CardioVascular

Royal Free London
NHS Foundation Trust

VASCULAR STUDIES UNIT
Lower Limb Venous – Doppler Ultrasound Examination

Introduction and Scope:

Venous insufficiency can cause significant morbidity to patients and negatively impact their quality of life. It can occur in the deep and/or superficial venous systems of the lower limbs and a Doppler ultrasound examination can provide information on the burden of any venous reflux along with anatomic information useful for planning treatment. It is also useful for establishing patency of the iliofemoral veins post thrombolysis and/or stenting.

Indications for scanning

- Suspicion of chronic venous insufficiency (CVI)
- Ongoing symptoms following treatment for deep vein thrombosis
- Known congenital disorder e.g. Klippel-Trénaunay-Weber Syndrome (KTS)

Contraindications and Limitations

For assessment of venous reflux, the clinical vascular scientist (CVS) must evaluate the patient's capacity to stand and weight-bear for an extended period before the examination is carried out. If the patient is deemed unfit in this manner, a limited study may be carried out at the discretion of the CVS, however the CVS must be mindful not to place themselves or the patient at risk of injury while adapting positions to accommodate limited mobility.

The CVS must also be aware of the possible syncopal episodes patients may experience as a result of the physiologic changes that take place during the examination. The CVS should monitor the wellbeing of their patient throughout the study to reduce any risk of syncope.

Extensive bowel gas, lower limb oedema, poor skin condition and tender legs may cause limitations to examination. Patients who are unable to cooperate due to cognitive function, such as dementia, involuntary movements, or due to reduced mobility meaning they cannot lay supine, may also be unsuitable for the examination.

Referral pathways:

- Routine referrals should be made by a member of the patient's care team via EPR.
- Urgent referrals should only be made when there is evidence of bleeding or infected varicose veins. A member of the patient's care team should make the referral via EPR and follow up with a phone call to the Vascular Studies Department

Equipment:

Approved Vascular Studies instrumentation should be used for this examination. Please see 'Equipment Schedule' document.

Preparation:

It is the duty of the Clinical Vascular Scientist (CVS) to ensure that both the patient and the equipment are positioned correctly to minimise risk of injury to themselves and the patient, and to take precautions to avoid unnecessary strain on the back and/or provocation of work related upper limb disorders (WRULD)[2]. The patient's dignity and privacy must be maintained at all times. It may be necessary to offer a gown and/or a chaperone.[1,3]

Consent:

It is a legal and ethical principle that valid consent be obtained before starting a physical investigation. This principle reflects the right of patients to determine what happens to their own bodies, and is a fundamental part of good practice. It is the responsibility of the CVS carrying out the investigation to ensure verbal consent is obtained[1].

Clinical Governance:

It is the duty of all staff to ensure that the patient's right to confidentiality is always observed and upheld, both during and after their hospital visit and that all patient identifiable records are stored in accordance with trust guidelines and Caldicott Principles.[4]

Method:

As with all scanning protocols the following should be used as a guide – It is the duty of the CVS conducting the study to make appropriate modifications to the examination based on their professional judgement and on the mental and physical health of the patient.

The patient is asked to remove clothing to expose the area for examination.

To assess for lower limb venous reflux, the patient should be examined standing with leg relaxed to facilitate distention of the veins and optimise visualisation. The target leg is slightly bent and externally rotated for optimum access to the medial aspect of the leg. A limited study can take place if the patient is unable to stand for long periods and it may be appropriate for the patient to be sat on a raised bed while assessing the calf veins, however it should be noted that results obtained when patient is not standing may yield a lower sensitivity.

The following superficial and deep veins should be identified and checked for unusual anatomy (e.g. absent popliteal vein or popliteal aneurysm), reflux, post thrombotic scarring and thrombus:

- saphenofemoral junction (SFJ)
- great saphenous vein (GSV)
- anterior accessory saphenous vein (AASV)
- saphenopopliteal junction (SPJ)

- small saphenous vein (SSV), thigh extension of small saphenous vein (TE-SSV) or Giacomini vein
- common femoral vein
- proximal profunda femoris vein
- femoral vein
- popliteal vein
- posterior tibial veins
- peroneal veins

Please note that venous anatomy can be highly variable and it is important to have a full understanding of possible variants.

Additionally, the leg should be visually examined to identify the distribution of any notable varicose veins. Any varicose veins found visually or on duplex should be traced to identify their source. This is to allow the CVS to investigate for any incompetent sources not listed in the above stated veins (e.g. a lateral thigh perforator or varices from a pelvic source).

To assess for superficial and deep venous reflux, colour and spectral Doppler simultaneous with distal augmentation is used. B-mode and compression techniques may also be used to aid identification of any post-thrombotic scarring or thrombus.

Where the GSV or SSV is found incompetent the following is important to determine: presence of scarring or thrombus, vessel calibre, whether the vessel remains within its fascia and whether there are any segments of marked tortuosity. If vein depth may cause difficultly for endovenous ablation (e.g. if the vein courses very superficial) this should also be noted.

For any incompetent perforators or branches found, their anatomical positioning and calibre should be determined (e.g. '3 mm incompetent perforator located 10cm above the medial femoral condyle').

For any vascular malformations, such as AVM / KTS, deviations from the above method are to be expected. Please discuss with the referring clinician for exact questions and requirements to aid scanning method and see 'AVM' protocol for further information.

Measurements and Grading Criteria:

Examination of venous stenting

Grading of venous stent stenosis is not well established. The CVS should take care to reflect this when reporting. Taking multiple diameter reduction measurements in various planes may be a useful technique to calculate a percentage stenosis as well as comparing contralateral venous haemodynamics.

Assessment of venous reflux

Venous Reflux Criteria [5, 6, 7]
<0.5sec reflux - normal
>0.5sec reflux within a superficial vein – suggests incompetence
>1.0secs reflux within a deep vein – suggests incompetence

Grading criteria may not be applicable in the presence of unusual anatomy, e.g. very large vessel, or vascular malformations, and is at the discretion of the CVS to use the above criteria as a guideline.

Where GSV and SSV incompetency is identified, any suitable segment of these truncal veins that may or may not be a good target for endothermal ablation should be established. An anatomically suitable segment should be straight, of good diameter (at least 3mm) and absent of post thrombotic scarring or thrombus. Segments smaller, more tortuous, or measuring >12mm in calibre should be highlighted along with any segments that course superficial to the fascia. If <12cm length of truncal vein appears suitable for ablation the approximate suitable length should be documented.

Reporting:

The status of the SFJ, GSV, SPJ, SSV and all deep veins, along with any other incompetent vein should be documented. In the event of truncal superficial venous insufficiency, the anatomic suitability for endothermal ablation should be documented. The presence of any incompetent perforators of 3mm diameter or greater should be documented.

Any absent superficial or deep veins should be stated and any anatomical variants/abnormalities documented where appropriate. A list of veins not examined and any limitations experienced should also be documented.

Abnormal findings may benefit from an accompanying diagrammatic illustration at the discretion of the CVS. This should be uploaded to EPR and the written report should direct the clinician towards it.

Reports should answer any specific diagnostic questions raised on the referral. As a minimum, images of the SFJ and SPJ as well as any disease should be uploaded to PACS, with other images stored as an aide memoire at the discretion of the CVS.

Urgent findings, such as acute thrombus, should be reported verbally to the on call Vascular Registrar via bleep 2977 as well as documented in the report on EPR.

References

[1] United Kingdom Association of Sonographers (UKAS), 2008, Guidelines for Professional Working Standards Ultrasound Practice, accessed at: www.sor.org/learning/document-library

[2]Society of Radiographers, 2002, The Causes of Musculoskeletal Injury Amongst Sonographers in the UK Society of Radiographers, accessed at: www.sor.org/learning/document-library

[3]Society for Vascular Technology Professional Standards Committee, 2020, Consent and Chaperone Guidelines, accessed at: https://www.svtgbi.org.uk/media/resources/Chaperone_2020.pdf

[4] Department of Health and Social Care, 2013, Caldicott Review: information governance in health and social care, accessed at: https://www.gov.uk/government/publications/the-information-governance-review

[5]Labropoulos N, Tiongson J, Pryor L, et al. Definition of venous reflux in lower-extremity veins. J Vasc Surg 2003;38:793-8. 10.1016/S0741-5214(03)00424-5

[6]Gloviczki P, Comerota AJ, Dalsing MC, et al. The care of patients with varicose veins and associated chronic venous diseases: clinical practice guidelines of the Society for Vascular Surgery and the American Venous Forum. J Vasc Surg 2011;53:2S-48S. 10.1016/j.jvs.2011.01.079

1 and 2

Clinical Indication: Left LL venous US scan Clinical History: Left leg VV
Findings:

US Doppler Lower Limb Venous Left
The Sapheno-Femoral Junction (SFJ) and thigh Greater Saphenous vein (GSV) are incompetent. The thigh GSV
measures 5mm and lies straight and within the fascia. Suitable for ablation. The GSV fills medial calf varices.
The mid calf to ankle GSV is competent.
The Sapheno-Popliteal Junction (SPJ) and Short Saphenous vein (SSV) are patent and competent.
No DVI.

Study Date: 18/08/2023
Reported By:
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3 and 4

Clinical Indication: REFLLUX Clinical History: VARICOSE VEINS
Findings:

US Doppler Lower Limb Venous Right
The Sapheno-Femoral Junction (SFJ) and thigh Greater Saphenous vein (GSV) are incompetent. The thigh GSV measures 5-7mm with multiple focal dilatations of 12-13mm. It lies straight and within the fascia. The GSV fills a large tortuous varix below the knee crease which courses posterior-medially.
The GSV is competent prox calf to ankle.
No Sapheno-Popliteal Junction (SPJ) and Short Saphenous vein (SSV) is competent.
All deep veins are patent and competent.

US Doppler Lower Limb Venous Left
The Sapheno-Femoral Junction (SFJ) and Greater Saphenous vein (GSV) are competent.
The Sapheno-Popliteal Junction (SPJ) and Short Saphenous vein (SSV) are competent.
All deep veins are patent and competent.

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5 and 6

Clinical Indication: VVs
Findings:

US Doppler Lower Limb Venous Right
The Sapheno-Femoral Junction (SFJ) and Greater Saphenous vein (GSV) throughout its length are incompetent. The proximal to mid thigh GSV measures 8-9mm and lies straight and within the fascia. The GSV leaves the fascia in the distal third of the thigh and becomes large and tortuous filling small varices in the calf.
No Sapheno-Popliteal Junction (SPJ) and Short Saphenous vein (SSV) is patent and competent.

No deep vein insufficiency (DVI) noted.

US Doppler Lower Limb Venous Left
The SFJ and GSV throughout its length are incompetent. The proximal to mid thigh GSV measures 7-8mm and lies straight and within the fascia. The GSV fills a small varix in the distal thigh. The GSV leaves the fascia in the distal third of the thigh and fills a large tortuous varix in the proximal calf which courses antero-medially. The remaining calf GSV is incompetent.
No SPJ and SSV is patent and competent.
No DVI noted.

Study Date: 15/08/2023
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7

Clinical Indication: venous insufficiency?
Findings:

US Doppler Lower Limb Venous Right
The Sapheno-Femoral Junction (SFJ) and Greater Saphenous vein (GSV) are patent and competent.
The Sapheno-Popliteal Junction (SPJ) and Short Saphenous vein (SSV) are patent and competent.
No deep venous insufficiency noted.

US Doppler Lower Limb Venous Left
The SFJ and GSV are patent and competent.
The SPJ and SSV are patent and competent.
No deep venous insufficiency noted.

Study Date: 19/11/2023
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8

Clinical Indication: VV's right leg Clinical History: ? SVI ? DVI
Findings:

US Doppler Lower Limb Venous Right
The Sapheno-Femoral Junction (SFJ) and thigh Greater Saphenous vein (GSV) are incompetent. The GSV leaves the fascia in the proximal calf and fills a tortuous varix which courses medially down the leg. The thigh GSV lies straight, within the fascia and measures 6-10mm in diameter. Thigh GSV is suitable for ablation.
No Sapheno-Popliteal Junction (SPJ) and Short Saphenous vein (SSV) is patent and competent.
All deep veins are all patent and competent.

Study Date: 21/08/2023
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US Doppler Lower Limb Venous Left
Clinical Indication: reflux Clinical History: varcose veins
Findings:

The Sapheno-Femoral Junction (SFJ) is competent. The Greater Saphenous vein (GSV) is incompetent from the pre-terminal valve to the mid thigh where the flow refluxes into a tortuous varix. A short segment of the GSV is competent in the mid thigh before the varix re-joins the GSV in distal third of the thigh rendering the GSV incompetent to the ankle.
The thigh GSV lies fairly straight and within the fascia, with a diameter range of 5-9mm.
The Sapheno-Popliteal Junction and Short Saphenous vein are patent and competent.
Moderate reflux in the proximal popliteal vein otherwise the common femoral, femoral, distal popliteal, posterior tibial and peroneal veins are competent.
No incompetent perforators detected.

Study Date: 31/08/2023
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Clinical Indication: Any reflux? Clinical History: Varicose vein both legs (right recurrence)
Findings:

US Doppler Lower Limb Venous Right
No sapheno femoral junction or thigh great saphenous vein (GSV) due to previous vein intervention. Neovascularisation at the groin, with the common femoral vein directly filling an incompetent tortuous superficial vein which fills further varices in the distal thigh and calf. The remnant GSV at the ankle is competent.
No Sapheno-Popliteal Junction (SPJ), and prox Short Saphenous vein (SSV) is competent. A varix joins the SSV at the mid calf, rendering it incompetent for a short segment <5cm. A varix leaves the SSV in the mid SSV and the remaining SSV is competent.
No deep vein insufficiency.
No incompetent perforators detected.

US Doppler Lower Limb Venous Left
The SFJ and thigh GSV are patent and competent. An incompetent varix fills the GSV in the mid calf and straight
after, the GSV fills a small varix that courses along the medial aspect of the calf. The remaining GSV is competent.
The SPJ and prox to mid SSV are incompetent. The prox to mid SSV measures 11-12 mm in calibre and lies fairly straight and within the fascia. The SSV fills a large tortuous varix at the mid calf which fills further varices in the calf.
All deep veins are all patent and competent.
No incompetent perforators detected.

Study Date: 15/09/2023
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11 and 12

Clinical Indication: CVI Clinical History: Bilateral LL varicose veins
Findings:

US Doppler Lower Limb Venous Right
The Sapheno-Femoral Junction (SFJ) and Greater Saphenous vein (GSV) are patent and competent.
The Sapheno-Popliteal Junction (SPJ) and Short Saphenous vein (SSV) are patent and competent.
All deep veins are all patent and competent.
No incompetent perforator detected.
Small incompetent superficial vein in the distal posterior thigh coursing down the posterior calf, with no truncal or perforator source.
Small incompetent tortuous anterior accessory mid-thigh branch which courses laterally down the leg.

US Doppler Lower Limb Venous Left
The Sapheno-Femoral Junction (SFJ) and Greater Saphenous vein (GSV) are patent and competent.
The Sapheno-Popliteal Junction (SPJ) and Short Saphenous vein (SSV) are patent and competent.
All deep veins are all patent and competent.
No incompetent perforator detected.
An incompetent superficial vein at the posterior knee fills small tortuous incompetent veins at the proximal posterior calf, with no truncal or perforator source.

Study Date: 18/09/2023
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13 and 14

Clinical Indication: Dusky feet Clinical History: ? SVI ? DVI
Findings:

US Doppler Lower Limb Venous Right
The Sapheno-Femoral Junction (SFJ) and Greater Saphenous vein (GSV) are patent and competent.
No Sapheno-Popliteal Junction (SPJ) and Short Saphenous vein (SSV) is patent and competent.
All deep veins are patent and competent.

US Doppler Lower Limb Venous Left
The SFJ and GSV are patent and competent.
No SPJ and SSV is patent and competent.
All deep veins are patent and competent.

Conclusion
No DVI or SVI noted bilaterally.

Study Date: 19/09/2023
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15 and 16

Clinical Indication: Leg pains and swollen legs and has varicose veins

US Doppler Lower Limb Venous Right

The Sapheno-Femoral Junction (SFJ) and Greater Saphenous vein (GSV) are patent and competent.
The Sapheno-Popliteal Junction (SPJ) and Short Saphenous vein (SSV) are patent and competent.
All deep veins are all patent and competent.
No incompetent perforators detected.
Incompetent small tortuous superficial posterior calf vein tracked up to the medial mid thigh, unable to track further, too small in calibre.
Small tortuous lateral thigh varix tracked up anterio-medially to the mid anterior thigh, unable to track further, too small in calibre.

US Doppler Lower Limb Venous Left

The Sapheno-Femoral Junction (SFJ) and thigh Greater Saphenous vein (GSV) are patent and competent.
Varices join the GSV below the knee rendering the GSV incompetent to the mid calf. Distal calf GSV is competent.
Incompetent superficial vein which joins the GSV in the calf was tracked up to the mid thigh, unable to track further, too small in calibre.
Posterior calf varix tracked up to the distal posterior thigh, unable to track further, too small in calibre.
The Sapheno-Popliteal Junction (SPJ) and Short Saphenous vein (SSV) are patent and competent.
All deep veins are all patent and competent.
No incompetent perforators detected.

Study Date: 17/09/2023
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17 and 18

Clinical Indication: ? venous insufficiency Clinical History: SSc with new ulcer on R lateral lower limb. To rule out alternative diagnoses
Findings:

US Doppler Lower Limb Venous Right
The Sapheno-Femoral Junction (SFJ) is competent. The proximal thigh to distal calf Greater Saphenous vein (GSV) consists of mild reflux (<1s).
The Giacomini vein and Short Saphenous vein (SSV) are mildly reflux.
The femoral vein and popliteal consists of mild reflux otherwise the common femoral vein, posterior tibial and peroneal veins are competent.

US Doppler Lower Limb Venous Left
The Sapheno-Femoral Junction (SFJ) is competent. The proximal thigh to distal calf Greater Saphenous vein (GSV) consists of mild reflux (<1s).
The Sapheno-Popliteal Junction (SPJ) and Short Saphenous vein (SSV) are incompetent. The SSV lies straight and within the fascia, measuring 3 to 7mm in calibre.
The femoral vein and popliteal consists of mild reflux otherwise the common femoral vein, posterior tibial and peroneal veins are competent.

Study Date: 18/09/2023
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19 and 20

Clinical Indication: asses his VV Clinical History: recurrence of vv bilaterally
Findings:

US Doppler Lower Limb Venous Right
No true thigh GSV due to previous vein intervention.
Neovascularisation at the groin where the common femoral vein directly fills superficial tortuous veins that fill tortuous varices in the leg which course medially down the leg and posterior laterally down the thigh and into the calf.
Posterior lateral thigh vein tracked up to the mid thigh- unable to track further.
No Sapheno-Popliteal Junction (SPJ) and Short Saphenous vein (SSV) is patent and competent.
No deep vein insufficiency noted in the common femoral vein, femoral vein, popliteal, posterior tibial and peroneal veins.

US Doppler Lower Limb Venous Left
No true thigh GSV due to previous vein intervention.
The SFJ stump is competent. Neovascularisation at the groin with tortuous incompetent veins filling tortuous varices in the leg and calf.
Mid calf perforator measuring 4mm in diameter fills varices in the posterior calf.
Remnant distal calf GSV is patent and competent.
No Sapheno-Popliteal Junction (SPJ) and Short Saphenous vein (SSV) is patent and competent.
No deep vein insufficiency noted in the common femoral vein, femoral vein, popliteal, posterior tibial and peroneal veins.

Study Date: 20/09/2023
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Clinical Indication: reflux Clinical History: varicose veins
Findings:
US Doppler Lower Limb Venous Right
The Sapheno-Femoral Junction (SFJ) is competent. The Greater Saphenous vein (GSV) is incompetent from the pre-terminal valve to the distal thigh. The GSV fills varix at the distal thigh which courses anterolaterally across the thigh. The thigh GSV measures 4 to 9 mm and lies fairly straight and within fascia.
The prox calf to ankle GSV is incompetent and lies straight, within the fascia and measures 3 to 6 mm.
The Sapheno-Popliteal Junction (SPJ) and Short Saphenous vein (SSV) are patent and competent.
No deep vein insufficiency noted in the common femoral, femoral, popliteal, posterior tibial and peroneal veins.
No incompetent perforators detected.

US Doppler Lower Limb Venous Left
The Sapheno-Femoral Junction (SFJ) and prox to mid thigh Greater Saphenous vein (GSV) are patent and competent.
The anterior accessory thigh vein (AATV) is incompetent from the junction. It is tortuous and leaves the fascia approx. 5cm from the junction. The incompetent AATV courses along the anterior aspect of the leg filling varices in the thigh.
One of the AATV varices joins the mid thigh GSV rendering it incompetent. The GSV fills varices in the thigh.
The GSV has a segmental dilation at the knee which measures 14mm and fills varices in the calf. The GSV is mild to moderately incompetent in the calf due to association with varices in the calf.
The SPJ and SSV are patent and competent.

No deep vein insufficiency noted in the common femoral, femoral, popliteal, posterior tibial and peroneal veins.
No incompetent perforators detected.

Study Date: 20/09/2023
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Clinical Indication: SST Bilat VVs
Findings:

US Doppler Lower Limb Venous Right
The Sapheno-Femoral Junction (SFJ) is competent. Prox to distal thigh Greater Saphenous vein (GSV) consists of very low volume reflux. Two competent GSV tributary in the mid thigh later branch and become incompetent and tortuous in the mid thigh. These varix course anteriorly across the knee and medially down the leg. A varix leaves the GSV in the distal thigh. The thigh GSV measures 7 to 8 mm and lies straight and within the fascia.
A small varix joins the distal calf GSV rendering it incompetent to ankle.
No Sapheno-Popliteal Junction (SPJ) and Short Saphenous vein (SSV) is patent and competent.
No deep vein insufficiency (DVI) noted.

US Doppler Lower Limb Venous Left
The SFJ and thigh to prox calf GSV are patent and competent. A small varix joins the prox calf GSV for rendering it incompetent for a short segment before refluxing into a competent perforator. Mid calf to ankle GSV is competent.
Tortuous incompetent superficial lateral thigh vein tracked up to the lateral posterior buttocks, unable to scan further. The incompetent lateral thigh vein fills small varices in the calf that course anteriorly across the shin.
No SPJ and SSV is patent and competent.
No DVI noted.

Study Date: 26/09/2023
Reported By:
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Clinical Indication: right leg ulcer Clinical History: ? SVI ? DVI
Findings:

US Doppler Lower Limb Venous Right
The Sapheno-Femoral Junction (SFJ) and thigh to proximal calf Greater Saphenous vein (GSV) are incompetent. The GSV fills a varix in the proximal calf which refluxes into a competent perforator in the distal calf. The remaining calf GSV is competent.
The thigh GSV measures 6 to 10 mm and lies straight and within the fascia.
The Sapheno-Popliteal Junction (SPJ) and Short Saphenous vein (SSV) are patent and competent.
No deep venous insufficiency noted.
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Study Date: 06/10/2023
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