Spring Fling
2018

Vascular Primer
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Disclosure

I have no relevant financial relationships or affiliations with commercial interests to disclose.
Goals of our 50 min Together

• Review the incidence and prevalence of vascular disease (arterial and venous)

• Review vascular exam findings

• Review signs and symptoms of common vascular disorders

• Brief overview of diagnostic testing
Arterial Vascular Disease Prevalence

Prevalence of PAD (%) by Age Group (years)

The prevalence of PAD increases with age for both men and women.\(^1\)

2011 Center for Disease Control and Prevention Statistics
8-12 Million People in USA

- Men and woman are equally affected by PAD
- General population awareness of PAD is estimated at 25%

2011 Center for Disease Control and Prevention Statistics
Ethnic-specific Prevalence of PAD

Figure 1. Ethnic-specific prevalence of peripheral arterial disease in men in the United States. \textsuperscript{18} AA indicates African Americans; AI, American Indians; AS, Asian Americans; HS, Hispanics; and NHW, non-Hispanic whites.

Circ Res. 2015;117:e12
PAD Risk Factors

- NO SMOKING!
- Glc 280!
- Cholesterol!
Odds Ratios for Risk Factors

Fig 1. The approximate odds ratios (ORs) for risk factors associated with the development of peripheral arterial disease (PAD). Adapted from Inter-Society Consensus for the Management of Peripheral Arterial Disease (TASC II).
Vascular Exam: PAD

• Should include examination of the ocular fundus and skin as well as the arterial, venous, and lymphatic systems.
Vascular Exam: Inspection

• Appearance of skin
  – Demarcation or transition
  – Shiny

• Hair growth
• Discoloration or rash
• Swelling
• Ulcer or wound
Vascular Exam: Inspection and Palpation

- Muscle atrophy
- Toenail growth

- Touch
  - Skin texture
  - Temperature
  - Pain level
Vascular Exam: Palpation

- Abdomen
- Distal pulses
- Capillary refill
Buerger’s test

Patient on his back

**A-Rising** the affected limb
cause **blanching** within 2-3 M.

**B-Lowering** the leg below the
below the horizontal plane
leads to **cyanotic congestion**

Bureger’s angle : is the angle
of elevation ay which the
pallor occurs

Normally no change of color
occur whatever the position of
the limb.
Thoracic outlet syndrome

**ADSON or scalene maneuver**

Radial pulse diminishes and disappears on turning chin to same side.
Decreases space between scaleneus anterior and medius.
Most Common Presentation

• Occult or Asymptomatic PAD!

• PAD patients die mostly of cardiac and cerebrovascular-related events and much less frequently due to obstructive disease of the lower extremities.

Clinical Presentation of PAD

- 20-50% Asymptomatic, diagnosis by ABI or other imaging
- 40-50% atypical leg pain
- 10-35% claudication
- 2% critical limb ischemia

Symptoms

- **Claudication**: Intermittent cramping pain or discomfort, often in the calf, that occurs consistently and reproducibly with exertion, causing the patient to stop walking, and is relieved by rest. Will sometimes occur in the buttocks and hips. Can cause weakness.

- **Atypical symptoms**: Similar to above but not severe enough to cause patient to stop walking or may not be relieved with rest.

Latin root= Limping

JAMA 2001;286:1317-1324
## Clinical Spectrum of Claudication

<table>
<thead>
<tr>
<th>Intermittent (Atherosclerosis)</th>
<th>Neurogenic (Lumbar Spinal Stenosis)</th>
<th>Venous (Deep Vein Thrombosis)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain is in the muscle of the calf, thigh or buttock</td>
<td>Pain is in whole leg can be associated with tingling and numbness</td>
<td>Involvement of whole leg.</td>
</tr>
<tr>
<td>Unilateral in femoropopliteal disease</td>
<td>Bilateral (Can also be less commonly unilateral)</td>
<td>Pt may describe feeling their &quot;leg is going to burst&quot;</td>
</tr>
<tr>
<td>Bilateral in aorto-iliac disease</td>
<td>Comes on suddenly on standing up or walking</td>
<td>Most commonly unilateral</td>
</tr>
<tr>
<td>Gradual onset after walking &quot;claudication distance&quot;</td>
<td>Relieved by sitting down, bending over and stopping walking</td>
<td>Gradual onset after beginning to walk</td>
</tr>
<tr>
<td>Pain is relieved by rest</td>
<td>Unable to straighten legs</td>
<td>Relief on elevating the leg</td>
</tr>
<tr>
<td>Absent/reduced pulses</td>
<td></td>
<td>Cyanosed</td>
</tr>
</tbody>
</table>

NB. The Claudication distance is a constant distance the patient was able to walk before the onset of symptoms.

Varicose Veins

Oedematous
## Classification of Claudication

<table>
<thead>
<tr>
<th>Fontaine</th>
<th>Rutherford</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage</td>
<td>Clinical</td>
<td>Grade</td>
<td>Category</td>
<td>Clinical</td>
</tr>
<tr>
<td>I</td>
<td>Asymptomatic</td>
<td>0</td>
<td>0</td>
<td>Asymptomatic</td>
</tr>
<tr>
<td>IIa</td>
<td>Mild claudication</td>
<td>I</td>
<td>1</td>
<td>Mild claudication</td>
</tr>
<tr>
<td>IIb</td>
<td>Moderate to severe claudication</td>
<td>I</td>
<td>2</td>
<td>Moderate claudication</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I</td>
<td>3</td>
<td>Severe claudication</td>
</tr>
<tr>
<td>III</td>
<td>Ischemic rest pain</td>
<td>II</td>
<td>4</td>
<td>Ischemic rest pain</td>
</tr>
<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>
Symptoms: Acute or Chronic Limb Ischemia (The “heart attack” of legs)

• **Acute** is sudden onset
  – Most commonly embolus from heart
  – Second most common acute thrombosis on chronic stenosis

• **Chronic** is >2 weeks
  – Collaterals are formed

  – ASSESS THE PATIENTS 6 P’s!!!
    • Pain, palor, paralysis, pulselessness, paresthesia, and poikilothermia

Circ Res. 2015;117:e12
Acute or Chronic Limb Ischemia

- Limb salvage!!!!  Amputations= early mortality
- Amputation itself carries 3-20% perioperative mortality
- The 5 year survival rate with CLI patients in the surgical literature is only 50-60%
- Approximately 80% of CLI patients die from cardiovascular or cerebrovascular events
Causes of PAD

• Atherosclerosis...
Causes of PAD

- Atherosclerosis
- Aneurysms
  - emboli
- Trauma/radiation
- Infection
- Fibromuscular dysplasia

- Functional spasms
  (Raynaud’s)
- Vasculitis
  - Buerger’s aka
    thromboangitis obliterans
  - Takayasu arteritis
- Anatomic abnormalities
  - Popliteal entrapment in
    young patients
  - Iliac syndrome in bicyclists

Vascular Disease: Jaff and White 2011;3-18
Appearance of Buerger’s: Ulnar artery

Takayasu arteritis
Fibromuscular Dysplasia
Exam Findings of PAD
Raynaud’s
Primary and Secondary
The Appearance of PAD: Arterial Ulcers and Gangrene
The Appearance of PAD: “Blue Toes” from Cholesterol Embolism
Diagnostic Testing for Suspected PAD

History and physical examination suggestive of PAD without rest pain, nonhealing wound, or gangrene (Table 4)

Suspect CLI (Figure 2)

ABI with or without segmental limb pressures and waveforms (Class I)

Noncompressible arteries
ABI: >1.40

TBI (Class I)

Normal (>0.70)

Abnormal (≤0.70)

Search for alternative diagnosis (Table 5)

Lifestyle-limiting claudication despite GDMT, revascularization considered

Anatomic assessment:
• Duplex ultrasound
• CTA or MRA (Class I)

Anatomic assessment:
• Invasive angiography (Class IIa)

Normal

Search for alternative diagnosis (Table 5)

Abnormal

Exercise ABI (Class I)

Continued GDMT (Class I)

Exercise ABI (Class IIa)

Exercise ABI (Class IIa)

Continued GDMT (Class I)

Do not perform invasive or noninvasive anatomic assessments for asymptomatic patients (Class III: Harm)

Normal

Exercise ABI (Class IIa)

Exercise ABI (Class IIa)

Continued GDMT (Class I)

Do not perform invasive or noninvasive anatomic assessments for asymptomatic patients (Class III: Harm)
Ankle Brachial Index (ABI)

ABI WORKSHEET

<table>
<thead>
<tr>
<th>Right Arm:</th>
<th>Left Arm:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Systolic Pressure</td>
<td>Systolic Pressure</td>
</tr>
<tr>
<td>mmHg</td>
<td>mmHg</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Right Ankle:</th>
<th>Left Ankle:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Systolic Pressure</td>
<td>Systolic Pressure</td>
</tr>
<tr>
<td>mmHg</td>
<td>mmHg</td>
</tr>
<tr>
<td>Posterior</td>
<td>Posterior</td>
</tr>
<tr>
<td>Tibial (PT)</td>
<td>Tibial (PT)</td>
</tr>
<tr>
<td>Dorsalis</td>
<td>Dorsalis</td>
</tr>
<tr>
<td>Pedis (DP)</td>
<td>Pedis (DP)</td>
</tr>
</tbody>
</table>

Right ABI equals Ratio of:
Higher of the Right Ankle Pressures (PT or DP)
Higher Arm Pressure (right or left arm)

Left ABI equals Ratio of:
Higher of the Left Ankle Pressures (PT or DP)
Higher Arm Pressure (right or left arm)

* The lower of these numbers is the patient’s overall ABI.

Overall ABI (lower ABI) = ________
<table>
<thead>
<tr>
<th>Steps</th>
<th>(1) Measurement of ABI</th>
<th>(2) Measurement of Systolic Pressures of the 4 Limbs</th>
<th>(3) Calculation of ABI</th>
<th>(4) Use and Interpretation of the ABI if Clinical Presentation of PAD</th>
<th>(5) Interpretation of ABI as a Marker of Subclinical CVD and Risk in Asymptomatic Individuals</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Doppler Method</td>
<td>Sequence of ABI at rest</td>
<td>For each leg: divide higher of the PT or DP pressure by higher of the right or left arm SBP</td>
<td>ABI used as a first-line noninvasive test for diagnosis of PAD</td>
<td>ABI provides incremental information beyond standard risk scores in predicting future CVD events</td>
</tr>
<tr>
<td></td>
<td>SBP in each arm</td>
<td>First arm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SBP in each ankle</td>
<td>First PT artery</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>First DP artery</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Other PT artery</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>Other DP artery</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Other arm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Cuff size</td>
<td>If the SBP of first arm is greater than SBP of other arm by at least 10 mmHg, repeat BP of first arm and disregard first measurement</td>
<td>As a diagnostic tool for patients with PAD symptoms, each leg is reported separately</td>
<td>ABI≤0.90 is the threshold for confirming diagnosis of lower-extremity PAD</td>
<td>ABI≤0.90 or ≥1.40=increased risk of CVD events and mortality</td>
</tr>
<tr>
<td></td>
<td>Width at least 40% of limb circumference</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Ankle cuff placement</td>
<td>Just above the malleoli</td>
<td>As a prognostic marker for CVD, use lower of the left and right ABIs (exception: noncompressible arteries)</td>
<td>If ABI&gt;0.90 with clinical suspicion of PAD=use postexercise ABI or other noninvasive tests</td>
<td>ABI between 0.91 and 1.00 is borderline for CVD risk; further evaluation is appropriate</td>
</tr>
<tr>
<td></td>
<td>Straight wrapping method</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Open lesions covered with impermeable dressing</td>
<td></td>
<td>When ABI between 0.80 and 1.00, it is reasonable to repeat the measurement</td>
<td>Postexercise ankle pressure decrease of &gt;30 mm Hg or postexercise ABI decrease of &gt;20%=diagnostic criteria for PAD</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>

ABI indicates ankle-brachial index; BP, blood pressure; CVD, cardiovascular disease; DP, dorsalis pedis; MI, myocardial infarction; and PAD, peripheral artery disease; PT, posterior tibial, and SBP, systolic blood pressure.
Relationship of High and Low Ankle Brachial Index to All-Cause and Cardiovascular Disease Mortality

The Strong Heart Study

Helaine E. Resnick, PhD, MPH; Robert S. Lindsay, MB, PhD; Mary McGrae McDermott, MD; Richard B. Devereux, MD; Kristina L. Jones, MPH; Richard R. Fabsitz, PhD; Barbara V. Howard, PhD

Background—The associations of low (<0.90) and high (>1.40) ankle brachial index (ABI) with risk of all-cause and cardiovascular disease (CVD) mortality have not been examined in a population-based setting.

Methods and Results—We examined all-cause and CVD mortality in relation to low and high ABI in 4393 American Indians in the Strong Heart Study. Participants had bilateral ABI measurements at baseline and were followed up for 8.3±2.2 years (36 589 person-years). Cox regression was used to quantify mortality rates among participants with high and low ABI relative to those with normal ABI (0.90 ≤ ABI ≤ 1.40). Death from all causes occurred in 1022 participants (23.3%; 27.9 deaths per 1000 person-years), and of these, 272 (26.6%; 7.4 deaths per 1000 person-years) were attributable to CVD. Low ABI was present in 216 participants (4.9%), and high ABI occurred in 404 (9.2%). Diabetes, albuminuria, and hypertension occurred with greater frequency among persons with low (60.2%, 44.4%, and 50.1%) and high (67.8%, 49.9%, and 45.1%) ABI compared with those with normal ABI (44.4%, 26.9%, and 36.5%), respectively (P<0.0001). Adjusted risk estimates for all-cause mortality were 1.69 (1.34 to 2.14) for low and 1.77 (1.48 to 2.13) for high ABI, and estimates for CVD mortality were 2.52 (1.74 to 3.64) for low and 2.09 (1.49 to 2.94) for high ABI.

Conclusions—The association between high ABI and mortality was similar to that of low ABI and mortality, highlighting a U-shaped association between this noninvasive measure of peripheral arterial disease and mortality risk. Our data suggest that the upper limit of normal ABI should not exceed 1.40. (Circulation. 2004;109:733-739.)

Key Words: epidemiology ■ mortality ■ peripheral vascular disease
Ankle-brachial index, toe-brachial index, and cardiovascular mortality in persons with and without diabetes mellitus

Suzanne Hyun, MD, a Nketi I. Forbang, MD, b Matthew A. Allison, MD, MPH, b,c Julie O. Denenberg, MAS, b Michael H. Criqui, MD, MPH, b and Joachim H. Ix, MD, MAS, d,e Loma Linda and San Diego, Calif

Background: The prognostic utility of the ankle-brachial index (ABI) may be hampered in persons with diabetes due to peripheral arterial stiffening in the ankles. Stiffening of toe arteries occurs infrequently in diabetes. We aimed to determine the nature of the relationship of the toe-brachial index (TBI) and ABI with cardiovascular disease (CVD) mortality and to determine whether the associations are modified in individuals with diabetes.

Methods: Individuals with clinically suspected atherosclerotic peripheral arterial disease who underwent ABI and TBI measurements in a vascular laboratory were monitored longitudinally for CVD mortality.

Results: Among 469 participants (89% men), the mean age was 68 ± 9 years, and 36% had diabetes. The mean ABI was 0.83 ± 0.28 and the mean TBI was 0.60 ± 0.24. During median 7.0 years of follow-up, there were 158 CVD deaths. The association of the ABI categories with CVD deaths differed in diabetic vs nondiabetic participants (P = .002 for interaction). In contrast, the association of the TBI categories with CVD deaths was similar, irrespective of diabetes status (P = .17 for interaction). Among diabetic patients, a U-shaped relationship was observed between ABI categories and CVD death: those with low (<0.90) and high (>1.30) ABIs were both at higher risk than those with normal ABIs (range, 0.90-1.30). In nondiabetic patients, association of ABI categories with CVD death was linear, such that those with an ABI >1.30 were at the lowest risk, whereas those with an ABI <0.90 were at higher risk. In contrast, the association of TBI categories with CVD death was linear irrespective of diabetes status. High TBI categories consistently predicted low risk, whereas risk was higher with progressively lower TBI categories.

Conclusions: Among diabetic individuals with clinically suspected peripheral arterial disease, those with low and high ABIs are both at higher risk of CVD death. In contrast, a linear relationship was observed between TBI categories and CVD death irrespective of diabetes status. These findings suggest that stiffened ankle arteries may limit the predictive value of the ABI in individuals with diabetes, a limitation that may be overcome by measurement of the TBI. (J Vasc Surg 2014;60:390-5.)
PVR is obtained with a cuff system that incorporates pneumoplethysmography
Diagnostic Imaging

- Doppler US
  - Noninvasive
  - Sonographer experience dependent
  - Useful for diagnosing specific areas of significant stenosis or occlusions
  - No contrast needed—preserves kidneys
  - Lower sensitivity than other imaging techniques
Diagnostic Imaging
Benefits include high sensitivity and specificity. Downside is the radiation, amount of contrast, and overestimated stenosis.
Benefits of MRA include no radiation, less nephrotoxicity with dye. Downside is cost, less sensitivity below the knee, artifact if stents have been placed prior and long scan times.
Diagnostic Imaging - Conventional Angiogram

“Gold standard”
Benefits include live time therapeutic options
Downsides include invasive risks, contrast, and radiation
Fig 2. The natural history of patients with intermittent claudication (IC) treated with non-invasive management. CV, Cardiovascular; MI, myocardial infarction. Adapted from American College of Cardiology/Americal Heart Association guidelines. ⁴³
Besides Heightened Awareness as Clinicians, What Else Can We Do?

• Increase awareness in patient education!
What is PAD?
PAD occurs when fatty deposits build up in the arteries and block blood flow similar to coronary artery disease (CAD) and carotid artery disease (CVD).

PAD is different from CAD and CVD because it affects arteries leading from the legs and arms instead of the heart and brain.

Symptoms
- Pain, numbness, or weakness in legs
- Ulcers or sores on leg or foot that won't heal
- Cold legs or feet
- Aching pain in feet or toes while at rest
- Skin color changes in legs or feet

Who Suffers?
- 8-12 million Americans
- 20% over age 65
- Men and Women are equally affected. Higher risk of getting PAD if you are of African American or Hispanic descent.

Common Risk Factors
- History of Smoking
- Age 65 or Older
- Lack of Exercise
- High Cholesterol
- Obesity
- Diabetes

Screening for PAD
Screening for PAD is easy. We simply ask a few questions and take your blood pressure in both arms and legs.

If the pressure is lower in your legs, this could be a sign of PAD. We'll refer you to your primary care doctor for further testing.

Treatment Options
Many PAD symptoms can be controlled by making moderate lifestyle changes. For those with more serious conditions, angioplasty is one of several options.

Angioplasty is a minimally invasive procedure where an Interventional Radiologist uses a catheter to inflate a small balloon in your arteries to

Reduce Your Risk
- Quit Smoking
- Exercise Regularly
- Eat Healthy
- Lose Weight
Table 1. San Diego Claudication Questionnaire*

1. Do you get pain, discomfort, or numbness in your legs when you walk?
   
<table>
<thead>
<tr>
<th></th>
<th>R</th>
<th>L</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Yes</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>No</td>
</tr>
</tbody>
</table>

2. Does this pain ever begin when you are standing still or sitting?

<table>
<thead>
<tr>
<th></th>
<th>R</th>
<th>L</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Yes</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>No</td>
</tr>
</tbody>
</table>

3. In what part of the leg or buttock do you feel it?

<table>
<thead>
<tr>
<th></th>
<th>R</th>
<th>L</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A) Includes calf/calves</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>(B) Includes thigh/thighs</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>(C) Includes buttock/buttocks</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

4. Do you get it when you walk uphill or hurry?

<table>
<thead>
<tr>
<th></th>
<th>R</th>
<th>L</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Yes</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>No</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>Never walk uphill or hurry</td>
</tr>
</tbody>
</table>

5. Do you get it if you walk at an ordinary pace on the level?

<table>
<thead>
<tr>
<th></th>
<th>R</th>
<th>L</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Yes</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>No</td>
</tr>
</tbody>
</table>

6. Does the pain ever disappear while you are still walking?

<table>
<thead>
<tr>
<th></th>
<th>R</th>
<th>L</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Yes</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>No</td>
</tr>
</tbody>
</table>

7. What do you do if you get this pain while you are walking?

<table>
<thead>
<tr>
<th></th>
<th>R</th>
<th>L</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Stop or slow down</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>Carry on</td>
</tr>
</tbody>
</table>

8. What happens to it if you stand still?

<table>
<thead>
<tr>
<th></th>
<th>R</th>
<th>L</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Lessens or relieved</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>Unchanged</td>
</tr>
</tbody>
</table>

9. How soon?

<table>
<thead>
<tr>
<th></th>
<th>R</th>
<th>L</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>10 minutes or less</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>More than 10 minutes</td>
</tr>
</tbody>
</table>
Venous system
Spectrum of Venous Disorders

• Deep venous thrombosis
• Superficial thrombophlebitis
• Pulmonary embolism
• Post thrombotic syndrome
• Axillary-subclavian stenosis
• Varicose veins
• Venous insufficiency
• May Thurner syndrome
• Arteriovenous malformations
• Thoracic outlet syndrome
Venous Thromboembolic Disease

PE commonly originates from lower limb DVT (75%)

Annual US VTE Incidence 1-2 per 1,000

5-10% of all deaths among hospitalized patients

March is DVT/Blood Clot Awareness Month!!!
Pulmonary Embolism Response Team (PERT) “Lung Attack”
The PERT team relies on multispecialty collaboration to help decide how to best treat patients. Since there are several options available for patients with massive and sub-massive PE, it helps to have the expertise of the team to weigh in on decisions that may be difficult to make individually. The specialties involved may include interventional radiologists, cardiologists, surgeons, pulmonary medicine specialties, emergency medicine, and intensive care specialists.
What Do These Patients Look Like?

Prevalence of Pulmonary Embolism among Patients Hospitalized for Syncope

Paolo Prandoni, M.D., Ph.D., Anthonie W.A. Lensing, M.D., Ph.D., Martin H. Prins, M.D., Ph.D., Maurizio Ciammaichella, M.D., Marica Perlati, M.D., Nicola Mumoli, M.D., Eugenio Bucherini, M.D., Adriana Visonà, M.D., Carlo Bova, M.D., Davide Imberti, M.D., Stefano Campostrini, Ph.D., and Sofia Barbar, M.D. for the PESIT Investigators

RESULTS
A total of 560 patients (mean age, 76 years) were included in the study. A diagnosis of pulmonary embolism was ruled out in 330 of the 560 patients (58.9%) on the basis of the combination of a low pretest clinical probability of pulmonary embolism and negative D-dimer assay. Among the remaining 230 patients, pulmonary embolism was identified in 97 (42.2%). In the entire cohort, the prevalence of pulmonary embolism was 17.3% (95% confidence interval, 14.2 to 20.5). Evidence of an embolus in a main pulmonary or lobar artery or evidence of perfusion defects larger than 25% of the total area of both lungs was found in 61 patients. Pulmonary embolism was identified in 45 of the 355 patients (12.7%) who had an alternative explanation for syncope and in 52 of the 205 patients (25.4%) who did not.

CONCLUSIONS
Pulmonary embolism was identified in nearly one of every six patients hospitalized for a first episode of syncope. (Funded by the University of Padua; PESIT ClinicalTrials.gov number, NCT01797289.)
# Approximate Risks of DVT in Hospitalized Patients

<table>
<thead>
<tr>
<th>Patient Group</th>
<th>DVT Prevalence, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical patients</td>
<td>10-20</td>
</tr>
<tr>
<td>General surgery</td>
<td>15-40</td>
</tr>
<tr>
<td>Major gynecologic surgery</td>
<td>15-40</td>
</tr>
<tr>
<td>Major urologic surgery</td>
<td>15-40</td>
</tr>
<tr>
<td>Neurosurgery</td>
<td>15-40</td>
</tr>
<tr>
<td>Stroke</td>
<td>20-50</td>
</tr>
<tr>
<td>Hip or knee arthroplasty, HFS</td>
<td>40-60</td>
</tr>
<tr>
<td>Major trauma</td>
<td>40-80</td>
</tr>
<tr>
<td>SCI</td>
<td>60-80</td>
</tr>
<tr>
<td>Critical care patients</td>
<td>10-80</td>
</tr>
</tbody>
</table>

*Rates based on objective diagnostic screening for asymptomatic DVT in patients not receiving thromboprophylaxis*
Risk Factors for Venous Thrombosis: Virchow’s Triad

<table>
<thead>
<tr>
<th>Stasis</th>
<th>Vessel wall injury</th>
<th>Hypercoagulability</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Obesity</td>
<td>• Surgery</td>
<td>• Hormone replacement</td>
</tr>
<tr>
<td>• Long travel</td>
<td>• Injury/trauma</td>
<td>• Smoking</td>
</tr>
<tr>
<td>• Immobility</td>
<td>• Personal history of VTE</td>
<td>• Pregnancy</td>
</tr>
<tr>
<td>• Congestive heart failure</td>
<td>• Indwelling device</td>
<td>• Cancer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Family history of VTE</td>
</tr>
</tbody>
</table>
### Recurrent Venous Thromboembolic Disease

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Rate of Recurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surgery</td>
<td>3% at 5 years</td>
</tr>
<tr>
<td>Non Surgical</td>
<td>15% at 5 years</td>
</tr>
<tr>
<td>Unprovoked</td>
<td>30% at 5 years</td>
</tr>
<tr>
<td>Cancer</td>
<td>15% annual risk</td>
</tr>
</tbody>
</table>
Symptoms of Venous Thrombosis

- Shortness of breath
- Chest pain
- Hemoptysis
- Syncope
- Arrhythmias

- Swelling in one or both extremities
- Pain or tenderness in one or both extremities
- Warmth
- Redness or purple discoloration
Phlegmasia Cerulea Dolens

- Occlusion of both deep and superficial venous system. Fluid sequestrations, significant edema, agonizing pain, cyanosis, bullae. Compartment syndrome, acute ischemia.

Symptomatic Proximal DVT?

For example:
- Symptomatic iliac, common femoral, or femoral DVT
- Limb threat (Phlegmasia Cerulea Dolens)
- Ideally less than 14 days of symptoms

Call 918-599-5566 to activate task force/transfer

**Step 1:**
Confirm no contraindications for anticoagulation
- Give IV Heparin or SC Lovenox before transfer

**Step 2:**
Urgent Vascular consultation with Cardiology and Interventional Radiology
Post Thrombotic Syndrome:
Patients with iliofemoral DVT have 2-year PTS rates of ≥ 50%, despite anticoagulation.
Diagnostics with D-dimer and Wells score

The original and simplified Wells rules and age-adjusted D-dimer testing to rule out pulmonary embolism: an individual patient data meta-analysis.

van Es N1, Kraaijpoel N1, Klok FA2, Huisman MV2, Den Exter PL2, Mos IC2, Galipienzo J3, Büller HR1, Bossuyt PM4

Abstract
Evidence for the simplified Wells rule in ruling out acute pulmonary embolism (PE) is scarce. This was a post-hoc analysis on data from 6 studies comprising 7268 patients with suspected PE. The simplified Wells rule combined with age-adjusted D-dimer testing may safely rule out PE. Given its ease of use, the simplified Wells rule is to be preferred over the original Wells rule.

SUMMARY: Background The Wells score and D-dimer testing can safely rule out pulmonary embolism (PE). A simplification of the Wells score has been proposed to improve clinical applicability, but evidence on its performance is scarce. Objectives To compare the performances of the original and simplified Wells scores alone and in combination with age-adjusted D-dimer testing. Methods Individual patient data from 7268 patients with suspected PE enrolled in six management studies were used to evaluate the discriminatory performances of the original and simplified Wells scores. The efficiency and failure rate of the dichotomized original and simplified scores combined with age-adjusted D-dimer testing were compared by use of a one-stage random effects meta-analysis. Efficiency was defined as the proportion of patients in whom PE could be considered to be excluded on the basis of a 'PE unlikely' Wells score and a negative age-adjusted D-dimer test result. Failure rate was defined as the proportion of patients with symptomatic venous thromboembolism during a 3-month follow-up. Results The discriminatory performances of the original and simplified Wells scores were comparable (c-statistic 0.73 [95% confidence interval (CI) 0.72-0.75] versus 0.72 [95% CI 0.70-0.73]). When combined with age-adjusted D-dimer testing, the original and simplified Wells rules had comparable efficiency (3% [95% CI 25-42%] versus 30% [95% CI 21-40%]) and failure rates (0.9% [95% CI 0.6-1.5%] versus 0.8% [95% CI 0.5-1.3%]). Conclusion The original and simplified Wells rules combined with age-adjusted D-dimer testing have similar performances in ruling out PE. Given its ease of use in clinical practice, the simplified Wells rule is to be preferred.

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## Simplified Wells Score

<table>
<thead>
<tr>
<th>Variable</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical Signs or Symptoms of Deep-Vein Thrombosis</td>
<td>3.0</td>
</tr>
<tr>
<td>Alternative Diagnosis Less Likely Than Pulmonary Embolism</td>
<td>3.0</td>
</tr>
<tr>
<td>Heart Rate &gt;100 bpm</td>
<td>1.5</td>
</tr>
<tr>
<td>Immobilization or Surgery in the Previous 4 Weeks</td>
<td>1.5</td>
</tr>
<tr>
<td>Previous Venous Thromboembolism</td>
<td>1.5</td>
</tr>
<tr>
<td>Hemoptysis</td>
<td>1.0</td>
</tr>
<tr>
<td>Active Cancer</td>
<td>1.0</td>
</tr>
</tbody>
</table>

A total Score of ≤4.0 Indicates that PE is Unlikely, and a Score >4.0 Indicates that a PE is Likely.

- **Simplified Wells Score**
  - **Simplified Wells Score ≤4.0**
    - Negative D-Dimer
      - No Further Testing
  - **Simplified Wells Score >4.0**
    - Positive D-Dimer
      - Computed Tomographic Pulmonary Angiography or Ventilation-Perfusion Lung Scan
Venous Doppler US
95% sensitivity above the knee 98% specificity

Be sure to pay attention to comments of quality of study!

<table>
<thead>
<tr>
<th>Direct signs</th>
<th>Indirect signs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intramural thrombus</td>
<td>Loss of phasicity: Proximal thrombosis</td>
</tr>
<tr>
<td>Incompressibility</td>
<td>Loss of augmentation: Distal thrombosis</td>
</tr>
<tr>
<td>+ Vein diameter</td>
<td></td>
</tr>
<tr>
<td>No flow in pulse Doppler</td>
<td></td>
</tr>
<tr>
<td>No flow in color Doppler</td>
<td></td>
</tr>
</tbody>
</table>

![Ultrasound images](image_url)
CT or MR Venogram
specific timing of injection
Sensitivity of 94-98% and specificity 100%
Iliac Vein Compression or May Thurner Anatomy

- Recurrent swelling in legs more commonly left more than right
- DVT occurs 5 times more frequent in the left leg
- CT Venogram
- Invasive angiogram with intravascular US
Antithrombotic Therapy for VTE Disease
CHEST Guideline and Expert Panel Report

Clive Kearon, MD, PhD; Elie A. Aki, MD, MPH, PhD; Joseph Ormelas, PhD; Allen Blaivas, DO, FCCP; David Jimenez, MD, PhD, FCCP; Henri Bounaumeaux, MD; mennon Huisman, MD, PhD; Christopher S. King, MD, FCCP; Timothy A. Mannis, MD, FCCP; Narmita Sood, MD, FCCP; Scott M. Stevens, MD; Janine R. E. Vintch, MD, FCCP; Philip Wells, MD; Scott C. Woller, MD; and COL Lisa Moores, MD, FCCP

BACKGROUND: We update recommendations on 12 topics that were in the 9th edition of these guidelines, and address 3 new topics.

METHODS: We generate strong (Grade 1) and weak (Grade 2) recommendations based on high- (Grade A), moderate- (Grade B), and low- (Grade C) evidence.
Prevalence of Venous Reflux Disease

Venous reflux disease is 2x more prevalent than coronary heart disease (CHD) and 5x more prevalent than peripheral arterial disease (PAD)\(^1\)

![Bar graph showing prevalence of various diseases](image)
Physical Findings of Venous Disease

Edema
Diffuse red-brown discoloration representing deep dermal deposits of hemosiderin from degraded extravasated erythrocytes.
Corona phlebectatica
Abnormally dilated veins around the ankle
Superficial Venous Anatomy

Vein Anatomy

- Femoral Vein (Deep Vein)
- Saphenous Vein (Superficial Vein)
- Perforator Vein (Communicating Vein)
- Varicose Veins
- Reticular Vein (Feeder Vein)
- Spider Veins
Manifestations of chronic venous insufficiency

- Skin discoloration
- Eczema
- Induration
- Venous ulcers
- Varicose vein rupture
- Leg swelling

Mechanism of varicose vein formation

Incompetent venous valve - blood flows backward away from the heart and into the superficial system causing venous congestion and high pressures within the superficial veins.

Competent venous valve - ensures the forward flow of blood by preventing reflux of blood during the relaxation phase of the calf muscles.
Diagnostics of Venous Insufficiency
Dependent on patient and sonographer
Symptoms of Venous Insufficiency

• Leg achiness, throbbing, or cramping
• Heavy feeling
• Burning or itching of the skin
• Leg or ankle swelling
• Skin discoloration or texture changes
• Varicose veins
• Restless legs
• Open wounds or sores
Risk Factors for Development of Venous Insufficiency

- Gender
- Age
- Heredity
- Pregnancy
- Standing occupation
- Obesity
- Prior injury or surgery
- Prior DVT
- Sedentary lifestyle
Spectrum of Venous Insufficiency

- Varicose Veins: 20-40 million
- Edema/Skin changes: 2-6 million
- Venous ulcers: 500,000
Venous Ulcers
Clinical pearls for ulcers

Venous
- Above medial malleoli
- Above lateral malleoli

Arterial
- Over toe joints
- Anterior shin
- Over malleoli
- Under heel

Neuropathic
- Over toe joints
- Inner side of first metatarsal head
- Under metatarsal head
- Under heel
Make Your Patient Pull up Their Pants, Lift Their Skirt, Put Them In a Gown
Become more “high touch” instead of “high-tech”