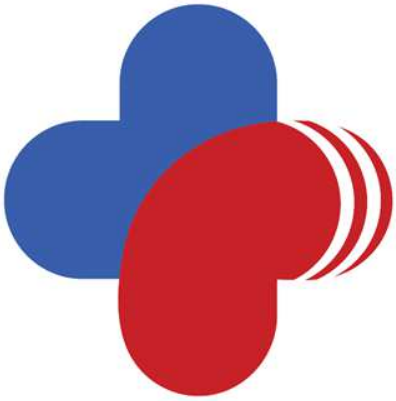

THE SOCIETY FOR VASCULAR TECHNOLOGY OF GREAT BRITAIN AND IRELAND

Vascular Technology Professional Performance Guidelines

Duplex Ultrasound Examination Prior to Native Arterio-Venous Fistula (AVF) 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 sonographers and other interested parties. It can be used in conjunction with local protocols agreed between sonography, renal and / or vascular departments. It may be used in part or in its entirety with suitable additions made by local policy implementors, and should be read in combination with the following SVT guidelines when setting up a fistula scanning service:

- Vascular Ultrasound Service Specifications[7]
- Native Arterio-Venous Fistula Duplex Ultrasound Examination: Upper Limb[8]
- Duplex Ultrasound Assessment of Prosthetic Arterio-Venous Dialysis Grafts (AVG.)[9]

Suggestions for improving this guideline are welcomed, and should be sent to the Chair of the PSC; see www.svtgbi.org.uk for current Chair details.

Purpose

Access to the vascular system is essential in patients with renal failure, in whom haemodialysis (HD) is required. Duplex ultrasound is used to assess the suitability of certain upper limb arteries and veins prior to AVF formation for HD.

The best form of access is a surgically created autogenous AVF, where an anastomosis is created between an artery and a vein. Sometimes a synthetic graft joins the artery and vein.

The fistula allows for high pressure blood flow in an easily accessible vessel (vein or graft), which is ideal for the repeated needle punctures required to divert blood to a dialysis machine. An AVF is usually created in an arm, and more rarely in a leg, and takes time to ‘mature’ as the ‘arterialised’ draining vein enlarges in response to increased flow. Typically, this takes about two months.

Common Indications
Common indications for performing this examination include:

- end stage renal failure
- previously failed AVF

Contraindications and Limits
Contraindications and limits for pre AVF examinations 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

Patient Pathway
These investigations apply to renal patient pathways, and in particular to patients who are approaching end stage renal failure, require renal replacement therapy and have chosen HD. This assessment will also apply to patients already on HD for whom current access is failing, to patients switching from peritoneal dialysis and to patients whose renal transplants have failed and need to commence HD. Since an autogenous AVF is the preferred access method HD, and that one typically takes two months to 'mature', it is important preoperative assessments and surgery are planned and take place as early as possible.

Further detailed guidance is given in a report jointly produced by The Renal Association, The Vascular Society and The British Society of Interventional Radiology.[1]

Patient Referral
The joint working group report[1] provides guidance on preoperative assessment and recommends units have in place a policy to ensure assessments do not delay surgery. Scans are indicated when surgery is considered. Ideally, all patients undergoing fistula surgery should have pre AVF assessment scans, but this is not mandatory. It may be requested in patients with poor calibre veins on clinical examination alone. The referral should include relevant clinical history: *e.g.* details of any previous fistula, central venous catheterisation or limb trauma,[3] and which hand is dominant. The Society for Vascular Ultrasound (SVU) publication[4] provides detailed information.

Patient Preparation
No specific preparation is required for either the pre or post AVF assessments. Ideally, these scans should be performed prior to dialysis. Access to the patient's limb will be required. The patient may sit or lie, but it is important to ensure veins are filled adequately.

Examination
The examination may be unilateral or bilateral depending on clinical symptoms and department policy. The patient is asked to remove their clothing to expose the upper limb. The patient is examined supine; head and shoulders can be raised. The limb to be examined may be abducted to approximately 90 degrees and the arm rested on a 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.

B-mode should be used to measure vessels in transverse and image their contents (*e.g.* plaque), and compress veins to assess for thrombus. Depth may also be measured as per local protocol.

Spectral Doppler should be used to determine direction of flow and detect abnormal flow patterns. Colour Doppler should be used to assess for the presence or absence of flow and aid the position of spectral Doppler when quantifying stenoses.

The brachiocephalic, internal jugular, subclavian, axillary and brachial veins should be assessed for patency. The diameters and depth of the cephalic and basilic veins should be measured along their course and patency confirmed. The subclavian, axillary, brachial, radial and ulnar arteries should be assessed, and any narrowing or calcification documented. Any high origin of the radial and ulnar arteries above the elbow, and the position of the axillay or brachial artery bifurcation, should be noted. Prominent tributaries, tortuosity, reasons for a vessel's unsuitability and the best location for a fistula should be recorded.

The diameter and depth of the cephalic or basilic vein at the proposed site of the vascular access are the main factors that determine whether or not a vessel is suitable for a fistula. However there are no nationally agreed minimum vein and artery diameters: these should be agreed locally with the vascular access surgeons. The following internal arterial and venous diameters are generally considered the minimum suitable for forming a native fistula.[5]

- cephalic and basilic veins >2.5mm ± 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] The veins (deep and superficial) must be free from thrombus. The arteries should be free from flow limiting stenoses. This is usually indicated by triphasic flow patterns with no focal increase in peak systolic velocity (PSV).

Ultrasound scanning is operator dependent and recorded images may not fully represent the entire examination. Images should be recorded in accordance with a locally agreed protocol. It is important to follow the sequence of events outlined in the protocol to avoid missing important information. It is appropriate to record images that show the investigation's results. Any stored images should display patient information, examination date and the organisation or department. Further explanation and guidance is given in section four of the UKAS Guideline[6] and SVT image storage guidelines.[2]

Reporting

For generic information regarding reports and their content, see the SVT Vascular Ultrasound Service Specification document.

The report should include:

- correct patient demographics; examination type and date; name and status of the CVS
- which limb was examined
- the vessels assessed, their patency and calibre
- flow characteristics
- use of tourniquet
- 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-operatively 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 representing the entire ultrasound examination, in accordance with local protocols and SVT Image Storage Guidelines.[2]

References

[1] The Organisation and Delivery of the Vascular Access Service for Maintenance Haemodialysis Patients; August 2006 Joint Working Party The Renal Association Vascular Society Great Britain and Ireland British Society of Interventional Radiology http://www.renal.org/docs/default-source/what-we-do/HD_Vascular_Access_Working_Party_Report_2006.pdf?sfvrsn=0

[2] SVT Guidance on Image Storage and use, for the vascular ultrasound scans 2012 http://www.svtgbi.org.uk/professional-issues/

[3] SVU Professional performance guidelines Vascular Technology. Upper Extremity Vein Mapping for placement of Dialysis Access 2009 http://www.svunet.org/practicemanagementmain/professionalperformanceguidelines

[4] SVU Professional performance guidelines Vascular Technology. Evaluation for Dialysis Access 2012. http://www.svunet.org/practicemanagementmain/professionalperformanceguidelines

[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: 1809-15

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

[7] Vascular Ultrasound Service Specifications. www.svtgbi.org.uk

[8] Native Arterio-Venous Fistula Duplex Ultrasound Examination: Upper Limb www.svtgbi.org.uk

[9] Duplex Ultrasound Assessment of Prosthetic Arterio-Venous Dialysis Grafts (AVG.) www.svtgbi.org.uk

Other Resources

Society for Vascular Ultrasound; Vascular Technology Professional Performance Guidelines; Upper Limb Extremity Vein Mapping for Creation of a Dialysis Access or Peripheral Vascular Bypass Graft 2012. www.svunet.org

Society for Vascular Ultrasound Vascular Technology Professional Performance Guidelines Lower Limb Extremity Venous Duplex Evaluation 2011 www.svunet.org

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

American Institute of Ultrasound in Medicine Practice Guideline for the Performance of Peripheral Venous Ultrasound Examinations 2010 www.aium.org

Australasian Society for Ultrasound in Medicine Policies and Statements D20 Peripheral Venous Ultrasound 2007 www.asum.com.au

M. E. Lockhart et al. Cephalic vein measurement before fore arm fistula creation; does use of a tourniquet to meet the venous diameter threshold increase the number of useable fistulas? J. Ultrasound Med. 2006; 25:1541 - 45

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

SVT Professional Standards Committee October 2018

Review : October 2021