Vascular Technology Professional Performance Guidelines

Duplex Ultrasound Examination
Prior to Native Arterio-Venous Fistula Formation: Upper Limb.

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 & other interested parties. This guideline may be used in part or in its entirety with suitable additions made by local policy implementers. 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 is used to assess the suitability of certain upper limb arteries & veins prior to surgical arterio-venous fistula (AVF) formation for haemodialysis.

Common Indications

Common indications for performing this examination include:

- end stage renal failure
- previously failed AVF

Contraindications & Limits

Contraindications and limits for pre AVF examinations are uncommon. However, some exist & include:

- obesity
- dressings, open wounds etc.
- patients who are unable to cooperate due to impaired cognition (e.g. dementia) or through involuntary movements
- excessive dehydration
- acoustic shadowing from calcified arteries

Equipment
Duplex Doppler ultrasound machine with imaging frequencies of 3.5MHz & greater; with both linear and curvilinear transducers available. Doppler frequencies of at least 5.0MHz should be available, with colour Doppler capability.
Compliance with the Medical Devices Directive is necessary. Electrical safety testing is required annually, with regular maintenance & quality assurance testing to specified level by qualified personnel. Review of in-service equipment should typically be undertaken four to six years after installation[1].
Examination couch should be height adjustable preferably electrical. The CVS's chair should provide good lumbar support, be height adjustable and allow for the CVS to move close to the examination couch[2,3].
The examination room should be temperature controlled with adjustable lighting levels suitable for the examination[6].

Explanation of Examination & Patient History
The CVS undertaking the examination should:

- introduce themselves
- confirm the patient's identity, e.g. full name & date of birth
- explain why the examination is being performed, the procedure and it's duration (consideration should be made to the age & mental status of the patient)
- obtain verbal consent for the examination
- obtain a relevant medical history from the patient & / or notes, including;
    - presence of risk factors
        - Impaired renal function
        - Diabetes
        - surgery to the limb
        - Previous thrombophlebitis & / or deep vein thrombus
        - Hypercoagulability
    - results of other relevant diagnostic tests & previous vascular studies
- complete a limited physical examination, observing the presence of any signs, previous surgery or vascular injury
- verify the requested procedure correlates with the patient's clinical requirements.

Examination
The examination may be unilateral or bilateral depending on clinical symptoms & department policy.
The patient is asked to remove their clothing to expose the upper limb. The patient is examined in the supine position, head & shoulders can be raised. The limb to be examined may be abducted to approximately 90 degrees & the arm rested on the CVS's lap/pillow. To negate the need to over stretch, the examination couch may be rotated to allow easy access to either side of the body.
Due to intimate nature of the examination it maybe considered necessary to offer a chaperone[4]

During the examination the patient's mental & physical status should be monitored and modifications made to the examination accordingly.

The following techniques should be used to evaluate the upper limb veins:

- B-mode
  - ✓ Should be used to image veins & their contents, compressing the vein in the transverse plane.
  - ✓ Should be used to image veins & arteries to measure calibre. Depth may also be measured as per local protocol.
- Spectral Doppler should be used to determine direction of flow & detect abnormal flow patterns
- Colour Doppler
  - ✓ May be used to detect thrombus in the veins as an aid to the B-mode procedure
  - ✓ Should be used to assess for the presence/absence of flow & aid the position of spectral Doppler when quantifying stenoses in arteries

The following vessels should be assessed:

- Brachiocephalic vein
- Internal jugular vein
- Subclavian vein
- Axillary vein
- Brachial veins
- Radial veins
- Ulnar veins
- Cephalic vein
- Basilic vein

- Subclavian artery
- Axillary artery
- Brachial artery
- Radial artery
- Ulnar artery

The following internal arterial and venous diameters are generally considered the minimum suitable for forming a native fistula[5]:

- Cephalic & basilic veins >2.5 ± tourniquet
- Radial artery >1.6mm

If vein diameters are borderline suitable, a tourniquet can be used at the forearm to assess the cephalic vein at the wrist, or at the axilla to assess cephalic and basilic veins above the elbow[5].

Reporting

The report is a record of observations & interpretations made during the pre-fistula duplex ultrasound examination. It should be written by the CVS undertaking the examination & viewed as integral to the whole examination[6].

The report should include:

- correct patient demographics; examination type & date; name & status of the CVS
- which limb was examined
- which vessels have been assessed, their patency, flow characteristics, calibre, use of tourniquet and the location the recordings were made
- any variation from the typical anatomy (e.g. tortuosity)
- a note of any prominent tributaries that may divert flow from a fistula
- which vessels have been pre-op. marked (if done)
- the reason for the unsuitability of a vessel for a fistula (e.g. thrombus, calcification)
- anything limiting the examination
- an impression of which vessels are suitable for a fistula, based on local protocols
- an appropriate number of annotated images that represent the entire ultrasound examination, in accordance with local protocols and SVT Image Storage Guidelines[6].

Referral of urgent results should be made to the referring consultant & / or appropriate medical / surgical team as per local protocol, so treatment plans can be developed, enforced or expedited accordingly.

RESOURCES

Society for Vascular Ultrasound Vascular Technology Professional Performance Guidelines Upper Extremity Vein Mapping for Creation of a Dialysis Access or Peripheral Vascular Bypass Graft 2013 www.svunet.org – member only

American Institute of Ultrasound in Medicine Practice Guideline for the Performance of Ultrasound Vascular Mapping for Preoperative Planning of Dialysis Access 2011 www.aium.org

Freedman B, Deane C. Ultrasound in Haemodialysis Access. *Ultrasound* (2005) 13:2 86-92

REFERENCES

[1] Standards for Ultrasound Equipment Royal College of Radiologists, February 2005 www.rcr.ac.uk

[2] Guidelines for Professional Working Standards Ultrasound Practice United Kingdom Association of Sonographers (UKAS) October 2008 www.sor.org/learning/document-library

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

[4] Society for Vascular Technology Professional Standards Committee Chaperone Guidelines April 2012 www.svtgbi.org.uk

[5] Ferring M, Henderson J, Wilmink A, Smith S. Vascular ultrasound for the pre-operative evaluation prior to arteriovenous fistula formation for haemodialysis: review of the evidence. *Nephrology Dialysis Transplant* (2008) 23: 1809-1815

[6] Society for Vascular Technology Professional Standards Committee Image Storage Guideline April 2012 www.svtgbi.org.uk