**Introduction**

This protocol was prepared by the Senior Vascular Physiologist. The SVT guidelines were used in conjunction with our current lab practices.

An upper limb deep venous duplex scan is performed to assess the deep and superficial venous system of the upper limbs to determine the presence or absence of thrombus.

**Common Indications**

1. Pain
2. Swelling
3. Tenderness
4. Known pulmonary embolism (PE).
5. Clinically diagnosed upper limb thrombophlebitis post PICC Line insertion

**Limitations**

1. Casts, dressings, open wounds which will limit visualisation
2. Obesity
3. Limited mobility i.e., unable to externally rotate or move upper limb
4. Patients with severe oedema and upper limb swelling
5. Patients with reduced cognitive function who are unable to follow instruction
6. Patient discomfort

**Patient Referral**

The referral should include details of the presenting symptoms.

**Patient Preparation**

No preparation is required. The examination should be fully explained to the patient and consent obtained. Patient name and date of birth must be confirmed. Relevant medical history should be taken prior to the examination. Such as:

* Presence of risk factors eg previous DVT, recent major surgery, active cancer, family history of DVT, oral contraceptive pill or hormone replacement therapy
* PICC Line insertion
* Nature of patients symptoms, i.e., specific area of pain
* Results of other relevant diagnostics

The Vascular Physiologist should complete a limited visual examination of the upper limb, cannula/PICC line sites and skin discolouration prior to conducting the ultrasound examination.

**Examination**

The examination may be unilateral or bilateral depending on clinical symptoms and consultant referral. The examination is performed in the supine position. The patient will be asked to remove upper limb clothing. A disposable gown may be placed over the patient’s torso in order to maintain patient dignity at all times.

1. Patient is examined in the supine position with the arm externally rotated on a pillow to allow for medial access.
2. Apply ultrasound gel to the correct linear array transducer and select the venous programme on the Ultrasound machine. A combination of the 8 MHz and the 18 MHz probes may be necessary.
3. Select the venous programme on the Ultrasound Machine.
4. There will be constant adjustment of the different functions on the control panel throughout the exam to ensure optimal imaging eg., depth, focus, gain, TGC, sample volume size, colour box, colour scale etc.

**Upper Limb Deep Veins**

1. In the transverse plane in B-mode begin at the clavicle, instructing the patient to turn his/her head in the opposite direction. Locate the Infraclavicular Portion of the Subclavian Vein inferior to the shadowing from the Clavicle Bone.
2. Rotate the transducer into the longitudinal plane and assess the Infraclavicular Portion of the Subclavian Vein for patency. Using Colour Doppler demonstrate normal or abnormal colour filling.
3. Using Spectral Doppler observe if phasic spontaneous flow is present, without angle correction. If continuous or abnormal flow is demonstrated within the Subclavian Vein this may be due to proximal venous obstruction and as such must be documented in the report with a recommendation for further imaging if clinically indicated.
4. Repeat steps 5 and 6, interrogating the entire vessel to confirm or out rule the presence of thrombus. Note: Never compress the Subclavian vein. If thrombus is located within the Subclavian Vein document the upper extent of the thrombus in centimetres inferior to the clavicle bone. If the upper extent of the thrombus cannot be identified record this in the report and recommend alternative imaging such as a CT Venogram.
5. In longitudinal B Mode locate the Axillary vein where it drains the Subclavian vein.
6. Using Colour Doppler demonstrate normal or abnormal colour filling.
7. Using Spectral Doppler observe if phasic spontaneous flow is present, without angle correction.
8. Rotating the transducer into transverse, the axillary vein should be compressed in 1 cm intervals from above the axilla to below the axilla to definitely out-rule thrombus. Care should be taken when compressing the vein or assessing for echolucent acute thrombus, to ensure the thrombus is not dislodged
9. In Transverse B Mode identify the Brachial deep Veins accompanying the Brachial artery.
10. Using Colour Doppler demonstrate normal or abnormal colour filling. Augmentation of the lower arm may be necessary.
11. Using Spectral Doppler observe if phasic spontaneous flow is present, without angle correction. Instruct the patient to take a deep breath and hold it in. Normal upper limb venous haemodynamics with respiration demonstrate increased flow on inspiration and absence of flow on the Doppler spectrum on exhale. Freeze the image and save it.
12. Rotating the transducer into transverse, the brachial veins should be compressed in 1 cm intervals from below the axilla to the site where the brachial artery bifurcates (usually below the antecubital fossa) to definitively out-rule thrombus. Care should be taken when compressing the vein or assessing for echolucent acute thrombus, to ensure thrombus is not dislodged
13. In Transverse B Mode identify the radial and ulnar deep Veins and their accompanying arteries.
14. Most upper limb venous examinations only require examination down to below the ACF. However on occasion there can be clinical suspicion of thrombosis within the forearm deep veins. If so the radial and ulnar veins should be examined using transverse compression throughout with some longitudinal plane images taken also.

**Upper Limb Superficial Veins**

1. In transverse and B Mode identify the Cephalic vein at the wrist
2. Using mild external pressure compress the vein to confirm patency.
3. In transverse and B Mode using the dual imaging function compress the Cephalic vein every 1cm from the wrist to the shoulder to outrule the presence of thrombus. Assess the vein for any evidence of dilation which may be indicative of acute thrombus. Take particular care at previous cannula sites which may be a source of thrombus.
4. Follow the cephalic vein to the site where it drains the infraclavicular Subclavian Vein.
5. Rotate the transducer into Longitudinal and using Colour Doppler demonstrate normal or abnormal colour filling. Careful use of both colour scale and colour gain is required to ensure overflow of colour of the vessel wall does not occur as this may disguise the presence of thrombus.
6. Using Spectral Doppler observe if phasic spontaneous flow is present, without angle correction. Freeze the image and save it.
7. In the presence of thrombus document if thrombus extends from the superficial cephalic vein into the deep Subclavian vein. Record and measure the length of thrombus extending into the deep vein using the callipers. Document if thrombus is occlusive, non-occlusive acute or chronic.
8. In transverse and B Mode identify the basilic vein in the medial aspect of the upper arm. Slide the transducer down the length of the vein from the upper arm to the lower forearm, assessing it for patency or the presence of thrombus
9. Using the dual imaging function compress the Basilic vein every 1cm, from the upper arm to the lower forearm to outrule the presence of thrombus. Assess the vein for any evidence of dilation which may be indicative of acute thrombus. Take particular care at previous or current PICC Line sites which may be a source of thrombus. Thrombus may be evident within the lumen of the vein surrounding the PICC Line.
10. Using mild external pressure compress the Basilic vein to confirm patency.
11. In Longitudinal identify where the Basilic vein drains the Axillary vein in the upper arm. In the presence of thrombus document if thrombus extends from the superficial Basilic vein into the deep Axillary vein. Record and measure the length of thrombus extending into the deep vein using the callipers. Document if thrombus is occlusive, non-occlusive acute or chronic.
12. Assess the median cubital vein (a connecting vein between the basilic and cephalic vein) and other unnamed superficial veins of the upper arm for potential sources of thrombus.

**Interpretation**:

If thrombus is identified anatomical landmarks can be used to identify where the thrombus begins and the upper extent of the thrombus. If the upper extent of the thrombus cannot be visualised due to limitations as a result of shadowing from the clavicle bone for example this must be documented in the report and alternative imaging recommended. B Mode can be used to evaluate if thrombus is acute or chronic from its echogenicity, attachment and vein dilation. Free floating thrombus tails exhibit a side to side waving motion within the lumen of the vessel.

**Reporting**

The report is a recording and interpretation of observations made during the assessment. It should be written by the Vascular Physiologist who performed the exam**.**

The Non-Invasive Vascular Unit has a standardised reporting system for each examination so that all Vascular Physiologists and clinicians alike can understand the report.

The report should include:

* Patient name, Medical Record Number, Date of examination, examination type, Vascular Physiologists initials.
* The presence/absence of phasic flow within the deep veins
* Which veins have been assessed, their patency or presence of thrombus
* Where thrombus is identified, the anatomical location, length, extent, degree of patency and if the thrombus is acute or chronic
* Any anatomical variations
* Any limitations encountered during the examination
* Recommendations for further imaging in the event of a limited examination
* Any incidental findings for example such as enlarged lymph nodes, abscesses, cysts, interstitial fluid, lipomas and arteriovenous malformations
* An appropriate amount of annotated images that represent the entire ultrasound examination in accordance with department protocol