

Ultrasound – Lower Extremity: Venous Insufficiency

PURPOSE:

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

SCOPE:

Applies to all studies performed in:

- UT Southwestern Zale-Lipshy University Hospital, William P. Clements Jr. University Hospital, and all University Hospital-based Clinics Imaging Services (UTSW)
- Parkland Health and Hospital System Department of Radiology (PHHS)

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. EPIQ 5G & 7G; Siemens Sequoia; GE E10) 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:

- 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
- Patient given warm blankets prior to beginning exam
- 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 non-occlusive 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
- If acute DVT is identified, the exam is to be terminated and changed to a DVT exam
- If chronic DVT is identified, consult with the IR Radiologist for confirmation to proceed
- Manual augmentation is applied inferior to the vessel interrogated for venous reflux
- Normal vessel diameter is $<3.0\text{mm}$, in the setting of small vessels and no external signs of insufficiency, no need to hunt for reflux. Only Doppler and measure the small above baseline waveform. Should the vessel size be $<3.0\text{mm}$ but extremity signs of insufficiency, dangle the foot for vessel dilatation.
- If the patient has visible varicosities, document Medial or Lateral of the Thigh or Calf and include diameter and reflux time.
- Reflux time is measured from the start to end of the reversed flow. Abnormal reflux time for superficial veins is $> 0.5\text{ sec}$ and for perforating veins is $> 0.35\text{ sec}$
- Perforating veins measuring $> 3.5\text{mm}$ 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

DOCUMENTATION:**DVT EVALUATION**

Anatomy	Compression Cine	Long grayscale	Color Doppler	Spectral Doppler with valsalva	Spectral Doppler with distal augmentation
CFV	X	X	X	X	
POP V	X	X	X		X

REFLUX EVALUATION

Anatomy	Trans AP diameter	Long spectral waveform with distal augmentation
GSV at SFJ	X	X
Accessory GSV's (when seen)	X	X
GSV Prox Thigh	X	X
GSV above Knee	X	X
GSV at Knee	X	X
GSV below Knee	X	X
SSV at SPJ	X	X
SSV Mid Calf	X	X

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

APPENDIX:**US VENOUS INSUFFICIENCY DIAGNOSTIC CRITERIA:****REFLUX TIME USING COMPRESSION IN THE STANDING POSITION**

Vein Segment	Abnormal reflux time (sec)
Femoral Veins	>1
Popliteal Vein	>1
Superficial veins	>.5
Deep calf veins	>.5
Perforating veins	>.35

REFLUX TIME USING VALSALVA MANEUVER IN 15 DEGREES REVERSE TRENDLENBURG

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

REVERSE FLOW VELOCITIES

Reflux Time	Result
>30 cm/s	Valve closure occurs within 1 sec
<30 cm/s	Reflux may occur as reverse flow persists even in competent valves

PERFORATING VEINS

Reflux Time	Result
<3.5 mm	Normal
>3.5 mm	Abnormal may indicate incompetent perforating veins

DEGREE OF INSUFFICIENCY

Grade	Length of Doppler reflux signal in seconds
I	0.5 – 2.0
II	2.0 – 3.0
III	3.0 – 6.0
IV	Continuous

CEAP CLASSIFICATION OF CHRONIC VENOUS DISEASE

C. Clinical (subdivisions: A for asymptomatic, S for symptomatic)

Classification	Description / Definition
0	No venous disease
1	Telangiectases
2	Varicose veins
3	Edema
4	Lipodermatosclerosis or hyperpigmentation
5	Healed ulcer
6	Active ulcer

E. Etiologic

Classification	Description / Definition
Congenital	Present since birth
Primary	Undetermined etiology
Secondary	Associated with post-thrombotic, traumatic

A. Anatomic distribution (alone or in combination)

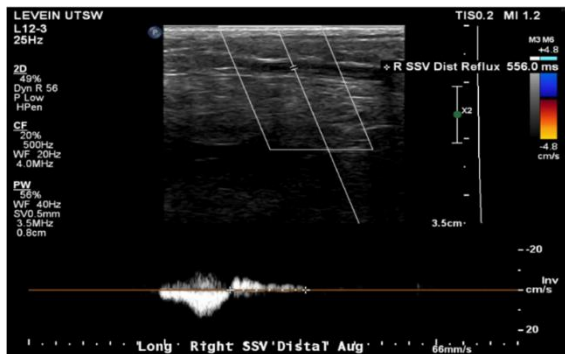
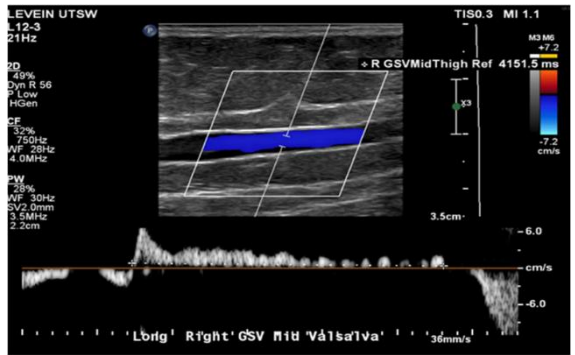
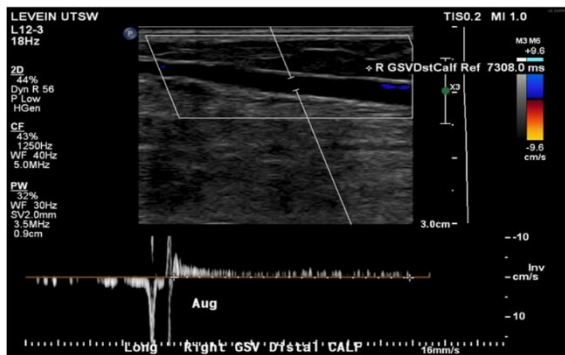
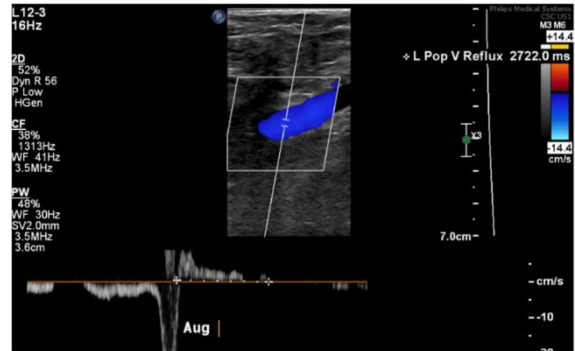
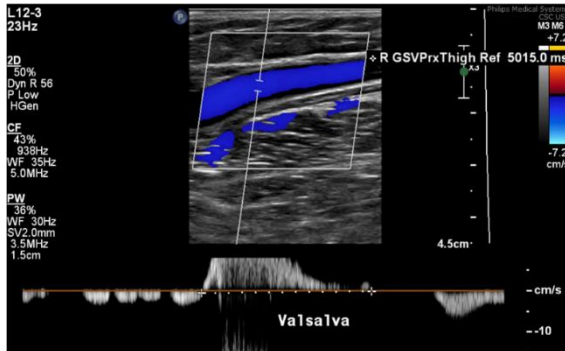
Classification	Description / Definition
Superficial	Great and short saphenous veins
Deep	Cava, iliac, gonadal, femoral, profunda, popliteal, tibial, and muscular veins
Perforator	Thigh and leg perforating veins

P. Pathophysiological

Classification	Description / Definition
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.

EXAMPLES:



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/>
- Contemporary Reviews in Cardiovascular Medicine. Chronic Venous Insufficiency. Robert T. Eberhardt, MD; Joseph D. Raffetto, MD. Circulation. 2005; 111: 2398-2409. <http://circ.ahajournals.org/content/111/18/2398.full>

CHANGE HISTORY:

<u>DATE:</u>	<u>SUBMITTED BY:</u> (NAME, TITLE)	<u>APPROVED BY:</u> (NAME, TITLE)	<u>SUMMARY:</u>
06/09/2016	Mark Reddick, MD		Submitted
06/20/2016		David Fetzer, MD, Director	Approved
12/15/2018	Eddie Hyatt		Reviewed
01/02/2019	David Fetzer, MD, Director		Updated diagnostic criteria
08/12/2019	Christine Chen		Updated description; documentation requirements
07/24/2023	Ashten Burleson		Updated diagnostic criteria; images of reflux measurement
06/27/2025	Bryana Ruth, RDMS, RVT		Updated vessel and documentation criteria and patient prep
05/11/2026	Jana Smith, RDMS, RVT	Pending	Applied accessibility compliance features; redesigned diagnostic data tables; reformatted change history table