Vascular Lab Diagnosis of Deep Vein Thrombosis (DVT)

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Animated version of the presentation is available on the course website.
Deep Veins of the Leg

- inferior vena cava
- common iliac vein
- internal iliac vein
- aorta
- common iliac artery
- internal iliac artery
- femoral artery
- femoral vein
- great saphenous vein
- popliteal artery
- popliteal vein
- anterior tibial artery
- peroneal artery
- anterior tibial vein
- posterior tibial artery
- posterior tibial vein
A Diagnostic Algorithm for Outpatient DVT

Risk factors/clinical symptoms determining DVT

DVT unlikely (low risk factors)

D-dimer test

Ultrasound

Treat with anticoagulation therapy

No DVT

DVT likely (high risk factors)

D-dimer test

Ultrasound

Repeat ultrasound 1 week

Treat with anticoagulation therapy

No DVT

Ultrasound

No DVT

Ultrasound

No DVT

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Components of Venous Duplex

- Gray scale imaging
  - Acute clot may be anechoic

- Image acquisition in transverse plane during compression
  - Tissue and veins cannot be compressed if there is overlying bone or significant lymphedema or lipedema

- Spectral waveform analysis
  - Waveform reflects right atrial waveform
Normal Compression of Vein
Noncompressible Vein = DVT
Evidence of DVT
Bifid Systems: Duplicated Veins are Common

Duplicating POP V’s (35%)

Duplicating FEM V’s (20-25%)

Diagnostic US, Rumack, 2005
Normal Spectral Doppler Demonstrates Phasic Flow

- Spontaneous
- Phasic w Resp
- Valsalva
- Augmentation

Intro to Vasc Ultrasonography, 2005
Abnormal Spectral Doppler

Proximal Obstruction

Distal obstruction

Tricuspid Regurgitation

Incompetent Valve
# Estimation of Thrombus Age

<table>
<thead>
<tr>
<th>Acute: 14 Days</th>
<th>Chronic &gt; 6 Months</th>
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<tbody>
<tr>
<td>- vein size compared to artery</td>
<td>- Small vein compared to artery</td>
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<tr>
<td>- Homogeneous texture</td>
<td>- Hyperechoic</td>
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<tr>
<td>- Hypoechoic</td>
<td>- Collaterals maybe present</td>
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<td>- Thrombus “Tongue” poorly attached</td>
<td>- Recanalization</td>
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GSV Saphenofemoral Thrombus

DVT Equivalent

18% rate of PE when thrombus was in saphenofemoral junction & 4% rate when located in saphenopopliteal junction

# High Risk Subgroups for PE in Calf DVT

<table>
<thead>
<tr>
<th>Condition</th>
<th>Relative Risk</th>
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<tr>
<td>Cancer</td>
<td>6.3</td>
</tr>
<tr>
<td>Bed Rest</td>
<td>1.7</td>
</tr>
<tr>
<td>Thrombophilia</td>
<td>5.3 (aCL AB)</td>
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<tr>
<td></td>
<td>5.1 (PT/FVL)</td>
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Calf Deep Veins

- Gastrocnemius (sural)
- Posterior tibial
- Peroneal
- Soleal
- CANNOT EVALUATE ANTERIOR TIB
Deep Veins Accompany Corresponding Arteries

- PTV
- Peroneal
- tibia
- fibula
Anterior tibial artery and veins
Tibia
Great saphenous vein
Posterior tibial artery and veins
Fibula
Superficial layer of crural fascia
Peroneal artery and vein
Deep layer of crural fascia
Small saphenous vein
Perforating veins
Soleal Vein Exception: Deep Veins With No Corresponding Arteries
Ancillary Findings

Metastatic Thigh Mass

Pseudoaneurysm
Lower Extremity Venous Duplex Examination: Ancillary Findings

- **Baker’s Cyst**
- **Varicosities**
- **Lymph Nodes**
Lower Extremity Venous Duplex Examination: Ancillary Findings

- Ruptured Baker’s Cyst (Knee Effusion)
- Soleal Sinus DVT
- Femoral Artery Occlusion
- Edema
Lower Extremity Venous Duplex Examination: Ancillary Findings

- Thigh Hematoma/Post-OP
- CFV
- Fem Art Aneurysm
- Muscle Tear

Images of ultrasound findings with annotations for GSV, CFV, Hematoma, and Femoral Artery Aneurysm.
Lower Extremity Venous Duplex Summary

- Ultrasound is very accurate (98%) and highly effective in the diagnoses of DVT in symptomatic patients.
- It has a reported specificity of 90% or greater in diagnosing DVT in asymptomatic patients.
- Accurate diagnosis is dependent on the examiner’s technical & anatomical knowledge & experience in interpretation and recognition of pitfalls on the venous exam.
Upper Extremity Deep Vein Thrombosis

• Vein wall microtrauma
  – Increasing incidence secondary to indwelling lines and catheters
  – Effort thrombosis (Paget-Schroetter) is less common
Anatomy of Upper Extremity Veins

- Internal Jugular (deep)
- Subclavian (deep)
- Cephalic
- Axillary (deep)
- Brachial (deep)
- Basilic
Normal Compression of the Internal Jugular Vein

Before compression

During compression
Compression Ultrasound of the Upper Arm Veins

- basilic vein
- brachial artery
- humerus

L BRAC V AND BAS V
Age and Etiology of Internal Jugular Vein Thrombosis

Internal Jugular

Carotid

R. IJV

Acute

Fibrin Sheath
Plus thrombus

Not Compressed
Compressed

compressed
Compression Ultrasound of the Subclavian Vein?

Cannot compress the subclavian vein within the thorax

Therefore evaluate-

- gray scale appearance
- spectral Doppler waveform
- color Doppler filling
Spectral Doppler of the Subclavian Vein
Influence of Pacemaker Leads on Venous Waveforms

- Blunted
- No resp variation
- CMP
- High RV filling
Effect of Intravenous Catheters on Upper Extremity Waveforms

• Single catheter should not alter waveform
• Dampened waveform suggests central venous thrombosis
• May not apply to multiple leads

Burbridge JVIR 1993
Patel Radiology 1999
Gray Scale of Intravenous Catheter
Use Multiple Lines of Evidence to Diagnose Thrombosis in the Subclavian Vein
Thoracic Outlet Compression Can Cause Vein Wall Microtrauma

- Neurologic
- **Venous**
  - UE DVT
- Arterial
  - UE Ischemia
  - Raynaud’s phenomenon
  - Aneurysm
Other Causes of Noncompressible Vein

Arteriovenous fistula

Higher pressures, less compressible
Look at gray scale of vein wall and lumen
Other Causes of Noncompressible Vein
Other Causes of Noncompressible Vein

Intravascular tumor
Renal Cell
Upper Extremity DVT

• 1º UE DVT rare; Typically due to a secondary cause:
  – Indwelling catheter/Pacemaker/ICD wire
  – Malignancy
  – Thoracic outlet syndrome

• Anticoagulation approach analogous to lower extremity DVT