



THE SOCIETY FOR
VASCULAR TECHNOLOGY OF
GREAT BRITAIN AND IRELAND

Vascular Technology Professional Performance Guidelines Arterial Duplex Ultrasound Examination

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 sonographers and other interested parties. It can be used in conjunction with local protocols agreed between sonography and 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 an arterial scanning service:

- Vascular Ultrasound Service Specifications¹

In addition, the Society for Vascular Ultrasound publications^{2,3,4} provide detailed indications for arterial Duplex investigations.

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

Purpose

Arterial Duplex ultrasound examinations are carried out to assess for occlusive and aneurysmal disease in the major arteries of the lower or upper limbs and abdomen. This test is also used for surveillance following interventions such as a bypass graft or stent.

Common Indications

Common indications for performing this examination include:

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- Claudication
- Rest Pain
- Critical limb Ischemia
- Ulceration/tissue loss/gangrene
- Surveillance following intervention
- Suspected aneurysmal disease, both native and as a result of intervention
- Pre – Renal transplant
- To exclude arterial disease where compression dressings are being considered
- Evaluation of suspected subclavian steal syndrome

Contraindications and Limits

Contraindications for arterial duplex ultrasound are few; however, some limitations exist and may include the following:

- Patients with high body mass index
- The presence of ulcers, wounds, bandaging or casts and for patients who have had recent surgery, ultrasound visualization may be limited due to oedema, haematoma, surgical staples, dressings etc
- Calcified plaque may cause acoustic shadowing limiting Doppler and B-mode image assessment.
- Patients who are unable to lie with their limbs flat or still due to extreme pain or pre-existing co-morbidities e.g. chronic obstructive pulmonary disease (COPD) and arthritis – although these patients may be able to tolerate being examined seated with the limb dependent or with the head of the bed raised where practical.
- Patients who are unable to cooperate due to reduced cognitive functions e.g. Alzheimer's or dementia and through involuntary movements
- Examinations undertaken portably at the patient's bedside maybe limited due to equipment and room dimensions.
- The presence of catheters or vascular access lines which limit visualization of the vessels.

Patient Pathway

An Arterial Duplex assessment is often the initial diagnostic test in the pathway of patients with suspected lower or upper limb arterial disease, and particularly where any intervention may be needed. It is used in surveillance programs to follow up patients who have had an intervention such as a bypass graft or stent.

Guidance is given to the use of Duplex in the National Institute for Health and Care Excellence "Peripheral Arterial Disease: diagnosis and management" ⁵ and Vascular Society Great Britain and Ireland document The Provision of Services for Patients with Vascular Disease 2015 ⁶.

Patient Referral

Referrals for arterial Duplex allow investigation or follow-up of patients with the above clinical indications and can be used to check technical adequacy following intervention.

The referral should include details of the presenting symptoms.

Patient Preparation

No specific preparation is required for scanning the leg arteries below the groin or for scanning the arteries of the arm^{2,4}. Access will be required to the patient's legs or arms. Scanning may be difficult in patients with leg ulcers or open wounds or high BMI. Sterile dressings or cling film will allow imaging over broken skin.. Bowel gas often makes imaging of the aorta and iliac segment³ (the arteries in the abdomen which supply the legs) difficult. Some centres use advanced preparation, such as fasting for 6 hours prior to the scan, in order to improve imaging of these vessels. Particular care should be taken with any advice given to diabetic patients prior to a scan appointment.

Explanation of Examination

The person 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
- give an explanation of the procedure and its duration – consideration should be made to the age and mental status of the patient
- obtain verbal consent for the examination
- obtain a pertinent relevant medical history from the patient and/or notes
 - Presence of risk factors e.g. diabetes, hypertension, hypercholesterolemia etc
 - Presence of cerebrovascular disease e.g. aphasia, dysphasic, paralysis etc.
 - 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. The patient is asked to remove their clothing to expose the relevant part to be examined (this may be the lower limb from groin to ankle, upper limb from neck to wrist, or abdomen). The examination is performed with the patient supine. Their dignity and privacy should be maintained at all times and due to intimate nature of the examination it may be considered necessary to offer a chaperone⁷.

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

Ankle brachial pressure index (ABPI) may be included according to local requesting policy.

The following appropriate techniques should be used to evaluate the lower or upper limb arterial systems:

- B-mode should be used to image the artery and assess for, aneurysmal dilation and vessel contents e.g. atheromatous plaque
- Colour Doppler should be used to assess for the presence/absence of flow and aid the position of spectral Doppler when quantifying stenoses.
- Pulsed wave or spectral Doppler should be used to determine the direction or absence of flow, and measure the velocity of flow to enable assessment of stenoses/occlusions.

Any areas where the colour flow Doppler appears disturbed should always be interrogated with pulsed Doppler. The highest peak systolic velocity should be measured at the site of the disturbance or narrowing (V_s) and in a normal area of the artery just proximal to the narrowing (V_p). Care should be taken to ensure that the Doppler angle is 60° or less when recording velocity measurements.

The main criterion used to grade the degree of narrowing in the artery is the ratio of V_s to V_p , known as the peak systolic velocity (PSV) ratio. The PSV ratio is used to grade the

severity of the narrowing. A PSV ratio of greater than 2 is generally used to define a stenosis that is causing a greater than 50% reduction in the diameter of the artery. A PSV ratio of greater than 4 is generally used to define a stenosis that is causing a greater than 75% reduction in the diameter of the artery^{8,9,10,11}. Changes in the shape of Doppler waveforms are important criteria in determining the presence of disease. Multiphasic waveforms are representative of normal flow, whereas monophasic/damped waveforms usually represent diseased flow.

For bypass grafts, the entire length of the graft should be scanned paying particular attention to the anastomoses. The inflow and outflow should also be assessed. Similarly, for stent insertions, particular attention should be given to imaging and assessing flow through the stent together with an assessment of the inflow and outflow to the stented area.

In cases of diameter mismatch (e.g. large diameter graft joined onto a smaller diameter outflow vessel), consideration can be given to using a distal peak systolic velocity instead of V_p ^{12,13}.

For lower limb assessments, evaluation of the following arteries should be included, as appropriate:

- Aorta
- Common iliac artery (CIA)
- External iliac artery (EIA)
- Common femoral artery (CFA)
- Proximal profunda femoris artery (PFA)
- Superficial femoral artery (SFA)
- Popliteal artery
- Tibio-peroneal trunk (TPT)
- Posterior tibial artery (PTA)
- Peroneal artery
- Anterior tibial artery (ATA)

For upper limb assessments, evaluation of the following arteries should be included, as appropriate:

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

An appropriate number of relevant annotated images that represent the entire ultrasound examination should be stored, in accordance with local protocol and the SVT Image storage Guidelines¹⁴.

Reporting

The report is a recording and interpretation of observations made during the arterial duplex ultrasound examination; it should be written by the person undertaking the examination and viewed as an integral part of the whole examination.

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

There are no specific recommendations for the structure and content of reports for upper and lower arterial scans, many referrers find a pictorial report with written conclusions helpful.

The report should include:

- An indication of which arteries have been assessed commenting on the presence/absence of flow, as appropriate.
- The anatomical position and length of any occlusions or stenoses
- The anatomical position and size of any aneurysms
- Any limitations of the assessment e.g. due to body habitus/calcified vessels/ bowel gas.
- Comments on the shape of the Doppler waveform at different locations.

Where the investigation was a surveillance or follow up scan of an intervention, the report should give details of the intervention and should specifically comment on the patency and flow in the region of the intervention.

The report should be signed by the operator carrying out the test. Where a computer generated reporting system is used, the locally agreed verification and authorisation procedure should be followed.

The report should be written as soon as possible following the assessment, and be made available to the referring clinician on the day of the test. Any urgent findings, should be brought to the attention of the referring clinician immediately according to local policy.

REFERENCES:

¹ Society for Vascular Technology Service specification document <https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=2ahUKEwjn6lfp48TeAhXRY8AKHVw-BlcQFjAAegQIAhAD&url=https%3A%2F%2Fwww.svtgbi.org.uk%2F&usg=AOvVaw27pPvXcl4nMAzgxyQmeBCW>

² Society for Vascular Ultrasound Professional Performance Guidelines; Upper extremity arterial duplex evaluation <http://www.svunet.org/svunet/practicemanagementmain/professionalperformanceguidelines>

³ Society for Vascular Ultrasound Professional Performance Guidelines; Abdominal aortoiliac arterial duplex evaluation. <http://www.svunet.org/svunet/practicemanagementmain/professionalperformanceguidelines>

⁴ Society for Vascular Ultrasound Professional Guidelines; Lower extremity arterial duplex evaluation. <http://www.svunet.org/svunet/practicemanagementmain/professionalperformanceguidelines>

⁵ National Institute for Health and Care Excellence “Peripheral Arterial Disease: diagnosis and management”

<https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=2ahUKEwj9x-Lf48TeAhWmK8AKHQL2DugQFiAAegQIBRAC&url=https%3A%2F%2Fwww.nice.org.uk%2Fguidance%2Fcq147&usg=AOvVaw2sZYRnA1mT7OvHCjN2jKYH>

⁶ Vascular Society Great Britain and Ireland document The Provision of Services for Patients with Vascular Disease

https://www.vascularsociety.org.uk/search/go?url=%7e%2f_userfiles%2fpages%2ffiles%2fResources%2fPOVS%25202015%2520Final%2520version.pdf

⁷ Society for Vascular Technology Chaperone Guidelines

<https://www.svtgbi.org.uk/professional-issues/#professional-performance-guidelines>

⁸ “Accuracy and reproducibility of Duplex ultrasonography in grading femoro-popliteal stenoses” Leng, G C; et al. J Vascular Surgery (1993);17(3): 510-7.

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⁹ “Quantitative Vascular Measurements in arterial occlusive disease” Ota, H; et al. Radiographics (2005); 25(5): 1141- 58 .

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¹⁰ “Guidelines for Non-invasive Vascular Laboratory testing: A report from the American Society of Echocardiology and the Society of Vascular Medicine and Biology”. Gerhard-Herman, M; et al. J Am Soc Echocardiography (2006); 19: 955-72.

<http://www.asecho.org/wordpress/wp-content/uploads/2013/05/Noninvasive-Vascular-Lab-Testing.pdf>

¹¹ “Comparison of contrast arteriography to arterial mapping with color-flow duplex imaging in the lower extremities” Cossman, D V; et al. J Vascular Surgery (1989); 10(5): 522-9.

[https://www.jvascsurg.org/article/0741-5214\(89\)90133-X/fulltext](https://www.jvascsurg.org/article/0741-5214(89)90133-X/fulltext)

¹² “Early detection of saphenous vein arterial bypass graft stenosis by colour-assisted duplex sonography: a prospective study”. Polak, J. Am J Roentgenology (1990); 154 (4): 857-61.

<https://www.ncbi.nlm.nih.gov/pubmed/2107689>

¹³ “Optimal Ultrasound Criteria for grading stenosis of the superficial femoral artery” Gao, M; et al. Ultrasound in Medicine and Biology (2018); 44(2): 350-8.

[https://www.umbjournal.org/article/S0301-5629\(17\)32389-X/abstract](https://www.umbjournal.org/article/S0301-5629(17)32389-X/abstract)

¹⁴ Society for Vascular Technology Image Storage Guidelines.

<https://www.svtgbi.org.uk/professional-issues/>

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