Peripheral Artery Disease
What You Need to Know

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February 8, 2020
Why is Peripheral Artery Disease (PAD) important?

Establishing the diagnosis of PAD

Management of PAD
  - Noninvasive: Risk Factor modification / Medications / Exercise
  - Invasive: Endovascular (EVR) / Surgery

Endovascular tools and techniques

Anatomic patterns of PAD
  - Aorto-Iliac
  - Femoral-Popliteal
  - Infra-Popliteal / Tibial

Case Study
PAD is characterized by atherosclerosis of the large and medium-sized arteries of the limbs.
PAD Fast Facts

- PAD affects 8 to 12 million people in the United States.
- One in every 20 Americans over the age of 50 has PAD.
- The risk of PAD increases dramatically with age.
PAD is Highly Prevalent in “High Risk” Populations

PARTNERS Study: PAD Prevalence in Primary Care Setting
N=6,979: Age > 70 or 50-70 with either DM or Tob use

PAD Present
29.0%

PAD Absent
71.0%
PAD is underdiagnosed

~10,000,000 PAD patients in US

2,500,000 Diagnosed

Only 400,000 (~4%) patients have undergone revascularization

Most PAD patients are asymptomatic.
Clinical Spectrum of PAD Severity

Asymptomatic

Intermittent Claudication

Chronic Limb Threatening Ischemia
PAD Risk Factors

- High Blood Pressure
- Hyperlipidemia
- Diabetes Mellitus
- Smoking increases risk of PAD by 400%
Patients with PAD have a large burden of other forms of CVD

CAD: Coronary Artery Disease
CeVD: Cerebrovascular Disease
PAD: Peripheral Artery Disease

24.7% of patients with CAD had concomitant disease in other vascular beds

61.5% of patients with PAD had concomitant disease in other vascular beds
Patients with PAD are at very high risk of death / MI / CVA
PAD Natural History:
5 Year Outcomes in Symptomatic Patients

Symptomatic Patients

Limb Morbidity

- Stable Claudication: 70-80%
- Worsening Claudication: 10-20%
- Critical Limb Ischemia: 1-2%
PAD Natural History: 1 Year Outcomes in Critical Limb Ischemia (CLI)

- Alive with 2 limbs: 50%
- Amputation: 25%
- CV-Death: 25%
Why is PAD Important?

Key Points

1. Highly Prevalent
2. Underdiagnosed
3. Often Asymptomatic
4. Highly Morbid (↑ Risk of CV events)
Outline

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Case Study
Findings Suggestive of PAD

History

- Claudication or other non-joint-related exertional symptoms
- Impaired walking function
- Ischemic rest pain

Physical Examination

- Abnormal lower extremity pulse examination
- Vascular bruit
- Non-healing lower extremity wound
- Other suggestive lower extremity physical findings (elevation pallor/dependent rubor)
# ABI for Diagnosing PAD

<table>
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<tr>
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<td>I</td>
<td>B-NR</td>
<td>In patients with <strong>history or physical examination findings suggestive of PAD</strong>, the resting ABI, with or without segmental pressures and waveforms, is recommended to establish the diagnosis.</td>
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<tr>
<td>III: No Benefit</td>
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<td>In patients <strong>not at increased risk of PAD</strong> and without history or physical examination findings suggestive of PAD, the ABI is not recommended.</td>
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Ankle-Brachial Index (ABI)

\[
\text{ABI} = \frac{\text{Ankle Systolic Pressure}}{\text{Brachial Systolic Pressure}} \\
\text{Higher of PT or DP} \\
\text{Higher of two arm pressures*}
\]
# Ankle-Brachial Index (ABI)

<table>
<thead>
<tr>
<th>Resting ABIs</th>
<th>Category</th>
<th>Exercise ABI</th>
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<tbody>
<tr>
<td>&gt;1.4</td>
<td>High ABI</td>
<td></td>
</tr>
<tr>
<td>1.31 to 1.4</td>
<td>Borderline High</td>
<td></td>
</tr>
<tr>
<td>1 to 1.3</td>
<td>Normal</td>
<td></td>
</tr>
<tr>
<td>0.91 to 0.99</td>
<td>Borderline low</td>
<td></td>
</tr>
<tr>
<td>&gt;0.7 ≤0.9</td>
<td>Mild</td>
<td>≤0.9</td>
</tr>
<tr>
<td>&gt;0.5 ≤0.7</td>
<td>Moderate</td>
<td>≤0.5</td>
</tr>
<tr>
<td>≤0.5</td>
<td>Severe</td>
<td>≤0.15</td>
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Lower ABI = Lower Survival

With every 0.1 decrease in ABI, there is a 10% increase in risk of CV event

Hiatt JW, N Eng J Med 2001
# ABI for Diagnosing PAD

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Patients at Increased Risk of PAD

- Age $\geq 65$ y
- Age 50 - 64 y, with risk factors for atherosclerosis (e.g., diabetes mellitus, history of smoking, hyperlipidemia, hypertension) or family history of PAD
- Age $< 50$ y, with diabetes mellitus and 1 additional risk factor for atherosclerosis
- Individuals with known atherosclerotic disease in another vascular bed (e.g., coronary, carotid, subclavian, renal, mesenteric artery stenosis, or AAA)
Limitations of ABI

- ABI < 0.9 is specific for PAD but not very sensitive.

- ABIs may be “normal” in patients with pelvic/iliac/inflow disease. Exercise ABI will often be abnormal in these patients.

- Calcified vessels may be elevated ABI because these vessels are non-compressible (elderly, DM, CKD).

- If the exam and clinical presentation do not correlate with the ABI, further non-invasive testing should be considered.
Other Noninvasive Tests

Duplex Ultrasonography (DUS)

CT Angiography (CTA)

Magnetic Resonance Angiography (MRA)
Duplex Ultrasonography (DUS)

**Advantages:** Noninvasive, No Contrast, Less Costly than other modalities

**Disadvantages:** Technician dependent, Limited views in certain patients
CTA
Identifies location and severity of plaque, tortuosity, calcification, and collaterals

Advantages:
- Noninvasive
- High spatial resolution
- Visualizes long vascular segments

Disadvantages:
- Requires contrast
- Radiation exposure
- Heavy calcium can obscure images
MRA

Advantages:

- Noninvasive
- No iodine-based contrast
- No radiation
- Better for small vessel visualization

Disadvantages:

- Not widely available
- ICD/PPM may preclude use
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Case Study
3 Major Goals for PAD

1. Reduce in CV morbidity / mortality

2. Reduce Adverse Limb Outcomes
   - Prevent progression to limb-threatening ischemia
   - Prevent amputation

3. Improve Quality of Life
   - Increase walking distance
   - Improve mobility
PAD Risk Factors

- Hyperlipidemia
- High Blood Pressure
- Diabetes Mellitus
- Smoking
Who said cigarette kills?

I'm 48 and still feeling good.
The 5 A’s to Quit Tobacco

Ask _____ to quit at every visit.

Advise _____ to quit tobacco at every visit.

Assess _______ willingness to quit at every visit.

Assist _______ quitting within 2 weeks with pharmacotherapy or counseling.

Arrange _____ follow-up contact in 1st week after quitting.

Tennessee Tobacco QUITLINE
1-800-QUIT-NOW
1-800-784-8669

CHANTIX® (varenicline) TABLETS
STARTING MONTH BOX (Your first 4 weeks)
Use the Starting Week (green) blister card first when beginning to take Chantix.

CHANTIX® is an FDA-Approved Aid for Quitting Smoking
Noninvasive Management

Medications

Statin
- Reduce rate of MI / CVA / Death associated with concomitant CVD
- Increase walking distance and improve patency post revasc

Antiplatelet Tx
- Both ASA and Plavix are indicated to reduce CV event rate in PAD.
- Plavix may be slightly more effective

Antithrombotic Tx
- COMPASS Trial: Low-dose rivaroxaban (2.5 mg bid) reduces CV and Limb event rates when combined with ASA vs. ASA alone

Cilostazol
- Improves walking distance
- Contraindicated in patients with HF
- Associated frequent adverse effects (headache, diarrhea)

References:
Noninvasive Management
Exercise Therapy

- Exercise Therapy is the most effective noninvasive therapy for improving walking distances.
- Supervised Exercise Therapy (SET) and Home-based Exercise Programs both shown to be effective
Noninvasive Management
Supervised Exercise Therapy (SET)

Gardner and Poehlman. JAMA 1995;274:975-80
Noninvasive Management
Supervised Exercise Therapy (SET)

CMS covers SET for symptomatic PAD
Up to 36 sessions over 12 weeks

All components must be met:

- Sessions lasting 30-60 minutes
- Conducted in a hospital outpatient setting or a physician’s office
- Be delivered by qualified auxiliary personnel who are trained in exercise therapy for PAD
- Under direct supervision of an MD, PA, on APN
Cardiopulmonary Rehabilitation
Supervised Exercise Therapy (SET) vs. Revascularization
CLEVER Trial
Exercise Therapy vs. EVR vs. Meds

Peak Walking Time

Claudication Onset Time

Optimal Medical Care
Stent
Supervised Exercise
Supervised Exercise Therapy (SET) vs. Revascularization vs. SET + Revascularization?
ERASE Trial
Exercise Therapy (SET) + EVR vs. SET alone

Fakhry et al. JAMA 2015;314:1936-44
Revascularization for PAD

Chronic Limb-Threatening Ischemia (CLTI)

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<td>In patients with CLI, revascularization should be performed when possible to minimize tissue loss.</td>
</tr>
<tr>
<td>I</td>
<td>C-EO</td>
<td>An evaluation for revascularization options should be performed by an interdisciplinary care team (Table 8) before amputation in the patient with CLI.</td>
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Intermittent Claudication (IC)

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<td>A</td>
<td>Revascularization is a reasonable treatment option for the patient with lifestyle-limiting claudication with an inadequate response to GDMT.</td>
</tr>
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Revascularization for Claudication

Endovascular (EVR) vs. Surgery

Traditionally: EVR for TASC A - C and Surgery for TASC D

Currently: “EVR First” approach for most lesions
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Case Study
Endovascular Tools & Techniques

- **Imaging Techniques**
  - Digital Angiography (DA)
  - Digital Subtraction Angio (DSA)

- **Sheath Size**
  - Diagnostic: 4F vs. 5F
  - Intervention: 6F vs. 7F

- **Access:**
  - Femoral Retrograde
  - Femoral Antegrade
  - Brachial
  - BTK Retrograde (PT/AT/Pop)

- **Wires**
  - 0.035 vs. 0.018 vs. 0.014
  - “Safe, Stiff, Slippery, Sharp”

- **Reentry Devices**

- **Balloons**
  - Standard PTA balloon
  - Scoring/Cutting balloon
  - Intravascular Lithotripsy (Shockwave)
  - Drug-Coated balloon (DCB)

- **Atherectomy Devices**
  - Rotational atherectomy
  - Laser
  - Directional atherectomy
  - Orbital atherectomy

- **Stents**
  - Stainless steel BES
  - Nitinol SES
  - Nitinol DES
  - Nitinol interwoven stent
  - Covered stents
Optimal PTA results from inflations that are slow, prolonged, and low-pressure
Balloons

Standard PTA Balloon

Cutting Balloon

Scoring Balloon (Angiosculpt)

Drug-Coated Balloon
Atherectomy Devices

Orbital Atherectomy

Laser Atherectomy

Directional Atherectomy

Rotational Atherectomy
Atherectomy Devices

Orbital Atherectomy
Atherectomy Devices

Directional Atherectomy
Stents

Balloon-Expandable Stainless Steel Stent

Nitinol Self-Expanding Stent

Nitinol/PTFE Covered Stent

Nitinol Drug-Eluting Stent (Zilver PTX / Eluvia)
Femoropopliteal Forces

Flexion
Compression
Torsion
Extension/Contraction
Interwoven Nitinol Stent: Supera
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Case Study
Three Anatomic Patterns

1. Aorto-Iliac
2. Femoral-Popliteal
3. Infra-Popliteal / Tibial
Aorto-Iliac Anatomy
Femoro-Popliteal Anatomy

- Common Femoral Artery (CFA)
- Deep Femoral Artery (Profunda)
- Superficial Femoral Artery (SFA)
Infra-Popliteal / Tibial Anatomy

- Tibioperoneal trunk (TPT)
- Anterior tibial artery (ATA)
- Posterior tibial artery (PTA)
- Peroneal artery (PA)
Infra-Popliteal / Tibial Anatomy
Aorto-Iliac Disease

- Accounts for $\frac{1}{3}$ of symptomatic PAD

- Symptoms may include:
  - Claudication of thighs / calves
  - Claudication of buttocks
  - Erectile dysfunction

- Revascularization (surgical & endovascular) is associated with significant improvement in symptoms and is among the most durable of anatomic subsets
Aorto-Iliac Disease
Aorto-Iliac Disease
EVR to the Left Common Iliac Artery (CIA)
Femoro-Popliteal Disease

- Typically present with claudication (involved in 80%)
- May also present with chronic limb-threatening ischemia (CTLI), especially in the setting of multi-level disease
- Complete occlusion is present in ~50% of cases
- EVR is typically successful but less durable than the iliac space
Femoro-Popliteal Disease
Infra-Popliteal / Tibial

- Commonly involved in patients with CLTI.
- DM and CKD increase likelihood of tibial involvement.
- Role for EVR is limited to patients with CLTI. Role in claudication is more limited.
- Goal of EVR is to avoid amputations by promoting wound healing.
Infra-Popliteal Disease

EVR of Anterior Tibial and Peroneal arteries
Infra-Popliteal Disease

EVR of Pedal Loop
Case

- 79 yo M
- Difficulty walking for years
- DM, HTN, HLD
- Still working 3 days / wk at grocery store.
- His legs “get tired” and he often has to stop while carrying groceries to customers cars
- Had been told he has neuropathy – No relief with gabapentin
- Referred for ABIs – Markedly abnormal with monophasic waveforms and non-compressible BTK disease
Summary

- PAD is under-recognized and associated with ↑ CV events.
- Medical therapy and risk factor modification represent the foundation of disease management.
- Symptomatic patients often benefit from exercise training.
- Patients with lifestyle-limiting claudication or critical limb ischemia should be considered for revascularization.
- Many tools allow for a treatment plan tailored to the specific patient and his/her angiographic findings.
- Field is evolving rapidly with new technologies and studies to evaluate the most effective & efficient use of current technology.
Thank You