Algorithm for Managing Acute Lower Extremity Ischemia

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Disclosure

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I have the following potential conflicts of interest to report:

Consulting: Silk Road, Surmodics, Profusa, CSI, Cardinal, Terumo

Chief Medical Officer: Intact Vascular, Cagent, Vesper

Scientific Advisory Board: Abbott, Medtronic, Boston Scientific

Slides courtesy of Jim McKinsey
Acute Limb Ischemia: Overview

- Lower Extremity Arterial ischemia:
  - Acute-Embolus, thrombosis
  - Acute on Chronic
    - Bypass graft that occludes
    - High grade stenosis that thromboses

- Acute arterial lower extremity ischemia is characterized by lack of blood flow leading to severe ischemia, cell death, loss of limb or life. (muscle death occurs within 6-8 hours of occlusion)

- Outcomes are poor, 30% amputation at 30 days
- In-hospital mortality rates as high as 20%

Courtesy J McKinsey
Acute Limb Ischemia: Etiology

**Emboli:**
- Cardiac
- Atrial fibrillation 60-75%
- Aneurysms (blue toe syndrome)
- Atherosclerosis
  - Emboli typically lodge where there is an narrowing (at bifurcation’s) of the artery:
    - Femoral – 28%
    - Upper extremity – 20%
    - Aortoiliac – 18%
    - Popliteal – 17%
    - Visceral and other – 9% each

**Thrombosis:**
- Atherosclerosis
- Hypercoaguable states
- Hypovolemia
- Polycythemia
- Trauma
- Previous bypass surgery
- Iatrogenic
Acute Limb Ischemia: Diagnosis (The P’s)

- **Pulseless:**
  - Pulse deficit
- **Paresthesias:** the first sign of arterial ischemia.
  - Most sensitive nerves are in the anterior compartment of the leg, and innervate the dorsum of the foot
- **Paresis:** Motor weakness is the next sign of arterial ischemia
  - Motor nerves are denervated after sensory nerves
- **Pain:**
  - Muscle tenderness is typically a late sign of muscle necrosis/ irreversible ischemia
- **Pallor:**
  - Good sign of distal perfusion

Severity of symptoms influences strategy.
### Acute Limb Ischemia: SVS Classification

<table>
<thead>
<tr>
<th>Category</th>
<th>Description/Prognosis</th>
<th>Findings</th>
<th>Doppler Signals</th>
<th>Arterial</th>
<th>Venous</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Viable</td>
<td>Not immediately threatened</td>
<td>Sensory Loss: None</td>
<td>Audible</td>
<td></td>
<td>Audible</td>
</tr>
<tr>
<td>II. Threatened</td>
<td></td>
<td>Muscle Weakness: None</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Marginally</td>
<td>Salvageable if promptly treated</td>
<td>Minimal (toes) or none</td>
<td>Inaudible</td>
<td></td>
<td>Audible</td>
</tr>
<tr>
<td>b. Immediately</td>
<td>Salvageable with immediate revascularization</td>
<td>More than toes, associated with rest pain</td>
<td>Inaudible</td>
<td></td>
<td>Audible</td>
</tr>
<tr>
<td>III. Irreversible</td>
<td>Major tissue loss or permanent nerve damage inevitable</td>
<td>Profound, anesthetic</td>
<td>Inaudible</td>
<td></td>
<td>Inaudible</td>
</tr>
<tr>
<td></td>
<td>Profound, paralysis (rigor)</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

-Evaluation. TASC classification: determining viability (which will guide therapy)
Acute Limb Ischemia: Treatment

Once diagnosis has been made in absence of absolute contraindication:

- Start IV Heparin with Bolus
- O2 even in absence of pulmonary disease
- Analgesia
- Foley catheter
- IV hydration
- Plan for Intervention:
  - Imaging (CTA or duplex)
Acute Limb Ischemia: Endovascular Treatment

Endovascular Techniques
- Angiographic evaluation of inflow and outflow
- Percutaneous aspiration thrombectomy (PAT)
  ➢ Rapid technique which is applicable with the use of a large lumen catheter (6–8F), Penumbra Cat 8 or Cat 6.
- Percutaneous mechanical thrombectomy
  ➢ Mechanical clot dissolution catheters, hydrodynamic/rheolytic catheters, mixed type, and ultrasonic catheters
  ➢ AngioJet
  ➢ Excimer laser
  ➢ Percutaneous mechanical thrombectomy is recommended in cases of stage Rutherford IIb ischemia and high surgical risk, because thrombolysis is time-consuming and could result in clinical deterioration and/or compartment syndrome.
- Pharmacological recanalization technique
  ➢ Operator crosses the occlusion with a guidewire and a multi-side-hole catheter, which allows direct delivery of the thrombolytic agent into the thrombus
  ➢ Can unmask arterial stenosis once thrombus is dissolved

Best in patients with moderate ischemia or prohibitive open surgical risk.

SAGE Open Med. 2013; SAGE Open Medicine
Acute Lower Extremity Ischemia: Catheter-Directed Thrombolysis

- tPA (Alteplase)
- Reduced endothelial damage
- Reduction in magnitude of surgical intervention required
  - Underlying lesion exposed
  - Improved outflow through lysis of distal vessels
- May require extended treatment times
- Higher bleeding risk
- May require secondary intervention-surgery, endovascular
- Mechanical thrombectomy devices (combination therapy)
Acute Limb Ischemia: Potential Contraindications to Thrombolysis

- Active bleeding disorder
- GI bleed
- CVA
- Intracranial/spinal surgery
- Head injury

- HTN SBP > 180mm Hg/DBP > 110mm Hg/Older patients
- CPR – 10 days
- Intracranial tumor
- Pregnancy
- Diabetic hemorrhagic retinopathy
- Recent eye surgery
- Hepatic failure
- Bacterial endocarditis
- Major surgery/trauma
Acute Limb Ischemia: Surgical Treatment

Surgical approaches to the treatment of ALI

• Thromboembolectomy with a balloon catheter
  – Profound ischemia in the setting of focal embolus
• Bypass surgery, Endarterectomy and patch angioplasty
  – Acute ischemia superimposed upon chronic
Acute Limb Ischemia:
Open Surgical Treatment

**Classic Thromboembolectomy:**
- Proximal and distal control
- Catheter passage beyond thrombus
- Withdraw inflated balloon
- Repeat until no residual thrombus

- Can be replaced by:
  - FATE – fluoro-assisted thromboembolectomy
Acute Limb Ischemia: Treatment

Initial treatment with intravenous heparin

Detailed examination and imaging

Stage I: Viable Limb
Stage IIa: Threatened marginally
Stage IIb: Threatened immediately
Stage III: Irreversible

Treatment according to severity

Stage I,II: Endovascular Revascularization or hybrid therapy
- Thrombectomy (Aspiration or Mechanical)
- Thrombolysis (Catheter-directed)
- Surgery (especially if event >14 days)

Stage III: Amputation
(For irreversible damage)
Complications After Treatment of Acute Arterial Ischemia

- Reperfusion acidotic washout
- Peripheral muscle edema and swelling
- Compartment syndrome
  - Numbness in distal extremity, tenderness to palpation
  - “Soft calf” on physical exam does not exclude compartment syndrome
  - Measure compartment pressure if in doubt.
  - Elevation of CPK can be caused by Compartment Syndrome
Acute Lower Extremity Ischemia

**Conclusion**

- Early recognition and treatment is critical for best outcomes for cases of acute limb ischemia.
- Consider endovascular treatment first for cases of non-severe acute ischemia.
  - Thrombectomy: Mechanical, aspiration, laser
  - Thrombolysis
  - Combined mechanical and pharmaceutical
- Surgical Intervention
  - Severe Ischemia especially with neurologic symptoms and if fasciotomies are required
  - More Chronic Ischemia (14 days)
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