Vascular Imaging of the Upper Extremity

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Disclosures

• None
Thank you!

• John Pellertio, MD
In this presentation

• Review upper extremity vascular anatomy
• Review ultrasound approach to imaging the upper extremity
• Review common findings in the upper extremity venous system
Indications

• Evaluation of possible venous thromboembolic disease in symptomatic individuals.
• Evaluation of veins before venous access.
• Follow-up for patients with known venous thrombosis at or near the anticipated end of anticoagulation to determine if residual thrombus is present.
• Follow-up of patients with known calf (distal) deep venous thrombosis who are not being treated but are being monitored for progression.
DVT

• The most common indication for evaluation of the vascularity of the upper extremity
• Most common clinical signs: swelling, pain, tenderness
Most common causes of DVT

- Catheters, catheters, catheters!
- Hypercoagulable states
- Cancer
- Trauma/Surgery
- Prior upper extremity DVT
• Proximal refers to the portion closest to the heart and NOT closest to point of origin
• Patient positioning
  • Supine
  • Arm extended comfortably
  • Position may affect waveform
    • Arm hyperextended $\rightarrow$ waveform
• **Venous compression** at each level (clavicle precludes compression of subclavian vein)

• **Pulsed Doppler waveforms** at each venous segment
Technique

Linear array transducers

- Transverse for compression
  - Lack of compressibility is most reliable finding for DVT diagnosis
- Sagittal for waveforms and augmentation maneuvers
  - Phasicity – respiratory variation
  - Proximal augmentation – Valsalva
  - Distal augmentation – calf/forearm compression
If patient is positive for DVT, no augmentation is performed.
• Low pulsatility
  • Portal and splenic veins
  • Lower extremity veins
• High pulsatility
  • IVC and hepatic veins
  • Upper extremity veins
Anatomy
Anatomy
• **Deep veins**
  • Internal jugular vein
  • Innominate vein
  • Subclavian vein
  • Axillary vein
  • Brachial veins
• **Superficial veins**
  • Cephalic vein
  • Basilic vein
Evaluation of the IJ vein
IJ waveform, pulsatile
Doppler of the Subclavian vein origin
Subclavian waveform, pulsatile
Axillary Vein
Axillary vein waveform
Brachial veins
Brachial veins
Upper arm
Upper arm

- Median nerve
- Basilic vein
- Brachial veins & artery
- Ulna nerve
Brachial veins
Basilic vein
Forearm veins, radial and ulna
Findings in Acute Upper Extremity DVT

- Hypoechoic thrombus – almost invisible, faintly echogenic along the edges
- Dilated vein, if obstructed – because the compliant vein struggles to stay patent
- Absent color / spectral Doppler
- Abnormal Compression - Spongy texture – so will deform with compression but not allow complete collapse
- Loss of pulsatility (continuous flow pattern)
- Hypoechoic poorly attached – no augmentation

Gooding et al. Radiology 1986;159:663
Thrombophlebitis
Loss of compression
Non-pulsatile flow/continuous flow pattern
Non-pulsatile flow/continuous flow pattern
• Hyperechoic – as the thrombin net squeezes the fluid components out of the thrombus
• Well attached – less of a threat of embolization
• Rigid texture – will not deform with probe pressure
• Large collaterals – indicates a chronic problem
• Thick vein walls
• Spontaneously lyse
• Propagate or embolize
• Recanalize over time
• Permanently occlude the vein
Port-a-cath access and a subclavian vein thrombosis with old (hyperechoic) thrombus and fresh (hypoechoic) thrombus
Collaterals
• Upper extremity venous imaging is more challenging than the lower extremity veins

• Compression sonography is most important maneuver

• Recognition of waveform changes allows diagnosis of central venous obstruction

• Comparison to the contralateral side can help in difficult situations
The End!