL BLOOD FLOW TO THE LOWER EXTREMITY

- Embolus
- In-situ thrombosis
- Dissection

ACUTE LIMB ISCHEMIA IS THE ABRUPT CESSATION OF NORMAL BLOOD FLOW TO THE LOWER EXTREMIT Y

- Embolus
  - Atheroembolism
  - Mural thrombus
  - Paradoxical
  - Atrial/Ventricular
- In-situ thrombosis
- Dissection

Acute limb ischemia is the abrupt cessation of normal blood flow to the lower extremity.

- Embolus
- In-situ thrombosis
  - Plaque rupture
  - Vasospasm
  - Hypercoagulable
- Dissection

PRESENTATION IS CLASSICALLY WITH THE 6 P’S

- Pain
- Paresthesias
- Paralysis
- Poikilothermia
- Pallor
- Pulselessness
# Three Classes of Acute Limb Ischemia


<table>
<thead>
<tr>
<th>Category</th>
<th>Description/prognosis</th>
<th>Findings</th>
<th>Doppler signals†</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Viable</td>
<td>Not immediately threatened</td>
<td>Sensory loss</td>
<td>Arterial</td>
</tr>
<tr>
<td></td>
<td></td>
<td>None</td>
<td>Audible</td>
</tr>
<tr>
<td>II. Threatened</td>
<td></td>
<td>Muscle weakness</td>
<td></td>
</tr>
<tr>
<td>a. Marginal</td>
<td>Salvageable if promptly treated</td>
<td>Minimal (toes) or none</td>
<td>(Often) inaudible</td>
</tr>
<tr>
<td>b. Immediate</td>
<td>Salvageable with immediate revascularization</td>
<td>More than toes, associated with rest pain</td>
<td>(Usually) inaudible</td>
</tr>
<tr>
<td>III. Irreversible</td>
<td>Major tissue loss or permanent nerve damage inevitable</td>
<td>Profound, anesthetic</td>
<td>Inaudible</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Profound, paralysis (rigor)</td>
<td></td>
</tr>
</tbody>
</table>
ACUTE LIMB ISCHEMIA (ALI) REMAINS A SIGNIFICANT PROBLEM

- Rates decreasing
  - 7.98/100,000 to 3.54/100,000
- Underestimate
  - Iatrogenic
  - Trauma

Prouse AF, et al. Vasc Med. 2018; [e-publication]
OPEN REVASCULARIZATION IS THE TRADITIONAL GOLD STANDARD
ENDOVASCULAR MANAGEMENT INCREASING

- Increased by 4% in VA over last decade
- Thrombolysis with endovascular procedures in NIS
  - Highest increase in utilization
  - Lowest mortality
**Endovascular May Be Associated With Lower Morbidity and Mortality**

- NIS
  - Increased utilization by 47%
  - Lowest in-hospital mortality - 3.2%
- Swedvasc
  - No difference in major amputation
  - NNT - 12 patients!

2016 AHA/ACC Guideline on the Management of Patients With Lower Extremity Peripheral Artery Disease

A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines

Still slow to recommend endo

- Available facilities and local expertise
- Consider transfers to facilities with expertise
PRCT DATA DOES NOT CLEARLY SHOW BENEFIT OF CDT

### Table 6. SURGERY VS. THROMBOLYSIS: COMPOSITE CLINICAL OUTCOME AT 1-MONTH (PER-PROTOCOL ANALYSIS—PATIENTS RECEIVING TREATMENT SPECIFIED AT RANDOMIZATION)

<table>
<thead>
<tr>
<th>Event</th>
<th>Surgery (N = 127)</th>
<th>Thrombolysis (N = 194)</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>Percent</td>
<td>No.</td>
</tr>
<tr>
<td>Composite clinical outcome</td>
<td>44</td>
<td>34.6</td>
<td>107</td>
</tr>
<tr>
<td>Death</td>
<td>6</td>
<td>4.7</td>
<td>9</td>
</tr>
<tr>
<td>Major amputation</td>
<td>8</td>
<td>6.3</td>
<td>10</td>
</tr>
<tr>
<td>Ongoing/recurrent ischemia</td>
<td>30</td>
<td>23.6</td>
<td>88</td>
</tr>
<tr>
<td>Major morbidity</td>
<td>20</td>
<td>15.7</td>
<td>43</td>
</tr>
<tr>
<td>Life-threatening hemorrhage</td>
<td>1</td>
<td>0.8</td>
<td>12</td>
</tr>
<tr>
<td>Perioperative complications</td>
<td>11</td>
<td>8.7</td>
<td>12</td>
</tr>
<tr>
<td>Renal failure</td>
<td>1</td>
<td>0.8</td>
<td>3</td>
</tr>
<tr>
<td>Anesthesia complications</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td>Vascular complication</td>
<td>4</td>
<td>3.1</td>
<td>22</td>
</tr>
<tr>
<td>Post-intervention wound complication</td>
<td>4</td>
<td>3.1</td>
<td>10</td>
</tr>
</tbody>
</table>

ULTRASOUND ASSISTED CATHETER
DIRECTED THROMBOLYSIS INCREASES SURFACE AREA

- Infusion catheter
  - Multi-lumen
- Ultrasonic Core
  - Up to 30 piezoelectric ceramic ultrasound transducers
  - 2-3 MHz RF energy
ULTRASOUND ASSISTED THROMBOLYSIS APPEARS TO IMPROVE SAFETY OF CDT

<table>
<thead>
<tr>
<th></th>
<th>Time to lysis</th>
<th>Rate of lysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>EKOS™</td>
<td>22 hours</td>
<td>Approx 0.01mg/kg/hr</td>
</tr>
<tr>
<td>Infusion only</td>
<td>2.3 days</td>
<td>0.01mg/kg/hr</td>
</tr>
</tbody>
</table>

RHEOLYTIC ASPIRATION DEVICES REMOVE THROMBUS AND INFUSE THROMBOLYTIC

• Hypotubes
  • Saline at > 20,000 PSI
  • Bernoulli effect
• Zone of negative pressure
• In reverse, power pulse spray
  • 10mg of alteplase in 50cc of saline
  • 20-25 minutes incubation
RHEOLYTIC POWER PULSE SPRAY AND ASPIRATION THROMBECTOMY

- PEARL registry
  - 34 institutions; 2007-2013
  - Propensity matched
- N=283
  - 26% Class I
  - 38% Class IIa
  - 35% Class IIb
- 1-yr
  - Limb salvage 89%
  - Survival 91%

ASPIRATION THROMBECTOMY SIGNIFICANTLY ADDS TO THE ARSENAL

• Dirigible tip is the key!
• 29in Hg (98.2kPa)
VACUUM ASSISTED THROMBECTOMY IS A SAFE AND EFFECTIVE TOOL

- N = 30
  - 63% Class I
  - 13% Class Ila
  - 20% Class IIb
- No dissections or embolization
- 9 of 30 required additional therapy
- Statistically significant improvement in thrombus burden

CASE 1:

- Cc: Occluded DP
- HPI: 81 yo female with rest pain and toe gangrene (W1 I2 fl 0)
  - s/p anterior tibial artery laser atherectomy
    - Balloon angioplasty of the anterior tibial artery and dorsalis pedis artery
  - Loss of pulse and Doppler signal in the dorsalis pedis POD #1
  - s/p intra-arterial tpa, anterior tibial artery stent placement
    - Repeat balloon angioplasty of the entire anterior tibial artery and dorsalis pedis
  - POD #2/3, new loss of DP pulse and Doppler signal
- PMH: HTN, CHF (EF 15%), dementia, s/p hip fracture
• Solent Distal catheter
  • Distal AT
• 10 mg of alteplase power pulse spray
• Aspirated for 240 seconds
CASE 2:

- Cc: Occluded tibioperoneal trunk
- HPI: 57 yo male with 1wk history of rest pain
  - Doppler examination shows patent iliac stents
  - Occlusion of the below the knee popliteal/tibioperoneal trunk
  - No Doppler signals, decreased motor and sensory function
- PMH: A-fib (Pradaxa), HTN, HLD, type I diabetes, CHF, s/p AICD for ventricular tachycardia, s/p bilateral kissing iliac stents
- Chronic thrombus, likely
  - Lysis unlikely to be effective
  - Angiojet less effective against chronic thrombus
- Penumbra CAT-6 with the separator
- No alteplase
CASE 3:

- Cc: Iliac artery stent, and fem-pt bypass graft occlusion
- HPI: 62 yo male with 1wk history of rest pain
  - CTA shows occluded right iliac stent
  - Occlusion of fem-PT bypass graft
  - No Doppler signals, decreased motor and sensory function
- PMH: Anxiety disorder, s/p prior kissing iliac stents, s/p re-lining of right iliac stent due to crush injury
• IVUS to verify proper wire passage
• Mostly hypoechoic structures
• Crushed stent
• Zelante
  • 10mg of alteplase
  • Aspirate for 90 seconds
• 6x60 In.Pact balloon
• Innova stent relining 8x60mm
• Post-dilate with an 8x60mm balloon
• Embolus at proximal anastomosis of fem-PT bypass
- Solent distal catheter
- 10mg of alteplase
- 180 seconds
- Penumbra 6-CAT catheter
• 3x220mm balloon angioplasty of the entire graft
• DP and PT signal at the end of the procedure.
CONCLUSIONS

• Endovascular management of acute limb ischemia appears safer
• Newer modalities render endovascular-only management of ALI feasible
• Future research and directions
  • Newer technology evaluation
  • Acute limb ischemia teams
  • Cost
  • Contemporaneous control arms with open surgical management
    • PRCT?