THE SOCIETY FOR VASCULAR TECHNOLOGY OF GREAT BRITAIN AND IRELAND

Vascular Technology Professional Performance Guidelines

Upper and Lower Limb Venous Duplex Ultrasound Examination for the Assessment of Deep Vein Thrombosis (DVT)

Introduction

This guideline was prepared by the Professional Standards Committee (PSC) of the Society for Vascular Technology (SVT) as a template to aid the clinical vascular scientist/vascular sonographer and other interested parties. It can be used in conjunction with local protocols agreed between local sonography and vascular departments. It may be used in part or in its entirety with suitable additions made by local policy implementers, and should be read in combination with the following SVT guidelines when setting up a upper and lower limb venous DVT scanning service:

- Vascular Ultrasound Service Specifications[1]

In addition, the IPEM Society for Vascular Technology Professional Publications provide detailed indications for lower limb venous DVT Duplex investigations[2].

Suggestions for improvement of this guideline are welcome and should be sent to the Chair of the PSC – see www.svtgbi.org.uk for current chair details.

Purpose

Duplex ultrasound examination is used to assess the deep and superficial venous system of the upper and lower limb to determine the presence or absence of thrombosis.
There are many risk factors for DVT[3] such as previous DVT, obesity, Cancer, varicose veins, smoking etc.. with secondary risk factors such as recent surgery, trauma, immobility, chemotherapy, pregnancy, dehydration etc.. The listed risk factors are not exhaustive.

Common Indications:

Common indications for performance of this examination include:

- Swelling
- Pain
- Tenderness

- ? source of Pulmonary Embolism (PE)
- Palpable Cord
- Assessment before, after or during central line placement

Contraindications and Limitations:
Contraindications for upper and lower limb venous duplex ultrasound for the assessment of DVT are unlikely; however, some limitations exist and may include the following:

- Obesity
- Casts, dressings, open wounds etc. Can limit visualisation
- Severe oedema/swelling/pain
- Limited mobility
- Give an explanation of the procedure and it's duration – consideration should be made to the age and mental status of the patient
- Patient discomfort
- Bowel gas when examining the abdominal veins
- IV or catheters that limit visualisation of vessels
- Bone; A short segment of the subclavian vein cannot be examined as it passes under the clavicle

Patient Pathway
Duplex ultrasound 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 [4]. The screening tests have high negative predictive values, but low positive predictive values. If these tests are positive a Duplex scan should be carried out[5,6].

Patient Referral
The main indication for this investigation is suspicion of DVT. It is important to note that it is difficult to diagnose a DVT by clinical symptoms alone and that other conditions such as cellulitis and lymphoedema can give similar symptoms[5].

Clinical features include sudden unilateral swelling, acute pain and tenderness. Patients with a suspected recurrent DVT or thrombophlebitis may also require this test. It may be requested to investigate the source for PE where this would inform a change in patient management.

The major risk factors for DVT include recent surgery or trauma, immobility (including long-distance travel), coagulation disorders, malignancy, pregnancy, oral contraceptives and hormone replacement therapy. Serial or repeat scanning to investigate propagation of DVT and/or recanalisation of veins may also be requested.

The referral for the investigation should contain relevant clinical history. This information should be verified and clarified for any discrepancies. The nature and duration of symptoms should be established. Any history of lower extremity venous insufficiency, upper limb paresthesia, prominent veins in shoulder region, previous DVT and/or superficial vein thrombosis, lower limb venous ulcers and/or varicosities should be noted[7,8].

Patient Preparation:
No specific preparation is required [9]. Clothing may need to be removed to allow easy access to the patient's leg or arm. Where appropriate, compression stockings and any other dressings should be removed.

This test involves using the probe to apply pressure on 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.

Explanation of Examination:
The CVS undertaking the examination should:

- Introduce themselves
- Confirm the patient's identity e.g. full name and date of birth
- Explain why the examination is being performed and give an indication of the test's duration
- Obtain verbal consent for the examination
- Obtain a pertinent relevant medical history from the patient and/or notes
  - Presence of risk factors e.g. previous DVT, recent major surgery, active cancer, family history of DVT, oral contraceptive pill or hormone replacement therapy
  - Results of other relevant diagnostics
- Verify that the requested procedure correlates with the patient's clinical presentation

Examination:
The examination may be unilateral or bilateral dependent upon clinical symptoms and departmental policy. Due to the intimate nature of the examination it may be considered necessary to offer a chaperone[9]. During the examination the patient's mental and physical status should be monitored and modifications made to the examination accordingly.

B-mode should be used to image the vein and its contents; using compression of the vein in the transverse plane.
Spectral Doppler should be used to determine direction of flow and detect abnormal flow patterns
Colour Doppler should be used to detect filling defects as an aid to the B-mode procedure in the detection of thrombus; it is an essential requirement for the assessment of the abdominal veins.

For lower limb venous DVT examination:
The patient is asked to remove their clothing to expose the lower limb from groin to ankle. The patient is examined in the supine position with the leg externally rotated and the knee slightly flexed. The head and shoulders should be raised to encourage distension of the leg veins. The legs may be tilted downwards from the head by at least 30 degrees. This helps to fill and distend the veins, making imaging easier. DVT can cause intense pain in the leg and positioning may have to be altered to reduce discomfort.

Start the examination in the groin at the common femoral vein (CFV). The CFV should be examined to assess for: spontaneous flow, respiratory and cardiac modulation, augmentation, compressibility, colour filling. The B-mode image should be examined to assess for the presence of echoes within the vein. 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 wave Doppler signal. An iliac vein assessment may also be required if the patient is under investigation for May Thurner syndrome. This condition even when present can be asymptomatic.

Continue to examine the lower limb veins distally examining the length of the femoral vein (FV) [11], the proximal profunda femoris vein, the popliteal vein (ensuring the whole length is visualised including the adductor region). Assessment of the calf veins remains controversial [11], but thrombosed deep calf veins are a course of propagating DVT and potential PE and should be assessed at the level of detail agreed with locally referring clinicians. The calf veins (soleal veins, gastrocnemius veins,

posterior tibial veins and peroneal veins) may be performed either with the patient supine or sitting up, although sitting the patient up with legs dependent may help fill the veins and make imaging easier.

Although not routinely examined the anterior tibial veins (ATV), greater saphenous vein (GSV) and small saphenous vein (SSV) may be examined if pain is localised to this area [11,13].

For upper limb venous DVT examination:
The patient is asked to remove their clothing to expose the upper limb and shoulder area. B-mode should be used to image the vein with and without compression. Incomplete compression of the vein indicates possible thrombus. It is also important to determine the occlusive nature of the thrombus using B-mode in conjunction with colour flow. Spectral Doppler should be used specifically within the subclavian vein to assess the waveform (i.e. whether it is phasic in nature). It is good practice to compare this with the other side when phasic flow is absent, even in a unilateral scan as venous flow differs widely from patient. In order to augment the phasic nature of flow it may be necessary to ask the patient to exaggerate their breathing. Continuous flow in the subclavian vein can be an indicator of more proximal occlusion. Colour Doppler should be used to assess for the presence/absence of flow in any areas where compression is not possible or incomplete. Squeezing of the hand/forearm can be performed to augment flow and identify occlusive/non-occlusive thrombus.

Evaluation of the following veins could be included:

- Internal jugular vein
- Brachiocephalic vein
- Subclavian, axillary, brachial, radial and ulnar veins
- Basilic vein
- Cephalic vein
- Median cubital veins

Any other superficial or connecting veins

For both upper limb and lower limb DVT assessment:

- Care should be taken when using compression to assess fresh acute DVT to ensure thrombus is not dislodged.
- If thrombus is identified the extent of the thrombus should be quantified making reference to the anatomical position of the thrombus with reference to anatomical landmark e.g. from medial femoral condyle; whether it is occlusive, non-occlusive or free-floating. B-mode can be used to evaluate if thrombus is acute or chronic, from its echogenicity, attachment and vein dilation, however, it is not always possible to differentiate between acute and chronic thrombus.

Reporting:
The report is a recording and interpretation of observations made during the upper and lower limb venous duplex examination; it should be written by the CVS undertaking the examination and viewed as an integral part of the whole examination [13].

The report should include correct patient demographics; date of examination; examination type and the name and status of the CVS.

The reporting should include:

- The presence/absence of phasic flow in the proximal veins.
- Which veins have been assessed & record the presence/absence of thrombus.
- Where thrombus is identified, the location, length/extent, degree of patency should be documented and where it can be documented whether thrombus is acute or chronic.

- Any limitations encountered during the examination.
- An appropriate number of annotated images that represent the entire ultrasound examination – in accordance with local protocols and SVT Image Storage Guidelines [14].

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 urgently.

The report should also include any incidental findings that mimic the symptoms of DVT, any differential diagnoses should be reported according to the sonographers training, competency and local requirements (e.g. Baker's cyst)

Ensure appropriate referral of critical ultrasound results to the referring consultant are made prior to the patient being discharged so treatment plans can be enforced or expedited accordingly.

Resources:

Society for Vascular Ultrasound Vascular Technology Professional Performance Guidelines Lower Extremity Venous Duplex Evaluation www.svunet.org

References:

[1] Society for Vascular Technology Service specification document www.svtgbi.org.uk

[2] Vascular Laboratory Practice Part IV (Lower Limb Venous Assessment). Cole, S.Waler, R. and Norris, R. 2001.IPEM.

[3] Nice Guideline: Venous thromboembolic diseases: the management of venous thromboembolic diseases and the role of thrombophilia testing

[4] Nice Guideline: Venous thromboembolic diseases: the management of venous thromboembolic diseases and the role of thrombophilia testing
http://ww.nice.org.uk/guidance/CG144

[5] 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

[6] 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.

[7] Deep Venous Thrombosis (DVT) Differential Diagnoses. Kaushal. K, Patel. M, Brenner. B. Emergency Medicine. 2017: 543-763.

[8] Vascular Technology Professional Performance Guidelines: Venous lower Limb Reflux Duplex Ultrasound Examination. www.svtgbi.org.uk

[9] Standards for the Provision of an ultrasound service. Royal College of Radiologists 2005
www.rcr.ac.uk/docs/radiology/pdf/StandardsforUltrasoundEquipmentJan2005.pdf

[10] Society for Vascular Technology Professional Standards Committee Chaperone Guidelines
www.svtgbi.org.uk

[11] Nomenclature of the veins of the lower limbs: an international interdisciplinary consensus statement. Caggiati, A. Bergan, JJ.Gloviczki, P.Jantet, G. Wendell-Smith, CP. J Vasc Surg 2002; 36: 416-11.

[12] Systemic review and meta-analysis of the diagnostic accuracy of ultrasonography for deep vein thrombosis. Goodacre, S. Sampson, F. Thomas, F. Van Beek, E and Sutton, A. British Medical Council Medical Imaging.2006: 5 (6): 1-168.

[13] Guidelines on the investigation and management of venous thrombosis at unusual sites. Campbell T, Baglin C, Watson H, Laffan M, Makris M, Perry D, Keeling D. British Journal of Haematology, 2012, 159, 28-38

[14] Society for Vascular Technology Professional Standards Committee Image Storage Guideline http://www.svtgbi.org.uk/professional-issues/

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