

# ULTRASONIC ANGIOLOGY DEPARTMENT

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Vascular protocol	<b>Lower Limb Venous Duplex Evaluation</b>
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Change History		
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**PURPOSE**

Lower Limb Venous (LLV) disease includes telangiectases or reticular veins, varicose veins, edema, skin changes such as pigmentation, venous eczema, lipodermatosclerosis and ulceration<sup>1</sup>.

Ultrasonography of the lower limb veins can determine the presence, severity and location of venous disease. This information may be used to confirm diagnosis, monitor disease progression, plan future treatments<sup>2</sup> (for example, radio-frequency ablation, foam sclerotherapy or vein stripping<sup>3</sup>), and determine the success of previous treatments.

**COMMON INDICATIONS**

Some of the common indications for LLV evaluation:

- Symptomatic LLV disease, including leg swelling, aching, cramping, discolouration and ulceration
- Visible varicose veins
- Suspected thrombophlebitis
- Pre-intervention, to plan treatment options<sup>2</sup>
- Post-intervention, for example to assess Radio-frequency ablation success<sup>4</sup>
- Monitor disease progression
- Vein mapping prior to bypass procedure

**CONTRAINDICATIONS AND LIMITATIONS**

Contraindications and limitations for LLV evaluation include:

- Patient discomfort (for example, severe leg pain including calf tenderness) may mean the scan cannot be tolerated
- Patient obesity, patient position, lower leg ulceration and dressings may limit visualisation of the lower limb veins
- Patient prone to fainting during LLV assessment

## **PATIENT COMMUNICATION**

### **The Vascular Scientist should:**

- Call the patient in from the waiting room and show them to the scanning bay
- Introduce self to the patient and explain the purpose of the exam performed and indicate the typical length of the exam
- Explain the procedure to the patient to ensure that the patient understands the necessity for each aspect of the evaluation
- Respond to questions and concerns about any aspect of the examination
- Refer patient's specific questions regarding diagnosis, treatment or prognosis to their physician
- Inform the patient when the scan has finished, and explain that the images will be reviewed and a report produced for their consultant

## **PATIENT ASSESSMENT AND PHYSICAL EXAMINATION**

### **The Vascular Scientist should:**

Patient assessment must be performed before the LLV imaging. This includes assessment of the patient's ability to tolerate the procedure and an evaluation of any contraindications to the procedure.

Obtain and record on the scribble sheet a complete, pertinent history by interview and/or review of the patient's medical record. A pertinent history includes:

- Current medical status
- Presence of any signs or symptoms of LLV, including visible varicose veins and ulceration
- Relevant risk factors for LLV disease including family history
- Relevant medications or therapies including compression stockings and previous varicose vein treatment
- Results and types of prior vascular procedures, interventions and prior studies when available

All consultations must be made and documented in accordance with the relevant trust policies, for example promoting dignity and respect, maintaining patient confidentiality and writing in patient records.

## **PATIENT POSITIONING**

Patient should remove their shoes, socks and trousers. A hospital gown should be offered to the patient.

- LLV from groin to knee assessment: position the patient standing on the floor or on a vein stand, leg turned out to the side
- LLV below knee assessment: position the patient sitting on the scanning couch with their legs dependent over the side of the couch, scanning couch raised
- Abdominal vein assessment: position the patient supine on the scanning couch, arms down by their sides, patient will need to lift their shirt to expose their abdomen

If the patient is in a hospital bed, the bed should be tilted (foot end lowered by 30°).

Examiner should be as close to the examined extremity as possible to allow for ergonomically sound scanning.

## **INSTRUMENTATION**

Utilize appropriate ultrasound instrumentation (for example a Philips IU22, EPIQ7 or CX50 ultrasound systems), with appropriate frequencies for the vessels being examined.

- Typically, a linear array (for example 9-3 MHz) to visualise the veins from groin level and below, a curved array (for example 5-1 MHz) may be used in larger patients
- Typically, a curved array (for example 5-1 MHz) should be utilized to visualise the abdominal veins

## **EXAM PROTOCOL**

**Throughout each examination the Vascular Scientist should:**

- Observe the sonographic characteristics of normal and abnormal blood vessels, and allow the necessary adjustment to optimize exam quality

- Assess and monitor the patient's physical and mental status, allowing modifications to the procedure plan according to the patient's clinical status
- Analyse sonographic findings to ensure that sufficient data is provided to the physician to direct patient management and render a final diagnosis
- Follow a standard exam protocol for each segment evaluated

#### LLV duplex assessment:

Patient standing facing examiner, leg turned out

- Starting at the inguinal ligament, image the Common Femoral Vein (CFV) in longitudinal view
- Identify the Superficial Femoral Junction (SFJ)
- Track the Femoral Vein (FV) from origin to knee
- Track the LSV from SFJ to knee

Patient standing facing away from examiner, leg relaxed with the knee slightly bent

- Image the popliteal vein (POPV)
- Track SSV from Sapheno-Popliteal Junction (SPJ) to ankle, identify level of SPJ (relative to the knee skin crease) and the anatomy of the SPJ including any communicating veins (including the Giacomini vein if present) and varicose veins arising at this level

Patient sitting on scanning couch, scanning couch raised

- Image Posterior Tibial Veins (PTVs) at mid-calf and ankle, Anterior Tibial Veins (ATVs) at ankle, and Peroneal veins (if required)
- Track LSV from knee to ankle

Patient supine

- If requested by the referring physician, in the absence of CFV respiratory modulation, in the presence of CFV Deep Vein Thrombosis (DVT), or if abnormal superficial veins are identified in the groin or abdomen (for example collateral veins), image the External Iliac Vein (EIV), tracking the artery to the Common Iliac Vein (CIV) and IVC

#### Additional focal areas of interest:

- Identify presence and location of varicose veins (measuring their location relative to the skin crease, knee or ankle), including their source

- Identify abnormal superficial veins, for example collateral veins present in the groin or abdomen may indicate an iliac vein obstruction
- Identify absent veins, for example due to congenital abnormality or previous harvesting for bypass procedure
- Identify incompetent perforator veins and their communications
- Identify DVT (if DVT is identified, refer to DVT SOP)
- Identify thrombophlebitis or thrombosed veins, including as a result of previous treatment
- In the presence of LSV, SSV or other LSV/SSV tributary reflux note vein tortuosity, varices and whether the vein travels superficial to the fascia
- If performing a vein map of the LSV (and/or SSV), note vein tortuosity, varices and whether the vein travels superficial to the fascia

Digitally store static images during the assessment.

Minimum image requirements:

Longitudinal view duplex ultrasound images including spectral Doppler waveforms with distal augmentation from:

- CFV—also including respiratory modulation on Spectral Doppler
- LSV at groin, mid-thigh, knee and mid-calf
- FV at groin, mid-thigh and knee
- POPV above and below knee
- SSV at knee, mid-calf and ankle
- PTVs at mid-calf and ankle
- ATVs at ankle

Spectral Doppler:

- Optimise the spectral Doppler trace, including appropriate adjustment of scale and gain
- Ensure the Doppler angle is correctly aligned to the blood flow and  $\leq 60^\circ$
- Identify the presence/absence of blood flow
- In longitudinal view assess vein flow characteristics, including phasicity, spontaneity and direction of flow

- Record Doppler traces for all veins on distal augmentation to identify reflux, and for cardiac and respiratory modulation in the CFV, IVC and iliac veins

Spectral Doppler incompetence diagnostic criteria<sup>5</sup>:

<0.5s	Competent
0.5-<1.0s	Moderate incompetence
>1.0	Significant incompetence

B-Mode imaging:

- Optimise the B-Mode image, including appropriate adjustment of time gain compensation, zoom and depth
- In the presence of LSV, SSV or other LSV/SSV tributary reflux measure vein diameter (mm) in transverse view using calipers positioned on the anterior and posterior artery walls, measuring from leading edge to leading edge
- If performing a vein map of the LSV (and/or SSV), measure vein diameter (mm) in transverse view using calipers positioned on the anterior and posterior artery walls, measuring from leading edge to leading edge
- Assess vein patency and identify thrombus (confirm using compression in transverse view) and its appearance:
  - If DVT is identified, refer to DVT SOP
  - Superficial vein mural thrombus
  - Thrombophlebitis (homogenous thrombus with low echogenicity indicative of fresh thrombus<sup>5</sup>)
- Identify previous intervention

Colour flow imaging:

- Optimise the Colour flow image, including appropriate adjustment of scale and colour box size
- Use distal augmentation to augment colour filling, confirming the presence of reflux and identifying the presence/absence of blood flow (including old thrombus with recanalisation)

- Identify collateral vessels

## **REVIEW OF THE DIAGNOSTIC EXAM FINDINGS**

### **The Vascular Scientist should:**

- Review data acquired during the LLV examination to ensure that a complete and comprehensive evaluation has been performed and documented.
- Explain and document any exceptions to the routine LLV examination protocol (for example, study omissions or revisions).
- Before the patient leaves the department, alert the referring clinician & Head of Department when immediate attention is indicated.

## **PRESENTATION OF FINDINGS**

### **The Vascular Scientist should:**

- Provide preliminary results to the clinical team based on LLV examination findings
- Present record of diagnostic images, velocity spectral data, explanations for suboptimal exams, and technical worksheet to the interpreting physician for use in rendering a diagnosis and for archival purposes

## **EXAM TIME RECOMMENDATIONS**

High quality accurate results are fundamental elements of LLV evaluation. A combination of indirect and direct examination components is the foundation for maximizing exam quality and accuracy. For a unilateral scan, recommended time for indirect examination components is 10 minutes and for direct examination components is 20 minutes. For a bilateral scan, recommended time for indirect examination components is 15 minutes and for direct examination components is 45 minutes.

Indirect examination components include:

Pre-examination activities

- Initiating examination and paperwork
- Equipment and examination room preparation: bay should be prepared, ensuring clean linen and transducers, white roll, gel and any equipment required are present



- Patient communication
- Patient assessment
- Patient positioning

#### Post-examination activities

- Examination room clean-up: bay should be prepared for the next patient, ensuring clean linen and transducers, white roll, gel and any equipment required are present
- Review of the diagnostic examination findings
- Processing of the examination data for preliminary reporting and/or final interpretation

Direct examination components include:

- Equipment optimization
- Hands-on, examination process

All scans should be reviewed and reported within the same session in which they are performed to minimise delays.

#### **Urgent Referral**

If immediate attention is indicated, alert the referring clinician & Head of Department before the patient leaves the department, for example if there is:

- Acute above-knee DVT (see DVT SOP)

#### **REFERENCES**

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