Peripheral Vascular Disease

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About me...

- Undergrad at the College of the Holy Cross
  - Worcester, MA

- Dartmouth Medical School
  - Hanover, NH

- Residency in Diagnostic Radiology/fellowship in Vascular and Interventional Radiology at the University of Virginia
  - Charlottesville, VA
Dr. Charles Tegtmeyer
Goals

- Epidemiology of peripheral arterial disease (PAD)
- Basic workup
- Role of endovascular therapy
- Case examples
Why Should We Care About PAD?

- To enhance the quality of patient care
  - High prevalence
  - High cardiovascular risk
  - Poor quality of life

- Improved ability to detect and treat degenerative vascular disease
  - Symptomatic lower extremity vascular disease
  - Renal artery stenosis
  - Mesenteric vascular disease
  - Asymptomatic abdominal and thoracic aortic aneurysm
PAD Prevalence and Epidemiology
Framingham Heart Study

- Objective: develop an IC risk profile using 38 years of follow-up data (Rose questionnaire)
- 5209 patients, started in 1948
- One of the first studies to show the benefit of risk factor modification in decreasing PAD and CAD

Peripheral ARterial Disease Detection, Awareness, and Treatment: NEw Resources for Survival

- Multicenter, cross-sectional study at 27 sites and 350 PCP offices in the US in 1999
- 6979 patients aged >70 or aged 50-69 with h/o smoking or diabetes
- PAD Dx: ABI < 0.9, prior dx, or h/o limb revascularization

Hirsch et al. JAMA 2001; 286:1317-24
29% of Patients in a Target Population Were Diagnosed With PAD Using An Office-Based ABI

ABI=ankle-brachial index; CAD=coronary artery disease.

Impaired glucose tolerance was defined as oral glucose tolerance test value ≥140 mg/dL but <200 mg/dL.
*P<.05 vs. normal glucose tolerance.
Rotterdam Study (ABI <0.9)\(^1\)
San Diego Study (PAD by noninvasive tests)\(^2\)

\(\text{ABI} = \text{ankle-brachial index}\)

6880 Consecutive Patients (61% Female) in 344 Primary Care Offices

Prevalence (%)

- Women
- Men

Age (years)
- <70
- 70–74
- 75–79
- 80–84
- >85

Adapted from Diehm C. Atherosclerosis. 2004;172:95-105
Ethnicity

The San Diego Population Study

Risk Factors for PAD

- Smoking
- Diabetes
- Age (per 10 years)
- Renal Insufficiency
- Hypertension
- Hypercholesterolemia
- Race (non-Caucasian vs Caucasian)
- Male Gender
- Hyperhomocysteinemia
- C-Reactive Protein

Cigarette Smoking

Dose-dependent
Former smoker status can equal non-smoker status one year after cessation

“At Risk” Patients

- Age <50 with diabetes + 1 additional risk factor
  - smoking, dyslipidemia, hypertension, or hyperhomocysteinemia
- Age 50-69 and history of smoking or diabetes
- Age >70 years
- Leg symptoms with exertion (suggestive of claudication) or ischemic rest pain
- Abnormal lower extremity pulse examination
- Known atherosclerotic coronary, carotid, or renal artery disease
Clinical Presentations of PAD

- Classic (Typical) Claudication: ~15%
- Atypical Leg Pain (functionally limited): ~33%
- Critical Limb Ischemia (rest pain, ulcers, gangrene): 1%-2%
- Asymptomatic: 50%
Prognosis of PAD
Rates of MI and Death

3649 subjects (average age 64 years) followed up for 7.2 years

Long-Term Survival

Survival (%)

Year

0 2 4 6 8 10 12

100 75 50 25 0

Normal subjects
Asymptomatic PAD
Symptomatic PAD
Severe symptomatic PAD

Natural history of atherosclerotic lower extremity PAD syndromes

PAD population (50 years and over)
Initial clinical presentation

- Asymptomatic PAD 20–50%
- Other leg pain 30–40%
- Typical claudication 10–35%
- Critical limb ischemia 1–3%

1-year outcomes
- Alive with two limbs 45%
- Amputation 30%
- Mortality 25%

5-year outcomes

- Limb morbidity
  - Stable claudication 70–80%
  - Worsening claudication 10–20%
  - Critical limb ischemia 5–10%
  - Amputation (see CLI date)

- CV morbidity and mortality
  - Non-fatal cardiovascular event (MI or stroke) 20%
  - Mortality 10–15%
  - CV causes 75%
  - Non-CV causes 25%

TASC II
Approach

- History
- Physical
- Special Tests
  - Duplex
  - ABI/PVRs
  - CT angiography
  - MR angiography
  - Nerve Conduction Studies
History

- **Claudication**
  - Major muscle group
  - Occurs with activity
  - Relieved with rest
  - Reproducible

- **Critical ischemia**
  - Rest/night pain
  - Tissue loss

- **DDX:**
  - Radicular pain/nerve root compression, spinal stenosis, arthritis, compartment syndrome, venous insufficiency
Physical

- Temperature, skin color & texture, hair
- Pulses: palpable? strong or weak?
- Pulses: Dopplerable?
- Rubor on dependency, pallor with elevation?
- Ulcerations or tissue loss?
History

- What type of shoes do you wear?
- How much walking do you do / can you do?
- Are you having problems with balance?
- Pain, paresthesias, numbness?
- Who takes care of your feet? self, family?
- Have you ever had a foot ulcer? – key predictor
- Can you see your feet?
- Can you reach your feet?
<table>
<thead>
<tr>
<th>Stage</th>
<th>Clinical</th>
<th>Fontaine Grade</th>
<th>Rutherford Category</th>
<th>Rutherford Clinical</th>
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<tbody>
<tr>
<td>I</td>
<td>Asymptomatic</td>
<td>0</td>
<td>0</td>
<td>Asymptomatic</td>
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<tr>
<td>IIa</td>
<td>Mild claudication</td>
<td>I</td>
<td>1</td>
<td>Mild claudication</td>
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<tr>
<td>IIb</td>
<td>Moderate to severe claudication</td>
<td>I</td>
<td>2</td>
<td>Moderate claudication</td>
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<tr>
<td></td>
<td></td>
<td>I</td>
<td>3</td>
<td>Severe claudication</td>
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<tr>
<td>III</td>
<td>Ischemic rest pain</td>
<td>II</td>
<td>4</td>
<td>Ischemic rest pain</td>
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<tr>
<td>IV</td>
<td>Ulceration or gangrene</td>
<td>III</td>
<td>5</td>
<td>Minor tissue loss</td>
</tr>
<tr>
<td></td>
<td></td>
<td>III</td>
<td>6</td>
<td>Major tissue loss</td>
</tr>
</tbody>
</table>
# Ankle-Brachial Index

<table>
<thead>
<tr>
<th>ABI</th>
<th>Symptoms</th>
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<tbody>
<tr>
<td>1.0-0.8</td>
<td>None</td>
</tr>
<tr>
<td>0.8-0.6</td>
<td>Claudication</td>
</tr>
<tr>
<td>0.6-0.3</td>
<td>Rest Pain</td>
</tr>
<tr>
<td>0.3-0</td>
<td>Tissue Loss</td>
</tr>
</tbody>
</table>
PVRs

Systolic peak
Dicrotic wave
Concave diastolic downslope
Rounded peak
Convex down slope
Delayed upslope

Normal Digital Pulse Contour
Obstructive Pulse Contour

Normal
Mildly Abnormal
Moderately Abnormal
Severe Abnormality
What is Interventional Radiology?

- Utilization of image guidance to perform minimally invasive procedures

- Two broad types of procedures:
  - Catheters advanced under fluoroscopy in hollow/tubular structures (e.g. biliary, urinary, vascular)
  - Needles advanced into solid organs under ultrasound, CT, or MR
Interventional Radiology

- **1895** – Roentgen Discovered X-rays
  - Dartmouth College Physics professor Gilman Frost

- **1896** – First Clinical X-ray
  
  Dartmouth College Physics professor Gilman Frost
Interventional Radiology

- 1952 - Seldinger Technique

Swedish radiologist Sven Ivar Seldinger:

“I found myself, disappointed and sad, with three objects in my hand - a needle, a wire and a catheter - and ... in a split second I realized in what sequence I should use them: Needle in, wire in, needle off, catheter on wire, catheter in, catheter advance, wire off”.

- 1964 - Intraarterial catheters

Interventional Radiology

- 1970s- Computed Tomography and Ultrasound

- 1974- Gruntzig
  - Balloon Dilatation catheters
Tools of the Trade

- Involves all forms of medical imaging
  - Fluoroscopy
  - Ultrasound
  - CT
  - MRI
  - Nuclear Medicine
Need to be an expert imager
Tools of the Trade

- Needles
- Wires
- Catheters
- Balloons
- Stents
- Embolic/Thrombolytic agents
- Atherectomy Devices
Wires
Catheters
Balloons
Balloon Angioplasty

Controlled injury
Balloon Angioplasty
Stents

Keep vessels open when angioplasty fails or there is a complication such as dissection.
Angioplasty and Stenting

- Thousands of articles reporting results of angioplasty, stenting and bypass surgery
- Few randomized prospective trials
- Aortoiliac lesions
  - 4 year primary and secondary patency rates 80-90% = aortofemoral bypass
  - Endovascular preferred due to significantly decreased morbidity
- SFA/pop lesions
  - 4 year primary and secondary patency 60-80%, gets worse with increasing disease segment length
  - Bypass is preferred for long segment lesions
- Critical limb ischemia
  - Limb salvage rate 80-90%
- Endovascular treatment is always preferred if patient is a poor surgical candidate
Anatomy
Cases
Case 1: Inflow Disease

- 62 y/o female with “tingling” in her legs on exertion, L>R
- Waitress
- Prior smoker (15 pyh)
- Blood pressure controlled on a betablocker
- ABIs = 0.8 on the right, 0.5 on the left
Case 2: SFA disease

- 69 y/o female with LLE rest pain
- Non-smoker
- On Aspirin 81mg
- ABI = 0.4
Case 2
Case 2
Case 2
Case 2

5-4 symmetry
Case 2
Case 3: Critical Limb Ischemia

- Manifestation of peripheral arterial disease (PAD) that describes patients with chronic ischemic rest pain or tissue loss (ulcers or gangrene)

- 59-year-old male with left lower extremity claudication and non-healing left heel ulcer
  - Diabetes
  - ESRD
  - Prior MI
  - ABI 0.3
Subintimal Recannalization
Subintimal Arterial Flossing with Anterograde/Retrograde Intervention (SAFARI)
- Technique invented at UVA in 2004, Spinosa
Conclusions
## Two Major Goals in Diagnosing and Treating Patients With PAD

<table>
<thead>
<tr>
<th>Improve Limb Outcomes</th>
<th>Decrease CV Morbidity and Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Improve ability to walk</td>
<td>• Decrease morbidity from non-fatal MI and stroke</td>
</tr>
<tr>
<td>• Increase in peak walking distance</td>
<td>• Decrease cardiovascular mortality from fatal MI and stroke</td>
</tr>
<tr>
<td>• Improve QoL</td>
<td></td>
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<tr>
<td>• Prevent progression to CLI and amputation</td>
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</tbody>
</table>

**Smoking Cessation, Treatment of DM/HTN/HL and other risk factors**
Endovascular Therapy

- Preferred over surgical bypass in many situations
  - Overall comparable patency rates
  - Significantly less morbidity (shorter hospital stay, faster recovery) associated with percutaneous procedures versus surgical bypass

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