

Ultrasound – Upper Extremity Deep Venous Thrombosis Evaluation

PURPOSE:

To evaluate the upper extremity superficial and deep venous system for patency.

SCOPE:

Applies to all ultrasound venous Doppler studies of the lower extremities in Imaging Services / Radiology

EPIC ORDERABLE:

- UTSW: US DOPPLER VENOUS DVT UPPER EXTREMITY BILATERAL
US DOPPLER VENOUS DVT UPPER EXTREMITY RIGHT
US DOPPLER VENOUS DVT UPPER EXTREMITY LEFT
- PHHS: US DOPPLER VENOUS DVT UPPER EXTREMITY BILATERAL
US DOPPLER VENOUS DVT UPPER EXTREMITY RIGHT
US DOPPLER VENOUS DVT UPPER EXTREMITY LEFT

INDICATIONS:

- Symptoms such as upper extremity swelling, pain, fever, warmth, change in color, palpable cord
- Suspected venous occlusion, or DVT based on clinical prediction rules (eg. Well's score or D-Dimer)
- Indwelling or recent PICC or central line
- Chest pain and/or shortness of breath
- Suspected or known pulmonary embolus
- Follow-up known deep venous thrombosis (DVT)

CONTRAINDICATIONS:

No absolute contraindications

EQUIPMENT:

Preferably a linear array transducer that allows for appropriate resolution of anatomy (frequency range of 9 MHz or greater), capable of duplex imaging. Sector or curvilinear transducers may be required for appropriate penetration in patients with edema or large body habitus.

PATIENT PREPARATION:

- None

EXAMINATION:

GENERAL GUIDELINES:

A complete examination includes evaluation of the superficial and deep venous system of the upper extremity including the internal jugular, innominate, subclavian, axillary, paired brachial, basilic, and cephalic veins.

EXAM INITIATION:

- Introduce yourself to the patient
- Verify patient identity using patient name and DOB
- Explain test
- Obtain patient history including symptoms. Enter and store data page

- Place patient in supine position with arm extended

TECHNICAL CONSIDERATIONS:

- Review any prior imaging, making note of any previous thrombus burden.
- General
 - Proximal and distal refer to the relative distance from the attached end of the limb (proximal brachial vein is closer to shoulder and distal brachial vein is closer to elbow).
 - Longitudinal axis is parallel to length of vein. Transverse or short axis is perpendicular to long axis of vein.
 - Evaluate entire length of the internal jugular (IJV), subclavian (SCV), and axillary veins. Include Y-view of innominate/brachiocephalic vein at the confluence of the IJV and SCV. Evaluate brachial (paired), cephalic, and basilic veins to the antecubital fossa.
 - If forearm symptoms are present, evaluate radial, ulnar, or median cubital veins as indicated.
 - For unilateral upper extremity exams, include evaluation of contralateral SCV with spectral Doppler to confirm symmetry of respiratory variation/cardiac pulsatility.
 - Note anatomic variations such as duplications.
 - Evaluate for nonvascular pathology such as adenopathy, hematoma, aneurysm, etc.
- Grayscale Evaluation
 - Optimize grayscale gain and display settings with respect to depth, dynamic range, and focal zones.
 - Adjust dynamic range (compression) to distinguish artifact from slow flow or true clot.
 - Refrain from increasing power/gain.
- Doppler
 - Utilize color Doppler with proper color scale and color box targeted to the vessel under interrogation to support presence or absence of thrombus.
 - Use power Doppler and/or spectral Doppler to confirm absent flow on color Doppler.
 - For spectral Doppler, evaluate vessels in long axis with waveform displayed below baseline.
 - If a segment of vein is not visualized, include view distal to nonvisualized segment with spectral Doppler (to document respiratory variation) and view proximal to nonvisualized segment with spectral Doppler during distal augmentation (to document flow augmentation across nonvisualized segment).
- Compression
 - Venous compression is applied in transverse plane with adequate pressure on the skin to completely collapse the normal vein lumen.
 - Acquire compression cine loops of each segment. For difficult to visualize vessels, images with arrow marking the vein and/or with color Doppler should be included.
 - Venous compression is the most diagnostic aspect of this examination. Therefore:
 - Gentle compression may be applied to vessels filled with thrombus in order to confirm non-compressibility (excluding slow flow). However, repeated or vigorous compression should be omitted in the presence of identifiable clot.
 - For suspected nonocclusive thrombus or equivocal intraluminal filling defects, compression should be attempted to document compressibility, or lack thereof.
 - In the presence of short-segment thrombus, compression of veins distal (peripheral) to this clot may be performed in equivocal cases (example: incomplete Doppler fill-in). This allows for documenting extent of the thrombus.

- Augmentation should be omitted in the presence of a proximal clot, particularly if large volume (greater than one venous segment), or acute-appearing (hypoechoic, expansile, free-floating).
- If veins are poorly seen due to large body habitus or edema, use color Doppler on compression images to identify and highlight the vessels.

DOCUMENTATION:

- Longitudinal images without and with color Doppler:
 - Superior and inferior internal jugular vein
 - Innominate / Brachiocephalic ('Y' View)
 - Medial subclavian vein
 - Mid subclavian vein
 - Lateral subclavian vein @ cephalic vein confluence
 - Axillary vein
 - Each of the paired brachial veins
 - Superficial Basilic and Cephalic veins
- Longitudinal images with spectral Doppler:
 - Inf internal jugular vein
 - Innominate / Brachiocephalic ('Y' View)
 - Mid subclavian vein
 - Axillary vein
 - Contralateral subclavian vein (mid) for unilateral exams (respiratory variation)
 - Brachial veins may be included if helping to determine slow flow or partial thrombosis
- Transverse Compression Cine Clips:
 - Superior, mid, inferior internal jugular vein
 - Axillary vein
 - Proximal, mid, distal of each brachial vein
 - Proximal, mid, distal basilic vein
 - Proximal, mid, distal cephalic vein
 - TECHNIQUE:
 - Cine acquisitions during compression.
 - QUICK loop from no compression -> complete collapse -> no compression (within 1-3 seconds)
 - If complete compression is not achieved, attempt a second or third time (in same cine loop)
 - For difficult to visualize vessels, compression images with arrow marking the vein and/or with color Doppler should be included.

- Data page(s)

Anatomy	Greyscale	Color Doppler	Waveform	Compression
<u>Trans</u> Internal jugular vein (superior to inferior)				T*
<u>Long</u> Internal jugular vein (superior & inferior only)	L	L	L (inf)	
Innominate / Brachiocephalic ('Y' View)	L	L	L	
Subclavian (medial, mid, lateral)	L	L	L (mid)	
Axillary	L	L	L	T
Brachial veins	L (mid [^])	L (mid [^])		T (prox; mid; distal)
Basilic vein	L (mid [^])	L (mid [^])		T (prox; mid; distal)
Cephalic vein	L (mid [^])	L (mid [^])		T (prox; mid; distal)
Contralateral mid subclavian vein *		L	L	
L – Longitudinal; T - Transverse				
* Not applicable for Bilateral studies.				
[^] Only applicable if vessel is patent. If thrombus identified, entire extent (proximal and distal) must be documented with grayscale, color Doppler, and compression				
* Single compression cine including sup to inf IJV is adequate unless thrombus identified. Then individual cine compressions at each level can be obtained.				

PROCESSING:

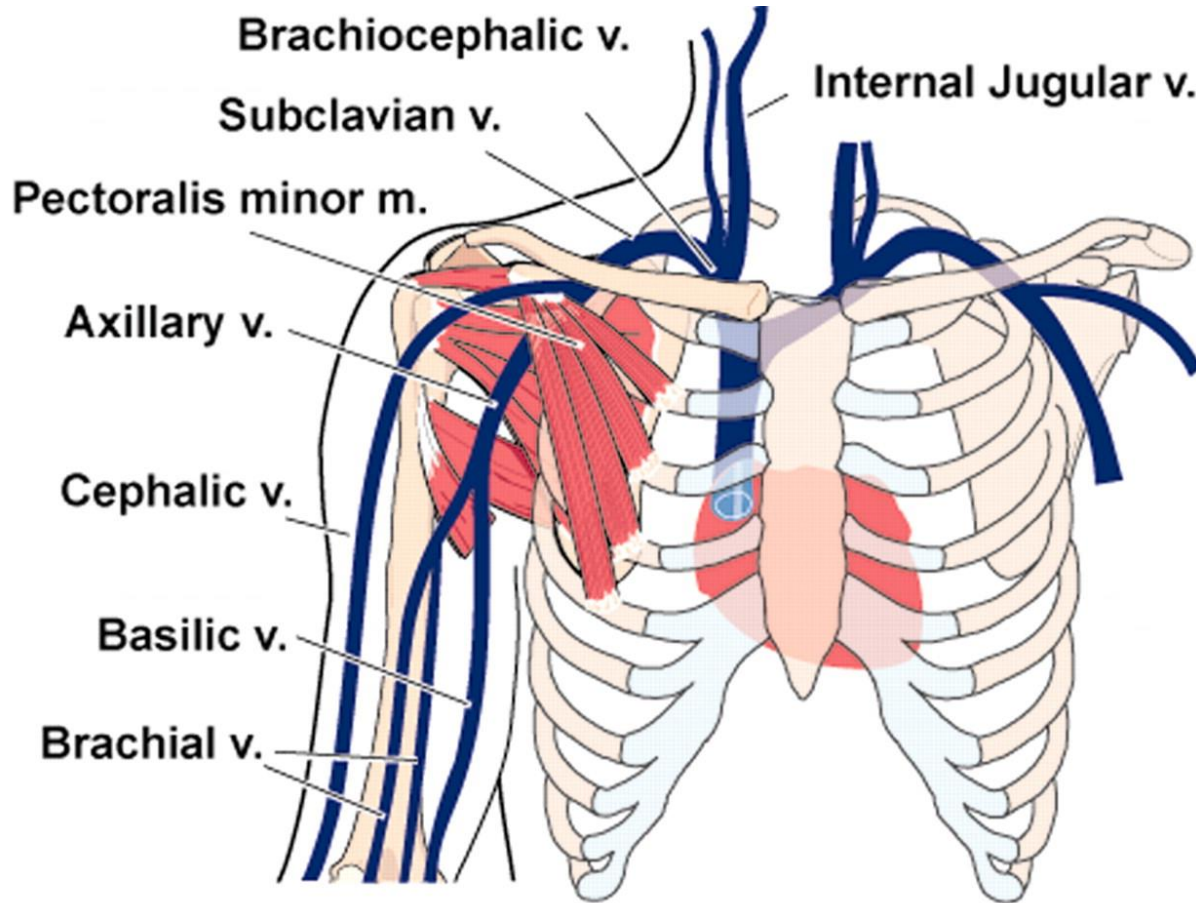
- Review examination images and data
- Export all images to PACS
- Document relevant history and any study limitations

REFERENCES:

ACR-AIUM-SPR-SRU Practice Parameters (Revised 2013; pre-release version 2017-2018)
 IAC (ICAVL) Guidelines (Update August 3rd, 2015)
 Ultrasound Quarterly, Dec 2005
 Radiology Clinics of North America, Vol 52, Issue 6, Nov 2014

APPENDIX:

Upper extremity venous anatomy



REVISION HISTORY:

SUBMITTED BY:	David T. Fetzer, MD	Title	Medical Director
APPROVED BY:	David T. Fetzer, MD	Title	Medical Director
APPROVAL DATE:	11-09-2015		
REVIEW DATE(S):	11/21/2018		David T. Fetzer
REVISION DATE(S):	2/13/2017	Brief Summary	Removed spectral tracing requirement for brachial veins
	04-18-2018	Brief Summary	Cine clips of segmental compression now required.
	09-19-2018		Corrected internal discrepancy between narrative and chart description of required images. Clarified cine loops technique
	05-31-2020		Review for brevity and workflow improvements
Skye Smola RDMS, RVT	9/20/23		Removed IJV "Mid" from Protocol requirements in "Long", changed spectral waveform to Inf IJV (instead of mid); removed previous notation to obtain still compression images during accreditation periods (no longer required).