MARY WASHINGTON HEALTHCARE IMAGING SERVICES

PERIPHERAL VENOUS ULTRASOUND – UPPER EXTREMITY

- I. **Primary Purpose of the Venous Examination**: To determine the presence or absence of venous thrombosis, obstruction and patency in the superficial or deep system.
- II. Clinical Indications: At least one of the following should be listed as a clinical indicator for the exam: arm pain, arm swelling, chest pain, SOB, erythematous, hemoptysis (unspecified), pulmonary embolism. Relevant patient history of previous DVT, pulmonary emboli, and prior surgical procedures such as filter placement, thrombolysis, and angioplasty/stent and if the patient is currently on Coumadin should be documented.
- III. Equipment: Performed with real-time Duplex scanner using a linear transducer with a frequency of 8 MHZ or higher. When evaluating the innominate vein, a smaller footprint transducer may be necessary. Appropriate imaging and Doppler frequency and focal zones should be used for the vessels being evaluated with an adjustable range-gated Doppler sample volume size with a visual and audible Doppler output.

IV. **Patient Preparation: None**

- V. **Patient Positioning:** Patient should lie supine on a bed or stretcher that supports the patient's trunk and upper extremity. For examination of the Jugular and Subclavian veins by duplex, the arm will be placed comfortably along patient's side. With the hand supine, the arm is then abducted and the elbow slightly bent for the remainder of the examination. Pillows may be utilized to aid patient comfort.
- VI. Upper Extremity Venous Duplex Procedure: A routine unilateral scan will be performed of the symptomatic extremity, along with a spectral Doppler waveform of the contralateral subclavian vein. A bilateral examination will be performed if requested by the referring physician or if there are indications of pulmonary embolism, such as chest pain or shortness of breath, if the contralateral waveform is abnormal or if acute or subacute DVT is seen when imaging the contralateral subclavian vein. The veins to be evaluated are the Internal Jugular, Subclavian, Axillary, Brachial, Cephalic and Basilic veins. The entire length of the veins must be evaluated for assessing venous patency. Comment must be made in the final report if veins or portions of veins are not seen. Additional sites may be imaged when indicated-Jugular/subclavian vein junction, brachiocephalic (innominate) or forearm veins.

Examination Protocol

A. <u>Annotations:</u>

- 1. Right or left
- 2. Transverse or longitudinal
- 3. Vessel identification suggested abbreviations:
 - 1. Internal Jugular vein = IJV
 - 2. Axillary Vein = Ax V
 - 3. Brachial veins = $\mathbf{Brach} \mathbf{V}$
 - 4. Cephalic vein = Ceph V
 - 5. Basilic vein= **Bas** $\hat{\mathbf{V}}$
 - 6. Radial Vein = $\mathbf{Rad} \mathbf{V}$
 - 7. Ulnar vein = Uln V

Transverse plane

On the left side of the split screen place the letter "V" beside or near the vein being imaged if not clearly visible.

On the right side of the split screen or transverse compression view, annotate one of the following:

comp (if vein completely compresses)
no comp (if vein does not compress)
partial comp (if vein is not completely compressible)

Longitudinal plane

When Spectral Analysis is done, these are the suggested annotations: Augmentation=Aug

In the Longitudinal plane, the Doppler signal should be assessed for the following qualities (see attachment on criteria for normal venous Doppler signals for a further explanation): **Spontaneity** – The venous signal should be present without manipulation **Phasicity** – The venous signal should change with respiration

Augmentation – The venous signal should augment with distal compression, with proximal compression release or with rapid inspiration/sniff test.

B. Imaging Technique

Transverse View

- 1. Optimize the image by using upper venous preset, DGC controls, Master Gain, Iscan, harmonics and the Transmit Focal Zone.
- 2. Beginning in the transverse scan plane, identify the internal jugular vein (IJV) as cephalad as possible (under the mandible). The size of the jugular vein varies greatly with respiration.
- 3. Slowly move the probe caudal, observing changes in the IJV with respiration. Obtain an image using split screen of the vein with & without compression. The vein may not completely disappear, but should change without having to fully compress the jugular vein.
- 4. ***IF THROMBUS IS SUSPECTED—re evaluate the area by moving the probe and asking the patient to breathe in and out.
- 5. A transverse image of the subclavian vein may not be obtainable due to the bony structure of the clavicle.
- 6. Continue evaluating the compressibility of the axillary, brachial, basilic and cephalic veins.
- 7. If thrombus is suspected, obtain an image using split screen of the vein, showing that it doesn't close around the clot. The extent and location of sites where veins fail to compress should be documented.

Longitudinal View

- 1. Obtain a longitudinal image of the IJV in gray scale & color Doppler. Adjust the color scale & gain if necessary. Use the low flow setting if appropriate. The color box should be angle corrected to match the lie of the vein. The standard color setting for normal venous flow should be displayed in blue. Obtain Doppler signal of the IJV, documenting spontaneous flow and changes with respiration as well as augmentation with sniff test.
- 2. Obtain a longitudinal image of the supra and infraclavicular Subclavian vein in gray scale. Although, the subclavian vein cannot usually be compressed due to bone structure, an attempt at showing collapsibility of vein with a rapid inspiration or "sniff" test should be done. Obtain spectral Doppler showing normal vein pulsatility and phasicity as well as augmentation with sniff test.
- 3. If thrombus is suspected, identify the vessel anatomy and gray scale thrombus characteristics. Utilize color flow analysis to assess the lumen for any filling defects. (See Criteria for Determining Presence and Age of Venous Clot)

- 4. Continue to assess the axillary vein in gray scale and color Doppler. Obtain Doppler signal documenting response to a distal augmentation maneuver. Obtain gray scale and color Doppler images of the brachial, cephalic and basilic veins.
- 5. If a continuous waveform is identified in the Subclavian vein, then assess Jugular and Innominate veins following the image protocol to assess for proximal venous disease.
- 6. When a unilateral examination is performed, a spectral Doppler waveform is taken from the contralateral Subclavian vein documenting a spontaneous flow, changes with respiration augmentation with sniff test.
- 7. After completing the exam, the technologist should scan the prescription for the exam into iSite and track the exam in the Syngo system
- 8. All venous studies require a priority reading by the Radiologist. If the exam is positive or a wet reading is requested by the ordering physician, the technologist should discuss the exam with an available radiologist (preferably one on-site), then reserve the exam with the RadReserve system. If necessary, the Radiologist will provide a verbal wet reading to the ordering physician with a priority written report to follow.

***NOTE:** The venous flow pattern in the Internal Jugular and Subclavian veins may normally show pulsatility as a result of the transmitted pulsations from the right atrium. The flow should change with respiration. The velocity should go up then almost bottom out, or return to baseline with respiration.

C. Miscellaneous

- 1. If the patient has open wounds with dressings, technologist may take off dressing if needed to complete exam with physician's approval only. (Document in patient chart and standard worksheet)
- 2. NO INSTRUMENT WILL BE PLACED DIRECTLY ON OPEN WOUNDS.
- 3. If the patient has intravenous or intra-arterial line, this area WILL NOT be assessed (to maintain sterility).

Upper Extremity Venous

Image Summary

- 1. Patient information screen
- 2. Trans split screen IJV with compression
- 3. Long IJV gray scale
- 4. Long IJV color Doppler
- 5. Long IJV phasicity with spectral Doppler
- 6. Long IJV augmentation by sniff test with spectral Doppler
- 7. Long split screen subclavian gray scale with sniff test for collapsing of vein.
- 8. Long Subclavian color Doppler
- 9. Long Subclavian phasicity with spectral Doppler
- 10. Long Subclavian augmentation by sniff test with spectral Doppler
- 11. Trans split screen Ax with compression
- 12. Long Ax gray scale
- 13. Long Ax color Doppler
- 14. Long Ax phasicity with spectral Doppler
- 15. Long Ax augmentation with spectral Doppler
- 16. Trans split screen Prox Brachial with compression
- 17. Trans split screen Mid Brachial with compression
- 18. Trans split screen Distal Brachial with compression
- 19. Long Brachial branch 1 gray scale
- 20. Long Brachial branch 1 color Doppler
- 21. Long Brachial branch 2 gray scale
- 22. Long Brachial branch 2 color Doppler
- 23. Trans split screen Basilic with compression
- 24. Long Basilic gray scale
- 25. Long Basilic color Doppler
- 26. Trans split screen Cephalic with compression
- 27. Long Cephalic gray scale
- 28. Long Cephalic color Doppler For bilateral scans, repeat the above steps on the opposite arm For unilateral scans, obtain the following:
- 29. Long contralateral split screen Subclavian gray scale with sniff test for collapsing of vein
- 30. Long Subclavian color Doppler
- 31. Long Subclavian phasicity with spectral Doppler
- 32. Long Subclavian augmentation by sniff test with spectral Doppler

Pause protocol in the presence of thrombus to obtain additional images when necessary. Obtain long/trans Split screen showing clot if applicable

If a continuous waveform is identified, then assess Jugular and Innominate veins following the image protocol to assess for proximal venous disease. When evaluating the Innominate vein, a smaller footprint transducer may be necessary, document vessel patency and assess the vessel lumen with color Doppler analysis for any filling defects.

<u>References</u>:

<u>Introduction to Vascular Ultrasonography</u>, 4th Edition; Zweibel, W.B. Saunders Co., Philadelphia Noninvasive Diagnosis of Vascular Disease, Hershey, Appleton Davies, Inc.

<u>Practical noninvasive Vascular Diagnosis</u>, Kempczinski, Yearbook Publishers, Chicago, IL. <u>Introduction to Vascular Ultrasonography</u>, second edition, "B-mode evaluation of peripheral arteries and veins", Talbot, Grune & Stratton, Inc.

<u>Ultrasound Atlas of Vascular Diseases;</u> Krebs, Giyanani, Eisenberg, Appleton and Lange, Stamord, CT

An Illustrated Vascular Technology Review for the Registry Exam; Rumwell, C; McPharlin, ACR Appropriateness Criteria® suspected upper-extremity deep vein thrombosis, E. Kent Yucel, MD, Jorge D. Oldan, MD; et al. [Rev 3/2013]

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