

DOCUMENT CONTROL PAGE	
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Reasons for performing the test:

To evaluate the functionality of venous valves in the deep and superficial venous systems.

In patients with severe chronic venous insufficiency (CVI), lower extremity skin changes of hyperpigmentation, lipodermatosclerosis and ulceration occurs. If refluxing segments of the veins can be removed, the severe condition of CVI may be improved. Duplex ultrasound imaging identifies the dysfunctional venous segments allowing the proper prescription of treatment and careful planning of the surgical approach that minimises the chances of recurrence.

Common Indications include, but are not limited to:

Skin changes, venous eczema, hyperpigmentation⁹

Venous ulcers

Recurrent swelling of the lower calf and ankles

Pain or feelings of heaviness in the lower extremity

Visible varicose veins

Venous claudication

Pain and oedema of the lower extremities

Contraindications and Limitations

Obesity

Casts, dressings, open wounds/ulcers etc can limit visualisation.

Patient severe oedema/swelling.

Limited mobility e.g. unable to stand

Patients who are unable to cooperate due to reduced cognitive functions e.g. Alzheimer's or dementia and through involuntary movements

Patient discomfort, particularly calf tenderness

Equipment used:

- Colour Duplex scanner

Service and quality control test are carried out by supplier/ Christie medical physics

Consumables required:

- Ultrasound gel
- Tissues
- Paper roll for the couch

Patient preparation:

Identify the patient using name, DoB and address, introduce yourself and ensure the patients are at ease by explaining the test to be carried out is a safe and painless procedure. Ensure patient can understand and they consent to the procedure, offering an interpreter and chaperone if one has not already been arranged. Obtain relevant clinical history to ensure correct test has been ordered, adapting the test performed to the patients symptoms and clinical findings (discuss with senior member of staff).

Procedure

9-3 MHz/17-5MHz linear array transducer is used with venous default setting selected on the Duplex machine to optimise the image to identify low velocity blood flow.

Patients are assessed whilst tilted on the couch (between 30-60°, see protocol for use of tilting couch, or standing on a stool) with the majority of weight on the contralateral limb. If patients are not able to weight bear, then they are lay on the couch with the headrest tilted as high as possible and couch tilted slightly to aid venous pooling. The ipsilateral limb is externally rotated at the hip, knee slightly bent and the foot turned outwards.

On thigh/calf augmentation, all veins should fill from wall to wall with uniform colour filling. If the vein does not fill wall to wall, thrombus may be present, but different steering angles and lower colour flow velocity profiles should be used to optimise colour filling. On release of the thigh/calf there should be little (<0.5 seconds ^(1, 2)) or no reflux, indicating competency of vein assessed. If spectral Doppler is used to assess incompetency, the Doppler sample volume is steered to a 60° Doppler angle with the venous flow in the vein being examined, and the sample volume size is increased across the full diameter of the lumen. Augmentation of the thigh/calf will result in venous return and a negative deflection on the spectral analyser. On release of the thigh/calf, reflux will be seen as a positive deflection of >0.5 seconds and the vein is reported to be incompetent. If the positive deflection is <0.5 seconds, the vein is competent.

The transducer is placed in the groin and the common femoral vein (CFV) is identified medial to the common femoral artery in a longitudinal plane. Using spectral and colour Doppler, assess the spontaneity and phasicity of flow and competency of the CFV.

Moving distally along the CFV and the length of the superficial femoral vein (SFV) are assessed for competency using colour and spectral Doppler assessment.

Returning back to the CFV in longitudinal plane, if the probe is moved distally the long saphenous vein (LSV) will appear as a superficial medial branch. Competency of the sapheno-femoral junction (SFJ) is noted using both colour and spectral Doppler assessments and patency of the SFJ is assessed using compression in B-mode transverse plane. The LSV is then traced along its length to the ankle as isolated segments of incompetence may be identified. Note that two facial planes are visible adjacent to the LSV and that this vein is located between the deep and superficial fasciae.

Perforating veins and branches are best identified by scanning in B-mode transverse plane as these are easily missed in longitudinal plane. The perforators are seen branching from the superficial veins towards the deep system. Competence of the perforating veins should be assessed with the probe rotated so the superficial and deep veins are visualised in longitudinal plane, and the normal flow direction is from superficial to deep. The location of any incompetent perforators are measured in relation to anatomical markers.

Patient is repositioned to be sat on the side of the couch with knees bent and the feet supported by a foot stool.

The transducer is placed into the popliteal fossa and the popliteal vein is identified and checked for competency (in longitudinal plane using colour and spectral Doppler).

The short saphenous vein (SSV) is identified in the posterior aspect of the upper calf in transverse plane where its ultrasound appearance can be likened to the iris of the eye as the shape of the eye is formed by the deep and superficial fasciae. The SSV is traced proximally to the sapheno-popliteal junction (SPJ) where patency is assessed using B-mode compression technique. The transducer is rotated so the SPJ can be assessed for competency using colour and spectral Doppler in a longitudinal plane. If the SPJ is incompetent, its level relative to the knee joint is noted. In some cases the SPJ may not be identified and the SSV extends proximally up the thigh becoming the giacomini vein, which terminates by joining the posteromedial tributary of the LSV, or (rarely) the internal iliac vein. The SSV is then traced distally, and continually checked for its competency and patency.

The anterior tibial veins may be seen as the first deep communication with the popliteal vein. Distal to this junction the tibio-peroneal trunk veins divide to form the posterior tibial and peroneal veins.

It is easiest to trace the deep calf veins from the ankle proximally. Placing the transducer posterior to the medial malleolus the posterior tibial artery and two veins can be visualised in a longitudinal plane. All calf veins can be augmented by squeezing the calf/ankle or foot. The posterior tibial veins should be traced proximally ensuring both are viewed along their length in longitudinal and/or transverse planes assessing for competency and patency.

The probe is angled slightly posteriorly and the peroneal artery and veins should be visualised deep to the posterior tibial vessels. They are traced proximally ensuring both are viewed along their length in longitudinal and/or transverse planes assessing for competency and patency.

NB The anterior tibial veins are not routinely scanned, however, if symptoms suggest ATV pathology these should be scanned.

Endo Venous Ablation

If a patient is referred for ?EVA then only superficial veins need to be scanned, unless otherwise specified.

The vein diameters, depths and tortuosity should be measured and reported to assess suitability for EVA.

EVA can be performed on LSV (above and below knee), anterior lateral branch of the LSV (assuming it is big enough) and SSV.

The reports should be a diagram giving vessel route and lowest point of incompetence along with the min and max diameter and depth.

Consultants need to know:

1. Is there any truncal vein incompetence (LSV, SSV and/or anterior thigh vein)
2. If yes, is this vein filling the visible varicosities.
3. Is the incompetent truncal vein incompetent over a length greater than 4 cm and does this segment have a diameter greater than 4mm
4. If so, is this segment very tortuous or very superficial.

Results

Patency/compressibility - inability to compress the vein suggests possible presence of intraluminal thrombus, which may be partially or completely obstructive.

Competency/reflux grading ^(1, 2) -

Normal valve function	reflux duration of < 0.5 secs
Mild reflux	reflux duration 0.5 - 1 sec
Moderate/severe reflux	reflux duration of > 1 secs

Superficial venous thrombus - must be reported on if present as this may affect surgical decisions and it may not be possible to operate upon a thrombophlebotic vein.

Image Storage

Images should be stored to PACS to represent the scan report written.

Image suggestions:

Sapheno femoral junction with spectral trace and augmentation

Sapheno popliteal junction with spectral trace and augmentation

Any deep venous incompetence.

Any abnormal pathology

Report

The report should include:

The presence/absence of phasic flow in the proximal deep veins (if assessed)

Which veins have been assessed , the competency of the veins, the extent of incompetent segments, the presence/absence of any thrombus.

Any anatomical variations due to previous procedures (i.e. absence of LSV due to previous strip)

Where thrombus is identified, the location, length/extent, degree of patency and estimated age should be documented

Incompetent superficial vein diameter, depth and tortuosity.

Any limitations e.g. if areas in the calf are not visualized due to ulceration

An appropriate number of annotated images that represent the entire ultrasound examination

Pitfalls

Anatomical variations of the long and/or short saphenous systems, especially in patients with recurrent varicose veins.

Anomalies such as venous duplication.

Mistaken identity of veins - can be prevented by locating and documenting major anatomic landmarks that confirm the identity of veins.

Compression difficulties - a vein may resist compression and yet contain no thrombus due to the depth of the vessel, the angle of the course of the vessel, and overlying tendons and muscles (e.g. iliac vein, profunda femoris vein and distal superficial femoral vein as it dives through the adductor canal).

At the end of the test inform the patient that the results will be sent to the consultant and they will be informed of the their results at their next visit.

Patient and staff safety

- Use output powers quoted by the manufacturer and in accordance to ALARA / AIUM criteria.
- Infection control: see latest Vascular Lab Infection control and working practices policy.
- Ensure couch and chair in optimum position to prevent work related upper limb disorders.

1. References & Bibliography

1. Coleridge-Smith, P, Labropoulos, N, Partsch H, Myers K, Nicolaides A, Cavezzi A. Duplex ultrasound investigation of the veins in chronic venous disease of the lower limbs –UIP Consensus Document. Part 1 Basic principles. Eur J Vasc Endovasc Surg 2006; 31:83-92
2. Lower Limb Venous system, Peripheral Vascular Ultrasound – How why and when. A Thrush, T Hartshorne