

# UT Southwestern Department of Radiology

## Ultrasound – Lower Extremity: Venous Insufficiency

### **PURPOSE:**

To evaluate deep and superficial venous systems for evidence of valvular incompetence (venous reflux).

### **SCOPE:**

Applies to all Ultrasound Lower Extremity Venous Insufficiency studies performed in Imaging Services / Radiology

### **INDICATIONS:**

- Venous ulcers
- Visible varicose veins
- Pre-op evaluation for venous insufficiency
- Feeling of heaviness in lower extremity
- Pain, edema, or discoloration

### **CONTRAINDICATIONS:**

- Patients with bandages, casts
- Patients who are unable to stand for an extended length of time
- Uncooperative patients (eg. altered mental status, involuntary movement)
- Patients with severe edema (relative contraindication)
- Obese patients with deep vessels (relative contraindication)
- Open draining ulcers

### **EQUIPMENT:**

- Commercial ultrasound device (eg. Philips iU-22, EPIQ 7G; Siemens Sequoia) with duplex Doppler capability
- Linear transducer with a frequency range from 7-18 MHz
- Curved transducer with a frequency range from 1-9 MHz

### **PATIENT PREPARATION:**

- In a standing position, the patient should stand facing the sonographer with the leg rotated slightly externally. The patient should place a majority of their weight on the contralateral leg.
- If the patient is unable to stand for an extended amount of time, lay the patient down in the reverse Trendelenberg position. The feet must be 15-20 degrees lower than the heart.

### **EXAMINATION:**

#### **GENERAL GUIDELINES:**

- A complete examination includes evaluation of the entire course of the accessible portions of each vein
- A complete venous duplex reflux exam must include both B-mode imaging and Doppler spectral analysis
- Study may be unilateral or bilateral
- Variations in technique must be documented

## 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

## TECHNICAL CONSIDERATIONS:

- The exam room should be warm to avoid vasoconstriction
- Equipment gain and display settings will be optimized while imaging vessels with respect to depth, dynamic range, and focal zones
- Color-flow Doppler images with proper color scale to demonstrate areas of high flow and color aliasing
- Spectral Doppler waveform assessment will be done in long axis and will be displayed below the baseline. Assess for spontaneity, phasicity, and augmentation
- Transverse gray scale imaging will be performed with and without transducer compressions
- The entire length of the veins will be evaluated.
- ☐ Venous compression:
  - Gentle compression may be applied to vessels filled with thrombus in order to confirm non-compressibility (excluding slow flow or other artifact). 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.
  - In the presence of short-segment thrombus, compression of veins distal (peripheral) to this clot may be attempted in equivocal cases. This allows for documenting the extent of the thrombus. Calf augmentation should be omitted distal/inferior to a defined clot.
- If there is no evidence of DVT, proceed with evaluation of venous insufficiency
- Manual augmentation is applied inferior to the vessel interrogated for venous reflux
- Reflux time is measured from the start to end of the reversed flow. Abnormal reflux time for superficial veins is > 0.5 sec and for perforating veins is > 0.35 sec
- Perforating veins measuring > 3.5mm in diameter are considered abnormal, indicating incompetent perforating veins
- If a perforator is identified, evaluate for competence. Incompetent perforating veins will have bi-directional flow.
- If the perforator is incompetent, evaluate the deep vein connection
- Normal perforators do not need to be documented

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**DOCUMENTATION:**

<b>DVT evaluation</b>		
1	Common femoral vein	Long grayscale, color with spectral Doppler waveforms and Valsalva
2	Common femoral vein	Cine compression
3	Femoral vein, proximal	Long grayscale, color with spectral Doppler waveforms and Valsalva
4	Femoral vein, proximal	Cine compression
5	Femoral vein, mid	Long grayscale, color with spectral Doppler waveforms
6	Femoral vein, mid	Cine compression
7	Femoral vein, distal	Long grayscale, color with spectral Doppler waveforms
8	Femoral vein, distal	Cine compression
9	Popliteal vein, proximal	Long grayscale, color with spectral Doppler waveforms
10	Popliteal vein, proximal	Cine compression
11	Popliteal vein, distal	Long grayscale, color with spectral Doppler waveforms
12	Popliteal vein, distal	Cine compression
13	Posterior tibial vein*	Long grayscale, color with spectral Doppler waveforms
14	Posterior tibial vein*	Cine compression
15	Peroneal vein*	Long grayscale, color with spectral Doppler waveforms
16	Peroneal vein*	Cine compression
* PTV and Peroneal vein assessment required at UT. At Parkland, only when sign, symptoms localize to calf		
<b>Venous Reflux evaluation</b>		
17	GSV, proximal thigh	Grayscale AP diameter
18	GSV, proximal thigh	Spectral Doppler waveform with augmentation
19	GSV, mid thigh	Grayscale AP diameter
20	GSV, mid thigh	Spectral Doppler waveform with augmentation
21	GSV, distal thigh	Grayscale AP diameter
22	GSV, distal thigh	Spectral Doppler waveform with augmentation
23	GSV, knee	Grayscale AP diameter
24	GSV, knee	Spectral Doppler waveform with augmentation
25	GSV, proximal calf	Grayscale AP diameter
26	GSV, proximal calf	Spectral Doppler waveform with augmentation
27	GSV, mid calf	Grayscale AP diameter
28	GSV, mid calf	Spectral Doppler waveform with augmentation
29	GSV, distal calf	Grayscale AP diameter
30	GSV, distal calf	Spectral Doppler waveform with augmentation
31	Long saphenous vein at SPJ	Grayscale AP diameter
32	Long saphenous vein at SPJ	Spectral Doppler waveform with augmentation

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33	Small saphenous vein	Grayscale AP diameter
34	Small saphenous vein	Spectral Doppler waveform with augmentation
35	Posterior medial accessory GSV	Grayscale AP diameter
36	Posterior medial accessory GSV	Spectral Doppler waveform with augmentation
37	Anterior lateral accessory GSV	Grayscale AP diameter
38	Anterior lateral accessory GSV	Spectral Doppler waveform with augmentation

### Perforating veins:

Incompetent perforating veins will have bi-directional flow. The deep vein connection should be evaluated if perforator incompetence is suspected. If evaluated, record perforating vein location, AP diameter, and spectral Doppler waveforms with augmentation as above.

Normal perforators do not need to be evaluated.

### PROCESSING:

- Review examination data
- Export all images to PACS
- Technologist will document in EPIC if patient is positive for DVT
- Note any study limitations

### CHANGE HISTORY:

STATUS	NAME & TITLE	DATE	BRIEF SUMMARY
Submission	Mark Reddick, MD	6/9/2016	Submitted
Approval	David Fetzer, MD, Director	6/20/2016	Approved
Review	Eddie Hyatt	12/15/2018	Reviewed
Revisions	David Fetzer	01/02/2019	Updated diagnostic criteria
	Christine Chen	08/12/2019	Updated description; documentation requirements

**US VENOUS INSUFFICIENCY DIAGNOSTIC CRITERIA**

<b>Reflux time using compression in the standing position</b>	
Vein Segment	Abnormal reflux time (sec)
Femoral veins	>1
Popliteal vein	>1
Superficial veins	>.5
Deep calf veins	>.5
Perforating veins	>.35
<b>Reflux time using Valsalva maneuver in 15 degrees reverse Trendelenburg</b>	
Vein Segment	Abnormal reflux time (sec)
Superficial veins	>.5
Greater Saphenous vein	>.5
Common Femoral vein	>1.5
Deep Femoral vein	>.5
Popliteal vein	Not Recommended
Deep calf veins	Not Recommended
<b>Reverse flow velocities</b>	
≥30 cm/s	Valve closure occurs within 1sec
<30 cm/s	Reflux may occur as reverse flow persists even in competent valves
<b>Perforating Veins</b>	
< 3.5mm	Normal
≥3.5 mm	Abnormal may indicate incompetent perforating veins
<b>Degree of Insufficiency</b>	
Grade	Length of Doppler reflux signal in seconds
<b>I</b>	0.5 – 2.0
<b>II</b>	2.0 – 3.0
<b>III</b>	3.0 – 6.0
<b>IV</b>	Continuous

<b>TABLE 1. CEAP Classification of Chronic Venous Disease</b>	
<b>Classification</b>	<b>Description/Definition</b>
<b>C, Clinical (subdivided into A for asymptomatic, S for symptomatic)</b>	
0	No venous disease
1	Telangiectases
2	Varicose veins
3	Edema
4	Lipodermatosclerosis or hyperpigmentation
5	Healed ulcer
6	Active ulcer
<b>E, Etiologic</b>	
Congenital	Present since birth
Primary	Undetermined etiology
Secondary	Associated with post-thrombotic, traumatic
<b>A, Anatomic distribution (alone or in combination)</b>	
Superficial	Great and short saphenous veins
Deep	Cava, iliac, gonadal, femoral, profunda, popliteal, tibial, and muscular veins
Perforator	Thigh and leg perforating veins
<b>P, Pathophysiological</b>	
Reflux	Axial and perforating veins
Obstruction	Acute and chronic
Combination of both	Valvular dysfunction and thrombus

Prior to performing augmentations, a modified examination must be performed to rule out the presence of DVT, evaluation should include: common femoral vein, proximal greater saphenous, femoral vein, popliteal veins, posterior tibial veins, and peroneal veins.

Superficial veins must be compressible and patent with no venous thrombosis and minimal diameter of 2mm in order to be considered a good conduit for a bypass graft.

Chronic outflow obstruction can contribute to venous insufficiency.

### **REFERENCES:**

- Pellerito, John and Polak, Joseph Introduction to Vascular Ultrasonography, 6th Edition. Philadelphia Elsevier/Saunders; 2012
- Zierler, R. Eugene, Strandness's Duplex Scanning in Vascular Disorders, 4th Edition Philadelphia: Lippincott Williams & Wilkins; 2010
- Imaging of Venous insufficiency. Seminars in Interventional Radiology. 2005;23(3): 178-184. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3036278/>
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