Vascular Evaluation of the Foot

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Peripheral Vascular Disease

• 15-20% of patients with DM have PAD at 10 yrs
• 45% of patients with DM have PAD at 20 yrs

What is Ischemia?

Ischemia = Demand > Supply

• Absolute Ischemia
  – absolute amount of flow present
• Relative Ischemia
  – discrepancy between amount of flow available and amount needed by the current clinical situation
History and Physical Exam

- Presence of hair
- Warm foot
- Normal skin color
- Palpation of pulses
- Status of the nail plates

Significant vascular disease present in 20% of patients with normal clinical exam...

Ischemia more likely with:
- location: toe or heel ulcer
- etiology: unknown or pressure area
- diminished pulses, shiny atrophic skin, infection
- dependent rubor / elevation pallor
**When to order NIV arterial testing?**

- Chronic non-healing ulcer/wound
- Pre-operatively to assess healing of proposed foot surgery
- Ulcers of the digits, or boney prominences
- Symptoms of claudication

**Noninvasive Modalities**

- Ankle Brachial Index
- Toe Brachial Index
- Toe Pressure
- Segmental Pressures
- Doppler waveforms
- Photoplethysmography
- Pulse Volume Recordings

**ABI / TBI**

- **Ankle Brachial Index:**
  - ratio of ankle / arm systolic blood pressure
  - normal 0.9 to 1.2
  - false elevation in DM due to medial calcification
  - good screening test in non-diabetic patients

- **Toe Brachial Index:**
  - ratio of hallux / arm systolic pressure
  - > 0.6 low risk
  - < 0.2 severe risk
  - digital vessels less affected by calcification in DM

**Medial Calcinosis**

- Tunica media
- neuropathy
- elevated pressures

- Goebel and Fuessel, Edmonds
Ankle and Toe Indices

• ABI Exam:

TBI Exam:

Doppler Waveforms

• Interpretation
  – triphasic/biphasic/monophasic
  – normal flow appears as narrow peak, followed by one or two smaller peaks
  – faster flow --> higher audible pitch, waveform resembles teepee
  – slower flow--> lower pitch, igloo waveform
  – as flow deteriorates, waves flatten

Doppler Waveform – Triphasic and Biphasic

Doppler Waveform - Monophasic
Photoplethysmography

- Transmission of IR light into tissue
- Reflection varies with blood content of microcirculation
- Transducer attached to digits for waveform

PVR - Reflected Wave Absent

PVR - Blunted and Bowed

Peripheral Arterial Disease: PAD

- Atherosclerosis
- Atherosclerotic lesions cause arterial blockages (stenosis & occlusion)
- Affects blood flow to critical arteries that supply brain, vital organs, and limbs
- Frequently affects lower extremities
- Associated with smoking, high blood pressure, diabetes, age, and hypercholesterolemia
Prevalence of PAD

<table>
<thead>
<tr>
<th>Category</th>
<th>Diagnosis</th>
<th>Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asymptomatic</td>
<td>ABI &lt; 0.9</td>
<td>&gt;50%</td>
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<tr>
<td></td>
<td></td>
<td>4-6 million</td>
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<tr>
<td>Claudication</td>
<td>Muscle pain, ache, cramps,</td>
<td>30%-35%</td>
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<tr>
<td></td>
<td>fatigue</td>
<td></td>
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<td></td>
<td></td>
<td>2-4 million</td>
</tr>
<tr>
<td>Critical Limb</td>
<td>Pain at rest, ulceration,</td>
<td>&lt;10%</td>
</tr>
<tr>
<td>Ischemia</td>
<td>gangrene</td>
<td></td>
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<td>400,000-1 million</td>
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Prevalence of PAD Increases With Age

Where is the patient along the risk spectrum of vascular disease?

A thorough assessment by history and exam should give you an idea

Symptoms

- Pain in buttocks, thigh, calf, arch
- Night ischemic pain
Peripheral Arterial Disease

• Intermittent claudication
  – “claudico” – to limp
  – Pain with walking
  – Relieved by rest
• Critical Limb Ischemia
  – Pain at rest, ulcers, or gangrene

Intermittent Claudication

Measured in amount of blocks

Reproducible

Consistent

Not Limb Threatening

Peripheral Arterial Disease

• Intermittent claudication
  – “claudico” – to limp
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Intermittent Claudication

• Differential Diagnosis
  – Pseudoclaudication
  – Degenerative Joint Disease
  – Diabetic Peripheral Neuropathy
**Natural History of CLI**

1 Year Outcomes

- Rest Pain
- Ulceration
- Gangrene

**Critical Limb Ischemia**

- Alive with both limbs 50%
- Amputation 25%
- Dead 25%

*Weitz JI, Circulation 1996*

**Diabetic vs. Nondiabetic Ischemic Patterns**

**Diabetic:**
- Distal: popliteal, ‘trifurcation,’ tibial, pedal
- Collateral Pathways: internal iliac, profunda femoral, tibial
- Calcified vessel walls
- Symmetrical

**Nondiabetic:**
- Proximal: aorta, iliac, femoral
- Axial Pathways: aorta, iliac, superficial femoral
- Usually noncalcified
- Symmetrical

**Timing of Vascular Assessment**

- In the acute presentation:
  - priority is to address limb threatening infection
  - should not delay necessary debridement
  - prompt bypass integral to limb salvage

- In routine outpatient management:
  - initial evaluation
  - non-healing wound
  - follow progression of known disease

**History and Physical Exam**

- Hx of CABG
- Hx of CEA
- Hx of tobacco
- Hx of MI
- Hx of CVA
- Hx of Angina

- Thigh, buttocks, calf pain upon walking
- Hx of previous ulcerations and how long it took to heal
History and Physical Exam

- many classic symptoms masked or absent in DM
  - claudication, rest pain
  - coolness / pallor absent due to a/v shunting
  - brisk capillary refill time false
  - pulses can mislead due to segmental nature of disease

Indications

- Claudication
- Rest pain
- Slow healing/non-healing ulcer/wound
- Gangrene
- Pre-operatively to assess healing potential

Sykes - Assessment

5 Minute Hyperemia Test

- Differentiates between organic occlusive disease vs. vasospastic disease

- Look for color return
  - Immediate
  - 5-8 seconds
  - > 10 seconds
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