

# PHYSIOLOGICAL MEASUREMENT – SERVICE SPECIFICATIONS

## Vascular Technology

### **Test : Assessment for Deep Venous Thrombosis (DVT)**

This investigation uses ultrasound to image and assess flow and to detect thrombus in the deep veins usually of the legs, but sometimes the arms. An ultrasound probe is used to scan the legs limb to assess flow and to detect the presence of thrombus in the deep veins. The superficial veins are also investigated to determine whether there is any thrombus close to the junction with the deep veins.

Patients who have suspected DVT, superficial thrombophlebitis or pulmonary embolism (PE) are likely to require this test. DVT is a common disorder that can lead to a fatal PE. Patients with a suspected DVT usually present with a painful, swollen and tender leg. Particular risk factors for developing a DVT are malignancy and immobility. Patients who have had recent surgery or who have thrombophilia are also at higher risk.

### **PATIENT PATHWAY**

Duplex assessment is the major diagnostic test in confirming the presence of acute DVT. To ensure best use of resources, the pathway often includes simple screening tests such as Wells scoring and D-dimer pathology testing before proceeding to a Duplex investigation. These screening tests have high negative predictive values, but low positive predictive values. If these tests are positive a Duplex scan should be carried out<sup>1, 2,3</sup>

### **REFERRAL**

#### **Clinical Indications**

The main indication for this investigation is suspicion of DVT. It is important to note that it is very difficult to diagnose a DVT by clinical symptoms alone and that other conditions such as cellulitis and lymphoedema can give similar symptoms<sup>4</sup>.

Clinical features for legs include sudden swelling of one leg, acute pain and calf tenderness with moderately raised temperature. Similar features are experienced in the arm.

Patients with a suspected recurrent DVT are also likely to require this test. It may be required to investigate the source for PE. It may also be used for patients with thrombophlebitis.

The major risk factors for DVT include recent surgery or trauma, immobility including air travel, coagulation disorders, malignancy, pregnancy, oral contraceptives and hormone replacement therapy.

Further information is given in the Society for Vascular Ultrasound guidelines for 'Lower Extremity Venous Duplex Evaluation (for deep and superficial vein thrombosis)'<sup>5</sup>.

Serial or repeat scanning to investigate propagation of DVT recanalisation of veins may also be requested.

#### **Contra indications**

The scan may be limited in the case of a very painful or swollen/oedematous leg/arm or where access is limited for example by a wound/ulcer or by a cast that cannot be removed.

## **EQUIPMENT**

### **Specification**

A high resolution imaging ultrasound duplex scanner which has colour, power and pulsed Doppler modalities is required. A midrange (covering nominal frequencies of 4-7MHz) flat linear array transducers (probe) should be used. A lower frequency (covering nominal frequencies of 2.5-4MHz) curved array transducer should be available, which will enable abdominal veins to be assessed if required or can be used to give better penetration if the thigh or calf is very oedematous.

There should be facilities to record images/measurements. The Royal College of Radiologists (RCR) has more detailed technical standards for ultrasound equipment<sup>6</sup>. The vascular and venous specifications are given on pages 15 to 17 of this document. ([www.rcr.ac.uk/docs/radiology/pdf/StandardsforUltrasoundEquipmentJan2005.pdf](http://www.rcr.ac.uk/docs/radiology/pdf/StandardsforUltrasoundEquipmentJan2005.pdf)). Further guidance can be found in Vascular Laboratory Procedures (VLP) part IV Duplex scanning for deep vein thrombosis section 4.1<sup>7</sup>. It should be noted that a range of relatively low cost portable scanners is now available, not all of which will be suitable for vascular work. It is important that the duplex scanner is of ergonomic design as explained in the health and safety section to minimise the risk of operator work related musculoskeletal disorders<sup>12</sup>.

### **Maintenance**

Equipment should be regularly safety-tested and regularly maintained in accordance with the manufacturer's recommendations. Further information is available from the British Medical Ultrasound Society (BMUS): 'Extending the provision of ultrasound services in the UK'<sup>8</sup>.

### **QA and Calibration**

Quality assurance (QA) procedures should be in place to ensure a consistent and acceptable level of performance of all modalities of the duplex scanner. Such procedures are likely to be set up with involvement from Medical Physics Departments or service engineers as they require specialist skills and will require both imaging and flow phantoms.

Detailed guidance on the QA of the imaging modality of duplex scanning is contained in the IPEM report 102 (Quality Assurance of Ultrasound Imaging Systems)<sup>9</sup>. The IPEM report 70 (Testing of Doppler Ultrasound Equipment) contains extensive information relating to performance testing of the pulsed and colour Doppler modalities of duplex scanners<sup>10</sup>.

Further general guidance is available in VLP part I section D2.1<sup>7</sup> and in the 'Guidelines for professional working standards: Ultrasound practice'<sup>11</sup>.

### **Set up procedures**

An appropriate probe should be selected. All duplex control settings should be set to defaults appropriate for a venous investigation. Equipment manufacturer will normally provide appropriate default venous settings. Detailed guidance on the appropriate control settings for venous scanning is given in the VLP part IV Duplex scanning for deep vein thrombosis section 4.2<sup>7</sup>.

## **Infection control**

There are no nationally agreed standards for vascular ultrasound scanning but local infection control policies should be in place and extensive guidance is given in the VLP part I section D1.2<sup>7</sup>. BMUS advises that users should refer to manufacturer's instructions for the cleaning and disinfection of probes and transducers and general care of equipment. It should be noted that ultrasound probes can be damaged by some cleaning agents and so manufacturer's specifications should always be followed. Sterile ultrasound gel and sheaths should be available and used in appropriate cases. Particular care should be taken around ulcers.

### **Accessory equipment:**

Examination couches and scanning stools must be of an appropriate safety standard and ergonomic design to prevent injury, particular consideration should be given to reducing the risk of operator work related musculoskeletal disorders.

## **PATIENT**

### **Information and consent**

There is no legal requirement that written patient consent be obtained prior to a venous duplex examination. However, patients should be fully informed about the nature and conduct of the examination so that they can give verbal consent. VLP IV Duplex scanning for deep vein thrombosis section 3.2<sup>7</sup> gives guidance on the explanation of the test. It is desirable that this information is provided in written format and is given prior to their attendance. This information should also be verbally explained to the patient when they attend for the investigation. Suggestions of additional information to include are given on:

- (i) [www.bmus.org/publications/pu-patientinfo.asp](http://www.bmus.org/publications/pu-patientinfo.asp)
- (ii) [www.rcr.ac.uk/docs/patients/worddocs/leafletus5.doc](http://www.rcr.ac.uk/docs/patients/worddocs/leafletus5.doc)

VLP part IV Duplex scanning for deep vein thrombosis section sections 3 and 3.1<sup>7</sup> gives further information. The Vascular Society and Circulation Foundation ([www.circulationfoundation.org.uk](http://www.circulationfoundation.org.uk)) have jointly produced leaflets which provide further information to patients.

### **Clinical history**

The written referral for the investigation should contain relevant clinical history. But this information should be verified and clarified for any discrepancies as explained in VLP part I section E.1<sup>7</sup>.

The nature and duration of symptoms should be established. Any history of lower extremity venous insufficiency, previous deep vein and/or superficial vein thrombosis, lower extremity trauma, venous ulcers and/or varicosities should be noted. Specific guidance for history taking for DVT investigations is given in VLP part IV Duplex scanning for deep vein thrombosis section 3.3<sup>7</sup>.

### **Preparation**

No specific preparation is required as explained in VLP part IV Duplex scanning for deep vein thrombosis sections 3 and 3.1<sup>7</sup>. Access will be required to the patient's leg or arm.

Compression stocking should be removed. Where appropriate any dressings should be removed.

This test involves using the probe to push onto the limb to compress the vein, and also squeezing the limb below the level of the probe. Careful explanation of this will aid compliance as pain is often felt at the site of thrombosis and compression can be uncomfortable or painful for the patient.

## **ENVIRONMENT**

A private room ( or curtained off area in a larger multiscan bay unit) is required to carry out the scan which should be darkened, with no natural light entry, and dimmer switch lighting. Air conditioning is required due to heat production from the scanning equipment. The ultrasound manufacturer should supply appropriate guidance on air conditioning requirements. A cold environment can cause veins to constrict making them difficult to image.

Further general guidance on the environment is given in the BMUS document<sup>8</sup>.

On occasion, assessment for DVT may also need to be carried out in other localities eg in theatre, theatre recovery or at the patient's bedside. These scans may be somewhat limited due to poor environmental conditions.

## **PROCEDURE**

The request will specify whether one or both legs should be scanned. The leg being scanned should be rotated slightly outwards and bent slightly at the knee. Ideally, the legs should be tilted downwards from the head by at least 30°. This helps to fill and distend the veins, making imaging easier. Popliteal and calf deep veins are often assessed with the patient sitting on the side of the couch and the leg extended and hanging over the side. DVT can cause intense pain in the leg and positioning may have to be altered to reduce discomfort. Care should be taken when using compression to assess fresh acute DVT to ensure thrombus is not dislodged.

Further guidance is given in VLP part IV Duplex scanning for deep vein thrombosis section 3.4<sup>7</sup>.

The ultrasound transducer (probe) is positioned on the leg. The transducer is manipulated to obtain images of the deep and superficial veins. At regular intervals down the limb, pressure is applied to the probe to compress transverse cross sectional images of the veins. This is the main technique for confirming vein patency. It is important that this is carried out in the transverse plane rather than longitudinal, as it is easy to slip to one side of the vein in longitudinal potentially giving a false impression of compressibility.

The colour and pulsed Doppler modalities are used to detect and assess venous flow.

Assessment of the impact on flow when the limb is squeezed distal to the site of the probe is important part of the investigation.

## **Protocol**

A local protocol should be set up in accordance with VLP part IV Duplex scanning for deep vein thrombosis section section 5<sup>7</sup> and agreed with referring clinicians. It is important to follow the sequence of events outlined in the protocol to avoid missing important information.

As a minimum, the examination should include assessment of the following veins: common femoral, proximal segment of the profunda, superficial femoral and popliteal. The saphenofemoral junction and long ( great) saphenous vein in the upper thigh should also be assessed. Thrombosed deep calf veins are a source propagating DVT and potential PE and should be assessed at the level of detail agreed with locally referring clinicians.

Assessment of the iliac veins should be included where there is suspicion of proximal obstruction as indicated by the referring clinician, the clinical history or where during the investigation, flow in the common femoral vein does not exhibit spontaneous phasic flow with respiration as seen using pulsed Doppler signal.

It is important that providers understand and take into consideration the protocol used by other local organisations. This will help reduce the repeat testing that often occurs when a patient is referred to another organisation.

### **Documentation**

It is recognised that ultrasound scanning is operator dependent and recording of images may not fully represent the entire examination. Recording of images should be done in accordance with a locally agreed protocol. Images that document the findings of the investigation are appropriate. Any stored images should have patient identification, examination date, organisation and department identification.

Further explanation and guidance is given in section 4 of the UKAS Guidelines<sup>11</sup>.

## **INTERPRETATION & REPORT**

### **Criteria**

This should be done in accordance with locally agreed criteria, but with reference to VLP part IV Duplex scanning for deep vein thrombosis section 6<sup>7</sup>.

The most important criteria for assessing vein patency is the compressibility of the vein. If the vein is patent and free of any thrombus, it should be possible to compress the vein completely with the anterior wall touching the posterior wall. The vein is incompletely compressible with a partially occlusive thrombus and is totally incompressible with a fully occlusive thrombus. In some areas, such as the distal thigh and the calf veins, the veins may lie too deep for compression to be used. In these areas, the colour and pulsed Doppler are the criteria that are used to confirm patency. Lack of phasicity or response to valsalva manoeuvre in the pulsed Doppler from the common femoral vein suggests obstruction proximal to the common femoral vein. Lack of colour filling upon manual compression in the calf veins indicates occlusion.

Other criteria used to confirm the presence of acute thrombus include visualisation of thrombus on B mode imaging, an increased diameter of the vein, increased flow in superficial veins or collaterals.

Criteria for chronic thrombosis are partial or non compressibility, collateral flow, recanalisation possibly with reflux and thickened wall. Old thrombus is more highly echogenic, but the age of thrombus is difficult to define using ultrasound.

VLP part IV Duplex scanning for deep vein thrombosis section section 6<sup>7</sup> gives detailed criteria.

### **Minimum report content**

There are no specific recommendations for the structure and content of reports for DVT scans. However, the report must specify whether the investigation was normal or abnormal. The site and extent of any thrombus should be stated. A note of the veins examined together with any technical limitations must be included. A tongue of thrombus that is poorly attached to the vessel wall is potentially very dangerous and, if detected, must be highlighted in the report and the referring clinician made aware immediately.

The report should also include any incidental findings that mimic the symptoms of DVT, such as thrombophlebitis, Bakers's cyst or tissue masses.

VLP part I E1, E2, and E3 and part IV Duplex scanning for deep vein thrombosis section 6<sup>7</sup> give further detailed guidance.

The report should be made available to the referring clinician on the day of the test. Any urgent findings, including a positive DVT, should be brought to the attention of the referring clinician immediately.

### **WORKFORCE**

It is well recognised that ultrasound diagnosis is highly operator-dependent, and it is essential that the workforce has the appropriate competencies and underpinning knowledge. This is achieved by ensuring the workforce has followed recognised education and training routes. This applies to both medically and non-medically qualified individuals.

#### **Education and training requirements**

All staff carrying out and reporting investigations should have successfully completed one of the following education and training routes:

- (i) Full SVT accreditation (AVS)  
([www.svtgbi.org.uk/Accreditation/Accreditation\\_Doc.pdf](http://www.svtgbi.org.uk/Accreditation/Accreditation_Doc.pdf))
- (ii) Post graduate qualification in ultrasound imaging from a Consortium for Accreditation of Sonographic Education (CASE) accredited course with successful completion of a vascular module which has included clinical competency in venous duplex scanning. A list of CASE accredited courses can be found at [www.case-uk.org](http://www.case-uk.org)
- (iii) Radiologists, medical and surgical staff should have successfully followed the RCR recommendations for training in vascular scanning to level 2 competencies in peripheral extremity veins ( Ultrasound training recommendations for medical and surgical specialties. BFCR(05)2 [www.rcr.ac.uk/docs/radiology/pdf/ultrasound.pdf](http://www.rcr.ac.uk/docs/radiology/pdf/ultrasound.pdf))

#### **Regulation**

It is important that both staff and employers are aware that although ultrasonography is not currently a regulated profession, there is a move towards statutory regulation of all healthcare science groups in the future. Current statutory or voluntary registration includes:

- (i) Registered on the SVT Voluntary Register
- (ii) UK Registered Physicians on the General Medical Council (GMC) Specialist Register
- (iii) Registered Clinical Scientist with Health Professions Council (HPC)
- (iv) Registered on the National Voluntary Register for Sonographers held by the Society & College of Radiographers (SCoR)

## **Maintaining competence**

It is important that scanning competence is maintained by all personnel performing this investigation either by performing a minimum number of scans each year or through a CPD scheme. Criteria for ensuring continuing competence are set by the professional bodies.

Details are available on:

- (i) [www.svtgbi.org.uk/Accreditation/Accreditation\\_Doc.pdf](http://www.svtgbi.org.uk/Accreditation/Accreditation_Doc.pdf)
- (ii) [www.rcr.ac.uk/docs/radiology/pdf/ultrasound.pdf](http://www.rcr.ac.uk/docs/radiology/pdf/ultrasound.pdf)
- (iii) [www.sor.org/public/educpd/cpd\\_policy.htm](http://www.sor.org/public/educpd/cpd_policy.htm)

## **Continuing Professional Development (CPD)**

Staff must undertake continuing professional development, to keep abreast of current techniques and developments, and to renew and extend their skills.

- (i) SVT accredited staff must maintain their accreditation by meeting the CPD requirements of the SVT. ([www.svtgbi.org.uk/Accreditation/Accreditation\\_Doc.pdf](http://www.svtgbi.org.uk/Accreditation/Accreditation_Doc.pdf))
- (ii) Staff with a post graduate qualification in ultrasound imaging should meet the CPD requirements of SCoR registration ([http://www.sor.org/public/ult/ult\\_search.php](http://www.sor.org/public/ult/ult_search.php)).
- (iii) Medical and surgical staff should follow the requirements outlined for maintenance of skills as well the need to include ultrasound in their ongoing CME. ([www.rcr.ac.uk/docs/radiology/pdf/ultrasound.pdf](http://www.rcr.ac.uk/docs/radiology/pdf/ultrasound.pdf))

## **AUDIT, SAFETY & QA**

### **Safety**

The provider should be aware of the guidelines for the safe use of ultrasound equipment produced by the Safety Group of BMUS. In particular, they should be aware of ultrasound safety precautions related to vascular scanning. These are outlined in VLP section D1.1<sup>7</sup>. All staff should be aware of local safety rules and resuscitation procedures.

Sonographers are at risk of work related musculoskeletal disorders. To minimise this risk the scanner and its control panel, the examination couch and scanning stool must be of appropriate safety standard and ergonomic design. Advice can found at:

[www.svtgbi.org.uk/Resources/Health\\_and\\_Safety/health\\_and\\_safety.html](http://www.svtgbi.org.uk/Resources/Health_and_Safety/health_and_safety.html)

A recently published document by the Society and College of Radiographers ( SCoR) 'Prevention of Work Related Musculoskeletal Disorders in Sonography'<sup>12</sup> gives clear guidance on this issue.

### **QA and Audit**

There are no specific requirements but a mechanism of audit/quality control to ensure patients continue to receive the expected level of diagnostic accuracy should be in place.

QA and audit programs should cover:

- Equipment performance
- Patient service
- Quality of investigation

VLP part I section D 2<sup>7</sup> gives guidance which covers all these areas. The BMUS document<sup>8</sup> and UKAS Guidelines<sup>11</sup> also give guidance. Equipment QA is covered in more detail in the equipment section of this document.

### **References:**

- <sup>1</sup> American College for Emergency Physicians. Clinical policy: critical issues in the evaluation and management of adult patients presenting with suspected lower-extremity deep venous thrombosis. Ann Emerg Med 2003; 42: 124-35.
- <sup>2</sup> Clinical Knowledge Summaries : Deep vein thrombosis. Newcastle upon Tyne: CKS; 2009.
- <sup>3</sup> British Committee for Standards in Haematology. Diagnosis of deep vein thrombosis in symptomatic outpatients and the potential for clinical assessment and D-dimer assays to reduce the need for diagnostic imaging. London: British Committee for Standards in Haematology; 2004.
- <sup>4</sup> Measurement of the clinical and cost-effectiveness of non-invasive diagnostic testing strategies for deep vein thrombosis. S Goodacre, F Sampson, M Stevenson, A Wailoo, A Sutton, S Thomas, T Locker and A Ryan. Health Technology Assessment 2006; Vol. 10: No. 15
- <sup>5</sup> 'Vascular Technology Performance Guidelines- Lower Extremity Venous Duplex Evaluation (for deep and superficial vein thrombosis)' Society for Vascular Ultrasound 2008.
- <sup>6</sup> 'Standards for Ultrasound Equipment' Royal College of Radiologists 2005
- <sup>7</sup> Vascular Laboratory Procedures published by the Institute of Physics in Engineering and Medicine on behalf of the Society of Vascular Technology for Great Britain and Ireland
- <sup>8</sup> 'Extending the provision of ultrasound services in the UK' BMUS 2003
- <sup>9</sup> 'Quality Assurance of Ultrasound Imaging Systems' IPEM report 102 2010
- <sup>10</sup> 'Testing of Doppler Ultrasound Equipment' IPEM report 70 1994
- <sup>11</sup> 'Guidelines for professional working standards - ultrasound practice' UKAS 2008
- <sup>12</sup> 'Prevention of Work Related Musculoskeletal Disorders in Sonography' Society and College of Radiographers 2007

### **Websites:**

[www.18weeks.nhs.uk](http://www.18weeks.nhs.uk)  
[www.rcr.ac.uk](http://www.rcr.ac.uk)  
[www.bmus.org](http://www.bmus.org)  
[www.svtgbi.org.uk](http://www.svtgbi.org.uk)  
[www.case-uk.org](http://www.case-uk.org)  
[www.ipem.ac.uk](http://www.ipem.ac.uk)  
[www.hpc-uk.org](http://www.hpc-uk.org)  
[www.rcplondon.ac.uk](http://www.rcplondon.ac.uk)  
[www.vascularsociety.org.uk](http://www.vascularsociety.org.uk)  
[www.circulationfoundation.org.uk](http://www.circulationfoundation.org.uk)  
[www.sor.org](http://www.sor.org)

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