PAD
Clinical Presentations

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• None
Individuals With PAD Present in Clinical Practice With Distinct Syndromes

**Asymptomatic**: Without obvious symptomatic complaint (but usually with a functional impairment).

**Classic claudication**: Lower extremity symptoms confined to the muscles with a consistent (reproducible) onset with exercise and relief with rest.

**“Atypical ” leg pain**: Lower extremity discomfort that is exertional but that does not consistently resolve with rest, consistently limit exercise at a reproducible distance, or meet all “Rose questionnaire” criteria.
This guideline recognizes that:

Individuals With PAD Present in Clinical Practice With Distinct Syndromes

**Critical limb Ischemia:** Ischemic rest pain, nonhealing wound, or gangrene/

**Acute limb ischemia:** The five “P”s, defined by the clinical symptoms and signs that suggest potential limb jeopardy:
- Pain
- Pulselessness
- Pallor
- Paresthesias
- Paralysis (& polar, as a sixth “P”).
Clinical Presentations of PAD

- Classic (Typical) Claudication: ~15%
- Atypical Leg Pain (functionally limited): ~33%
- Critical Limb Ischemia: 1%-2%
- Asymptomatic: 50%
## Claudication vs. Pseudoclaudication

<table>
<thead>
<tr>
<th>Characteristic of discomfort</th>
<th>Claudication</th>
<th>Pseudoclaudication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cramping, tightness, aching,</td>
<td>Cramping, tightness, aching, fatigue</td>
<td>Same as claudication plus tingling, burning,</td>
</tr>
<tr>
<td>Fatigue</td>
<td></td>
<td>numbness</td>
</tr>
<tr>
<td>Location of discomfort</td>
<td>Buttock, hip, thigh, calf, foot</td>
<td>Same as claudication</td>
</tr>
<tr>
<td>Exercise-induced</td>
<td>Yes</td>
<td>Variable</td>
</tr>
<tr>
<td>Distance</td>
<td>Consistent</td>
<td>Variable</td>
</tr>
<tr>
<td>Occurs with standing</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Action for relief</td>
<td>Stand</td>
<td>Sit, change position</td>
</tr>
<tr>
<td>Time to relief</td>
<td>&lt;5 minutes</td>
<td>( \leq 30 \text{ minutes} )</td>
</tr>
</tbody>
</table>

Also see Table 4 of Hirsch AT, et al. *J Am Coll Cardiol.* 2006;47:e1-e192.
Leg Pain Has a Differential Diagnosis

- Spinal canal stenosis
- Peripheral neuropathy
- Peripheral nerve pain
  - Herniated disc impinging on sciatic nerve
- Osteoarthritis of the hip or knee
- Venous claudication
- Symptomatic Baker’s cyst
- Chronic compartment syndrome
- Muscle spasms or cramps
- Restless leg syndrome

Also see Table 3 of Hirsch AT, et al. J Am Coll Cardiol. 2006;47:e1-e192.
ABI and Functional Outcomes

Proportion Stopping During 6-Minute Walk

Mean Distance Achieved in 6-Minute Walk

ABI=ankle-brachial index

Factors That Increase Risk of Limb Loss in Patients With Critical Limb Ischemia

- Factors that reduce blood flow to the microvascular bed
  - Diabetes
  - Severe renal failure
  - Severely decreased cardiac output (severe heart failure or shock)
  - Vasospastic diseases or concomitant conditions (e.g., Raynaud’s phenomenon, prolonged cold exposure)
  - Smoking and tobacco use

- Factors that increase demand for blood flow to the microvascular bed
  - Infection (e.g., cellulitis, osteomyelitis)
  - Skin breakdown or traumatic injury

Also see Table 5 of Hirsch AT, et al. J Am Coll Cardiol. 2006;47:e1-e192.
Objectives for Diagnostic Evaluation of Patients With Critical Limb Ischemia

- Localization of the responsible lesion(s) and measurement of relative severity
- Assessment of the hemodynamic requirements for successful revascularization (vis-à-vis proximal versus combined revascularization of multilevel disease)
- Assessment of individual patient endovascular or operative risk

Also see Table 6 of Hirsch AT, et al. J Am Coll Cardiol. 2006;47:e1-e192.
Clinicians who care for individuals with PAD should be able to provide:

- A vascular review of symptoms
- A vascular-focused physical examination
- Use of the noninvasive vascular diagnostic laboratory (ABI and toe-brachial index [TBI], exercise ABI, Duplex ultrasound, magnetic resonance angiography [MRA], and computed tomographic angiography [CTA])
- When required, use of diagnostic catheter-based angiography
The Vascular Review of Symptoms: An Essential Component of the Vascular History

Key components of the vascular review of systems (not usually included in the review of systems of the extremities) and family history include the following:

- Any exertional limitation of the lower extremity muscles or any history of walking impairment. The characteristics of this limitation may be described as fatigue, aching, numbness, or pain. The primary site(s) of discomfort in the buttock, thigh, calf, or foot should be recorded, along with the relation of such discomfort to rest or exertion.

- Any poorly healing or nonhealing wounds of the legs or feet.

- Any pain at rest localized to the lower leg or foot and its association with the upright or recumbent positions.

- Post-prandial abdominal pain that reproducibly is provoked by eating and is associated with weight loss.

- Family history of a first-degree relative with an abdominal aortic aneurysm.
Comprehensive Vascular Examination

Key components of the vascular physical examination include:

- Bilateral arm blood pressure (BP)
- Cardiac examination
- Palpation of the abdomen for aneurysmal disease
- Auscultation for bruits
- Examination of legs and feet

- Pulse Examination
  - Carotid
  - Radial/ulnar
  - Femoral
  - Popliteal
  - Dorsalis pedis
  - Posterior tibial

- Scale:
  - 0=Absent
  - 1=Diminished
  - 2=Normal
  - 3=Bounding (aneurysm or AI)
The First Tool to Establish the PAD Diagnosis: 
*A Standardized Physical Examination*

Pulse intensity should be assessed and should be recorded numerically as follows:

- 0, absent
- 1, diminished
- 2, normal
- 3, bounding

Use of a standard examination should facilitate clinical communication.
Recognizing the “at risk” groups leads to recognition of the five main PAD clinical syndromes:

- **No leg pain**
- **“Atypical” leg pain**
- **Classic claudication**
- **Chronic critical limb ischemia (CLI)**
- **Acute limb ischemia (ALI)**

Perform a resting ankle-brachial index measurement
How to Perform an ABI Exam

- Performed with the patient resting in the supine position.

- All pressures are measured with an arterial Doppler and appropriately sized blood pressure cuff (edge 1-2 inches above the pulse; cuff width should be 40% of limb circumference).

- Systolic pressures will be measured in the right and left brachial arteries followed by the right and left ankle arteries.
ABI Procedure

• **Step 1:** Apply the appropriately sized blood pressure cuff on the arm above the elbow (either arm).

• **Step 2:** Apply Doppler gel to skin surface.

• **Step 3:** Turn on the Doppler and place the probe in the area of the pulse at a 45-60° angle to the surface of the skin, pointing to the shoulder.

• **Step 4:** Move the probe around until the clearest arterial signal is heard.
ABI Procedure

• **Step 5:** Inflate the blood pressure cuff to approximately 20 mmHg above the point where systolic sounds are no longer heard.

• **Step 6:** Gradually deflate until the arterial signal returns. Record the pressure reading.

• **Step 7:** Repeat the procedure for the right and left posterior tibial and dorsalis pedis arteries. Place the probe on the pulse and angle the probe at 45° toward the knee.

• **Step 8:** Record the systolic blood pressure of the contralateral arm.
Understanding the ABI

The ratio of the higher brachial systolic pressure and the higher ankle systolic pressure for each leg:

\[
\text{ABI} = \frac{\text{Ankle systolic pressure}}{\text{Higher brachial artery systolic pressure}}
\]
Calculate the ABI

1. For the left side, divide the left ankle pressure by the highest brachial pressure and record the result.
2. Repeat the steps for the right side.
3. Record the ABIs and place the results in the medical record.

**ABI Interpretation**

≤ 0.90 is diagnostic of peripheral arterial disease

Interpreting the Ankle-Brachial Index

<table>
<thead>
<tr>
<th>ABI Range</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00–1.29</td>
<td>Normal</td>
</tr>
<tr>
<td>0.91–0.99</td>
<td>Borderline</td>
</tr>
<tr>
<td>0.41–0.90</td>
<td>Mild-to-moderate disease</td>
</tr>
<tr>
<td>≤0.40</td>
<td>Severe disease</td>
</tr>
<tr>
<td>≥1.30</td>
<td>Noncompressible</td>
</tr>
</tbody>
</table>

Adapted from Hirsch AT, et al. J Am Coll Cardiol. 2006;47:e1-e192. Figure 6.
ABI Limitations

- Incompressible arteries (elderly patients, patients with diabetes, renal failure, etc.)
- Resting ABI may be insensitive for detecting mild aorto-iliac occlusive disease
- Not designed to define degree of functional limitation
- Normal resting values in symptomatic patients may become abnormal after exercise
- **Note:** “Non-compressible” pedal arteries is a physiologic term and such arteries need not be “calcified”
The toe-brachial index (TBI) is calculated by dividing the toe pressure by the higher of the two brachial pressures. TBI values remain accurate when ABI values are not possible due to non-compressible pedal pulses. TBI values ≤ 0.7 are usually considered diagnostic for lower extremity PAD.
Hemodynamic Noninvasive Tests

- Resting Ankle-Brachial Index (ABI)
- Exercise ABI
- Segmental pressure examination
- Pulse volume recordings

These traditional tests continue to provide a simple, risk-free, and cost-effective approach to establishing the PAD diagnosis as well as to follow PAD status after procedures.
Segmental Pressures (mm Hg)

150  Brachial  150

150  150

110  146

108  100

62   84

0.54 ABI  0.44
Pulse Volume Recordings

Upper thigh

Lower thigh

Calf

Ankle

Upper thigh

Lower thigh

Calf

Ankle
Exercise ABI Testing

- Confirms the PAD diagnosis
- Assesses the functional severity of claudication
- May “unmask” PAD when resting the ABI is normal
- Aids differentiation of intermittent claudication vs. pseudoclaudication diagnoses
Exercise ABI Testing: Treadmill

- Indicated when the ABI is normal or borderline but symptoms are consistent with claudication;
- An ABI fall post-exercise supports a PAD diagnosis;
- Assesses functional capacity (patient symptoms may be discordant with objective exercise capacity).
Color Duplex Ultrasonography
Magnetic Resonance Angiography (MRA)

- MRA has virtually replaced contrast arteriography for PAD diagnosis
- Excellent arterial picture
- No ionizing radiation
- Noniodine–based intravenous contrast medium rarely causes renal insufficiency or allergic reaction
- ~10% of patients cannot utilize MRA because of:
  - Claustrophobia
  - Pacemaker/implantable cardioverter-defibrillator
  - Obesity
- Gadolinium use in individuals with an eGFR <60 mL/min has been associated with nephrogenic systemic fibrosis (NSF)/nephrogenic fibrosing dermopathy
Computed Tomographic Angiography (CTA)

- Requires iodinated contrast
- Requires ionizing radiation
- Produces an excellent arterial picture
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