



THE SOCIETY FOR
VASCULAR TECHNOLOGY OF
GREAT BRITAIN AND IRELAND

Vascular Technology Professional Performance Guidelines

Duplex Ultrasound Examination Pre- creation of Dialysis Arterio-Venous Fistulas (AVF) and Arterio-Venous Grafts (AVG)

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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.

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 with 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 guideline when setting up a fistula ultrasound assessment service:

- Vascular Ultrasound Service Specifications¹

In addition, the SVU publications ^{2 3 4} provide further detailed guidance in relation to assessment prior to creation of fistulas.

Suggestions for improving this guideline are welcome 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. The ideal form of access is a surgically created autogenous arterio-venous fistula (AVF), where an anastomosis is created between an artery and a vein. Sometimes a synthetic graft joins the artery and vein to create an arterio-venous dialysis graft (AVG).

This allows for high volumes of 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. The majority of AVFs and AVGs are created in the upper limb, however if all upper limb options are exhausted, the thigh or abdomen may be utilised. The new conduit takes time to “mature” as the “arterialised” draining vein enlarges in response to increased flow. Typically, this takes about two months.

Duplex ultrasound is used to assess the suitability of upper or lower limb arteries and veins prior to and post AVF or AVG formation for HD.

Common Indications

Common indications for performing these examinations include:

- end stage renal failure
- planning for dialysis access

Contraindications and Limits

Contraindications and limits for pre AVF examinations include:

- Obesity
- Dressings, open wounds etc
- Patients who are unable to co-operate due to impaired cognition (e.g. dementia) or through involuntary movements
- Excessive dehydration
- Acoustic shadowing from calcified arteries
- Previous phlebitis/scarred veins
- Previously failed fistulae in the same arm
- Presence of a cannula/line may negatively impact image quality

Patient Pathways

Pre-access assessments apply to renal patients who are approaching end stage renal failure, those switching from peritoneal dialysis and those for whom current access is failing. Since an autogenous AVF is the preferred access method for HD, and takes

typically two months to “mature”, it is important that pre-operative 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 Radiology⁵.

Patient Referral

The joint working group report⁵ provides guidance on pre-operative assessment and recommends departments have in place a policy to ensure assessments do not delay surgery. Scans are indicated when surgery is considered and ideally, all patients undergoing fistula surgery should have a pre AVF assessment scan. It may also 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 trauma³, and may specify which arm to assess (although this may be dependent on whether bilateral assessment is normal local practice). Where access is not anticipated to be possible in either arm, a referral may request assessment of proximal leg vessels to inform future creation of a leg loop.

Patient Preparation

No specific preparation is required although access to the relevant limb will be required. The patient may sit or lie, but it is important to ensure veins are filled adequately for the pre AVF assessments.

If an open wound is present, sterile gel⁶ and a probe cover should be used. Use of a clear dressing or sterile pad may be helpful.

Due to the intimate nature of the examination it may be necessary to offer a chaperone⁷.

Examination

The examination may be unilateral or bilateral depending on clinical relevance and departmental policy. Bilateral assessment is advised, particularly for patients who do not have a suitable cephalic vein in their non-dominant arm.

The patient is asked to remove their clothing to expose the relevant limb(s) and ideally be examined supine for assessing central veins. The head and shoulders can be raised to allow filling of more distal arm veins and the arms may be abducted to nearly 90 degrees and rested on a lap or pillow. To avoid stretching, the examination couch may be rotated to allow easy access to either side of the body. Where it is necessary to assess the lower limb, the knee of the leg to be examined can be bent slightly and thigh abducted.

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

Venous

Patency of the proximal deep veins should be assessed (brachiocephalic, internal jugular, subclavian, axillary and brachial veins). The diameters/depth of the cephalic and basilic veins should be measured along their course, their patency confirmed, as well as assessment of continuity back to the deep veins. Prominent tributaries, tortuosity, reasons for a vessel's unsuitability and ideal locations for a fistula may also be recorded.

Arterial

The subclavian, axillary, brachial, radial and ulnar arteries should be assessed, and any narrowing or calcification documented. Any anatomical variants should be noted (e.g. high origin of the radial and ulnar arteries), and it may be helpful to note the position of the axillary or brachial artery bifurcations. Colour Doppler should be used to assess for the presence or absence of flow and aid the position of spectral Doppler when quantifying stenoses. Spectral Doppler should be used to determine direction of flow and detect abnormal flow patterns.

Suitability of veins and arteries for a successful fistula

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 a vessel is suitable for a fistula (AVF). 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 diameter are generally considered the minimum suitable for forming a native fistula ⁸.

- Cephalic and basilica 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 ⁸. The veins (deep and superficial) must be free from thrombus. The arteries should be free from flow limiting stenosis. This is usually indicated by triphasic flow patterns with no focal increase in peak systolic velocity (PSV).

The following internal arterial and venous diameter are generally considered the minimum suitable for forming prosthetic AVGs:

- vein with a diameter of at least 4.0mm is required, ^{9 10}
- minimum arterial diameter of 2.0mm.¹⁰

General considerations

Ultrasound scanning is operator dependent and recorded images may not fully represent the entire examination. It is important to follow the sequence of events outlined in the protocol to avoid missing important information and images should be recorded in accordance with this locally agreed protocol. Any stored images should

display patient information, examination date and the organisation or department. Further explanation and guidance is given in professional guidance documents ^{11 12}.

Reporting

For generic information regarding reports and their content, see the SVT Vascular Ultrasound Service Specification document ¹.

The report should include:

- Correct patient demographics; examination type and date; name and status of the CVS
- Which limbs were examined
- The vessels assessed, their patency, calibre and depth, as appropriate
- Flow characteristics
- Use of tourniquet
- Any variation from the typical anatomy (e.g. tortuosity)
- Anything limiting the examination

Based on local referrer requirements, the report may additionally include the following details:

- A note of any prominent tributaries that may divert flow from a fistula/graft
- Which vessels have been pre-operatively marked (if done)
- The reason for the unsuitability of a vessel for a fistula (e.g. thrombus, calcification)
- An impression of which vessels are suitable for a fistula, based on local protocols

There should be an appropriate number of annotated images representing the entire ultrasound examination, in accordance with local protocols and SVT Image Storage Guidelines ¹¹.

General Considerations

Measurement technique should ensure accuracy is optimised as appropriate to the clinical scenario; this may require:

- Optimal adjustment to scale, gain and cursor placement for velocity measurements
- Selection of an appropriate probe including knowledge of probe resolution (axial/lateral) for linear measurements.
- Ensuring reported linear measurements are consistent with the level of accuracy/resolution possible, including the use of rounding where appropriate.

- Optimised technique for volume flow measurements, applying knowledge of all sources of error and ensuring reported measurements do not imply a level of accuracy which is not possible.

References

¹ The Society for Vascular Technology of Great Britain & Ireland “Vascular Ultrasound Service Specifications” www.svtgbi.org.uk

² Society for Vascular Ultrasound Professional Performance Guideline “Evaluation of Hemodialysis Access” <https://www.svu.org/practice-resources/professional-performance-guidelines/>

³ Society for Vascular Ultrasound Professional Performance Guideline “Upper Extremity Vein Mapping for Creation of a Dialysis Access or Peripheral Vascular Bypass Graft” <https://www.svu.org/practice-resources/professional-performance-guidelines/>

⁴ Society for Vascular Ultrasound Professional Performance Guideline “Lower Extremity Vein Mapping” <https://www.svu.org/practice-resources/professional-performance-guidelines/>

⁵ 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_Wroking_Party_Report_2006

⁶ UK Health Security Agency Guidance. (2021) Good Infection Control Practice: using ultrasound gel: <https://www.gov.uk/government/publications/ultrasound-gel-good-infection-prevention-practice>

⁷ Society for Vascular Technology Professional Standards Committee Chaperone Guidelines <https://www.svtgbi.org.uk/professional-issues/>

⁸ Ferring M, Henderson J, Wilmlink 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(6): 1809-15 <https://academic.oup.com/ndt/article/23/6/1809/1877968>

⁹ 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

¹⁰ Allon M, Robbil M.L. Increasing arteriovenous fistulas in haemodialysis patients: Problems and solutions; Kidney International, Vol. 62 (2002), pp 1109-1124 [https://www.kidney-international.org/article/S0085-2538\(15\)48653-3/fulltext](https://www.kidney-international.org/article/S0085-2538(15)48653-3/fulltext)

¹¹ SVT Guidance on Image Storage and use, for the vascular ultrasound scans <http://www.svtgbi.org.uk/professional-issues/>

¹² Guidelines for Professional Ultrasound Practice. The Society and College of Radiographers and the British Medical Ultrasound Society Dec 2019 https://www.sor.org/getmedia/00882406-9321-4b7d-b565-47262c2467de/2020.1.19_scor_bmus_guidelines_-.pdf_2