#### PERIPHERAL VENOUS ULTRASOUND – LOWER 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. It is our policy that venous duplex scans in our laboratory are not intended for the evaluation of venous insufficiency. However, if venous insufficiency is observed with reflux >1 second, the technologist is to record representative images. The interpreting physician is to report this as an incidental finding along with the statement: If valvular insufficiency is a concern, further evaluation can be performed.
- II. **Clinical Indications:** At least one of the following should be listed as a clinical indicator for the exam: leg pain, leg 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. The curved 5 MHZ transducer may be necessary when imaging deeper veins as well as the IVC and iliac veins. 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 Position:** The patient should lie supine (on a bed or a stretcher) with their head elevated 30-45 degrees. The patient will be slightly rotated (to the side of the leg being evaluated) with the lower extremity externally rotated and knee slightly bent. The exceptions are if (1) the patient is pregnant; she should be positioned with the weight on the opposite hip of the extremity being assessed (i.e. if the right leg is being assessed, she will be positioned with her weight on her left hip. (2) If the patient is s/p hip replacement, the lower extremity will not be externally rotated. This is to decrease the potential of dislocation. When assessing calf veins, the patient may be placed in a reverse trendelenburg position and use the posteromedial approach.

## VI. Lower Extremity Venous Duplex Procedure:

A routine unilateral scan will be performed of the symptomatic extremity, along with a spectral Doppler waveform of the contralateral CFV. 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 CFV. The veins to be evaluated are the common femoral, saphenofemoral junction/terminal GSV, femoral, deep femoral, popliteal, PTV & peroneal 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.

# **Examination Protocol**

## A. <u>Annotations:</u>

- 1. Right or left
- 2. Transverse or longitudinal
- 3. Vessel identification suggested abbreviations
  - a. Common Femoral Vein=CFV
  - b. Saphenofemoral Junction=SFJ
  - c. Greater Saphenous Vein=GSV
  - d. Proximal Femoral Vein= Prox Fem V
  - e. Mid Femoral Vein=Mid Fem V
  - f. Distal Femoral Vein=Dist Fem V
  - g. Popliteal Vein= Pop V
  - h. Lessor Saphenous Vein=LSV
  - i. Posterior Tibial Veins= PTV
  - j. Peroneal Veins= Pero V

## **Transverse plane**

On the left side of the split screen, place the letter "v" under or near the vein and "a" under or near the artery being imaged if not clearly visible

On the right side of the split screen (the side where the compression is being applied) annotate one of the following:

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

# Longitudinal plane

When Spectral Analysis is done, these are the suggested annotations: Augmentation=Aug Valsalva=Vals Proximal Compression=Prox Comp

In the Longitudinal View, assessment must be made, where indicated in the protocol, with the Spectral Analysis. The Doppler signal should be assessed for the following qualities (see the 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

## **Miscellaneous Annotations**

• If imaging is required above the inguinal canal, these are the suggested annotations: Inferior Vena Cava=IVC Common Iliac Vein=CIV External Iliac Vein=EIV

# **B.** Imaging Technique

**<u>Transverse View:</u>** The transverse view is performed to assess for the presence of thrombus using the compression technique.

- 1. Optimize the image by using the lower venous preset, DGC controls, Master Gain, i-scan, harmonics and the Transmit Focal Zone.
- 2. Beginning the in the transverse plane identify the Common Femoral Vein (CFV) and the Common Femoral Artery (CFA); the CFV is usually medial. Advance the scan head to the junction of the greater saphenous vein
- 3. To evaluate the entire section of vein, start at the most superior aspect and slowly move the probe caudad compressing the vein every 2 centimeters. The compression maneuver should be strong enough to compress the vein to the point of disappearing from the image. To assess whether or not the transducer compression is adequate, evaluate the adjacent artery (when assessing the deep system). If the artery is deformed when pressure is applied with the transducer, the compression should be adequate to collapse the vein. When evaluating the distal femoral vein, a posterior approach may be taken, imaging cephalad to the popliteal fossa. Another option is to image from the medial thigh and using the non-scanning hand, compress from the opposite direction. Either of these maneuvers may aid in visibility of the distal femoral vein and decreased discomfort of the patient. If necessary, to evaluate the calf veins start at the most inferior aspect and move cephalad.
- 4. IF THROMBUS IS SUSPECTED identified by non-compressibility or partial compressibility of the vein, STOP and reevaluate. Reposition the transducer and ensure the patient is relaxed, not holding his/her breath, and properly positioned and attempt compression again. If the vein still fails to compress, identify and evaluate the area of non-compressibility. (See criteria for determining presence and age of Venous Clot).
- 5. Follow the above steps to evaluate the following veins:
  - a. CFV above SFJ
  - b. CFV at SFJ
  - c. Fem vein prox, mid & dist
  - d. Pop vein
  - e. PTV
  - f. Pero vein
- 6. Record gray scale images of any incidental findings. Incidental findings may include Baker's cyst, lymph nodes and masses.

**Longitudinal View:** The longitudinal view is performed to evaluate hemodynamics by displaying the Doppler waveforms at rest and during ancillary maneuvers such as distal augmentation and proximal compression or Valsalva.

- Obtain an image with color ensuring the color does not "bleed" out of the vessel walls, adjusting the color scale/gain if necessary. Use the low flow or penetration setting if appropriate. The color box should be angle corrected to match the lie of the vein. <u>The standard color setting for normal venous flow should be displayed</u> <u>in blue.</u> If the tibial veins are difficult to visualize due to depth, switch to the curved 5 MHz transducer.
- 2. Optimize Doppler signals before acquiring images. The standard Doppler signal for normal venous flow should be displayed below the baseline. Adjust the Doppler baseline/scale to display the full augmentation signal. Be sure to run the spectral Doppler for adequate time following augmentation. Ipsilateral foot flexion may be utilized if needed to augment venous flow. Have patient perform Valsalva maneuver or do a proximal compression, if appropriate, to assess valvular competence.

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- 3. Obtain the following images:
  - a. CFV <u>above</u> SFJ (grayscale, color, Doppler spectral evaluation)
  - b. SFJ/terminal GSV (grayscale, color)
  - c. CFV bifurcation to fem v & DFV (grayscale & color)
  - d. Fem vein (grayscale, color & Doppler spectral evaluation)
  - e. Pop vein (grayscale, color & Doppler spectral evaluation)
  - f. PTV (grayscale & color)
  - g. Pero vein (grayscale & color)
- 4. If thrombus is identified, obtain a longitudinal image of the venous segment, identifying the vessel anatomy and gray scale thrombus characteristics (see criteria for determining presence and age of venous clot).
- 5. After completing the exam, the technologist will scan the order for the exam into iSite and track the exam in the Syngo system.
- 6. 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.

#### 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).

Image Summary

- 1. Patient information screen
- 2. Trans split screen CFV with compression
- 3. Long CFV gray scale
- 4. Long CFV color Doppler
- 5. Long CFV phasicity with spectral analysis
- 6. Long CFV valsalva / proximal compression with spectral analysis
- 7. Long CFV distal augmentation with spectral analysis
- 8. Long CFV/SFJ/terminal segment of GSV gray scale
- 9. Long CFV/SFJ/terminal segment of GSV color Doppler
- 10. Trans split screen CFV/SFJ with compression
- 11. Long CFV to FV/PFV gray scale
- 12. Long CFV to FV/PFV color Doppler
- 13. Trans split screen Prox Femoral vein with compression
- 14. Trans split screen Mid Femoral vein with compression
- 15. Trans split screen Dist Femoral vein with compression
- 16. Long Femoral vein gray scale
- 17. Long Femoral vein color Doppler
- 18. Long Femoral vein phasicity with spectral analysis
- 19. Long Femoral vein valsalva / proximal compression with spectral analysis
- 20. Long Femoral vein augmentation with spectral analysis
- 21. Trans split screen Popliteal vein with compression
- 22. Long Popliteal gray scale
- 23. Long Popliteal color Doppler
- 24. Long Popliteal phasicity with spectral analysis
- 25. Long Popliteal valsalva /proximal compression with spectral analysis
- 26. Long Popliteal augmentation with spectral analysis
- 27. Trans split screen PTV with compression
- 28. Long PTV's color Doppler
- 29. Trans split screen Peroneal veins with compression
- 30. Long Peroneal veins color Doppler For bilateral scans, repeat the above steps on the opposite leg. For unilateral scans, obtain the following:
- 31. Trans split screen contralateral CFV with compression
- 32. Long contralateral CFV gray scale
- 33. Long contralateral CFV color Doppler
- 34. Long contralateral CFV phasicity with spectral analysis
- 35. Long contralateral CFV distal augmentation with spectral analysis

Pause protocol in the presence of thrombus to obtain additional images. Document with a waveform at the obstruction and distal to the obstruction (superior to, as venous flow is towards the heart). Follow the clot as far superior as possible. If the clot extends into the pelvis, document the iliac vein and IVC as well when possible.

The following additional sites may be imaged when indicated: inferior venacava, common & external iliac, greater saphenous, lessor saphenous, proximal deep femoral, gastrocnemius, soleal and anterior tibial veins.

Note: It is important to compare the phasicity & amplitude of right & left common femoral veins. A waveform that is continuous or significantly decreased in amplitude compared to the opposite side is a sign of proximal venous obstruction whether it is from a blood clot or from external venous obstruction; therefore steps should be taken to look for the obstruction when possible. Record represented images of venous insufficiency when present as well as incidental findings such as Baker's cyst, lymph nodes or masses. [Rev 3/2013]

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