



## **VASCULAR STUDIES UNIT**

### **Lower Limb Arterial – Doppler Ultrasound Examination**

#### **Introduction and Scope:**

An ultrasound scan of the abdominal and lower limb arteries can be used to identify the presence of arterial disease, including atherosclerotic plaque, thrombus and aneurysms, among other abnormal arterial pathology, such as pseudoaneurysms and dissections.

#### **Indications for examination**

Indications for performing the examination include:

- claudication
- rest pain
- ulceration or non-healing wound
- ischaemia
- aneurysm
- pseudo aneurysm
- post-revascularisation
- gangrene
- arterial trauma

We should not perform this investigation for patients suffering with claudication unless revascularisation is being considered. Here, exercise ankle/toe brachial pressure index (ABPI/TBI) testing should be performed to document their symptomatology, as well as quantify their walking distance and level of disease.

Contraindications and limitations for scanning may include open wounds, obesity, bowel gas (aortoiliac arteries), casts, and dressings/bandaging where appropriate redressing is unavailable. Patients who are unable to cooperate due to cognitive function, such as dementia, involuntary movements, or due to reduced mobility meaning they cannot lay supine, may also be unsuitable for the examination.

#### **Referral pathways:**

- Routine referrals should be made by a member of the patient's care team via EPR. If an inpatient referral, the patient's care team must discuss with the Vascular Surgeons prior to scan request.
- Urgent referrals from the Emergency Department, vascular clinic and vascular surgeons should be made on EPR and followed up with a phone call to the Vascular Studies Laboratory (where possible this should be done while the patient is still in the hospital)



### **Equipment:**

Approved Vascular Studies instrumentation should be used for this examination. Please see 'Equipment Schedule' document.

### **Preparation:**

It is the duty of the Clinical Vascular Scientist (CVS) to ensure that both the patient and the equipment are positioned correctly to minimise risk of injury to themselves and the patient, and to take precautions to avoid unnecessary strain on the back and/or provocation of work related upper limb disorders (WRULD)<sup>2</sup>. The patient's dignity and privacy must be maintained at all times. It may be necessary to offer a gown and/or a chaperone.<sup>1,3</sup>

### **Consent:**

It is a legal and ethical principle that valid consent be obtained before starting a physical investigation. This principle reflects the right of patients to determine what happens to their own bodies, and is a fundamental part of good practice. It is the responsibility of the CVS carrying out the investigation to ensure verbal consent is obtained<sup>1</sup>.

### **Clinical Governance:**

It is the duty of all staff to ensure that the patient's right to confidentiality is always observed and upheld, both during and after their hospital visit and that all patient identifiable records are stored in accordance with trust guidelines and Caldicott Principles.<sup>4</sup>

### **Method:**

**As with all scanning protocols the following should be used as a guide – It is the duty of the CVS conducting the study to make appropriate modifications to the examination based on their professional judgement and on the mental and physical health of the patient.**

The patient is asked to remove their clothing to expose the abdomen and lower limb(s). To achieve optimal imaging during investigation various positions should be considered, such as laying supine with knee slightly bent and rotated laterally.

During a lower limb arterial ultrasound the following arteries can be scanned using B-mode, colour Doppler and spectral Doppler: abdominal aorta, common iliac, proximal internal iliac, external iliac, common femoral, proximal profunda femoris, superficial femoral, popliteal, tibioperoneal trunk, anterior tibial, dorsalis pedis, posterior tibial and peroneal.

For some diagnostic questions it may be appropriate to perform segmental scans of the arterial tree. Limited or partial examinations should be performed at the discretion of the CVS based on the clinical indications and diagnostic question provided on the referral.

Waveform analysis must be carried out throughout the examination and the anatomical location of any abnormal pathology must also be noted.



For patients with critical limb ischaemia (CLI) who may be a candidate for arterial bypass surgery, consider additional venous mapping (please see 'vein mapping/POM' protocol for further information).

For patients with critical limb ischaemia (CLI) who may be a candidate for angioplasty and who have ipsilateral common femoral artery (CFA) calcification or >50% atherosclerotic disease, consider scanning the contralateral CFA to aid decision making for angioplasty access.

### Measurements and Grading Criteria <sup>5,6,7,8,9</sup>:

- Where changes in velocities are identified the degree of stenosis is graded by measuring the maximum peak systolic velocity (PSV) proximal to and within the stenotic region. The ratio between these two measurements is then used to grade the degree of stenosis as per below criteria (Table 1.).

**Table 1. Criteria for lower limb artery duplex examination**

PSV ratio	% Stenosis
< 2	< 50%
≥2<4	50-74%
≥4	75-99%
Absence of flow	<i>Occluded</i>

- Grading criteria of aorto-iliac arteries is less well established. It is at the discretion of the CVS to use the above criteria as a guideline when grading aorto-iliac lesions. Haemodynamic changes and B-mode information should be incorporated into the grading of stenosis.
- Where normal velocity criteria cannot be applied (e.g. in the presence of shadowing or immediately after bifurcations) qualitative descriptions of haemodynamic waveforms should be provided along with their possible clinical causes.
- Qualitative descriptions of waveform changes should be accompanied by explanation of their likely haemodynamic cause.
- Where aneurysms are noted please refer to the 'Aorto-iliac Aneurysm' protocol for information on accurate measurement and grading.
- For infrainguinal arteries, aneurysms are defined as 1.5 times the adjacent normal diameter. Thresholds for intervention of common femoral and popliteal artery aneurysms are 3.5 cm and 3.0 cm, respectively.



## Reporting:

Images documenting any disease, as well as images including waveforms (unless occluded) of each of the examined arteries should be stored on PACS.

All reports should include the severity and location of any arterial stenosis/occlusions identified, and the size and location of any focal ectasia/aneurysm.

The report must answer the questions raised in the referral, for example, the location and size of a pseudoaneurysm.

The report should be made available on EPR. This may be accompanied by a diagram to illustrate the findings, which should be uploaded to EPR. A comment in the written report should direct the reader to any diagram produced as part of the report.

Urgent findings must be reported verbally to the vascular team on call via bleep 2977 and also to the referring clinical team if not a vascular referral.

Urgent findings include newly found acute thrombus, dissection or pseudoaneurysm. Incidental finding of an aneurysm exceeding the threshold for intervention should also be urgently escalated if the patient is not attending clinic for same day follow up.

## References:

<sup>1</sup> United Kingdom Association of Sonographers (UKAS), 2008, Guidelines for Professional Working Standards Ultrasound Practice, accessed at: [www.sor.org/learning/document-library](http://www.sor.org/learning/document-library)

<sup>2</sup> Society of Radiographer, 2002, The Causes of Musculoskeletal Injury Amongst Sonographers in the UK Society of Radiographers, accessed at: [www.sor.org/learning/document-library](http://www.sor.org/learning/document-library)

<sup>3</sup> Society for Vascular Technology Professional Standards Committee, 2020, Consent and Chaperone Guidelines, accessed at: [https://www.svtgbi.org.uk/media/resources/Chaperone\\_2020.pdf](https://www.svtgbi.org.uk/media/resources/Chaperone_2020.pdf)

<sup>4</sup> Department of Health and Social Care, 2013, Caldicott Review: information governance in health and social care, accessed at: <https://www.gov.uk/government/publications/the-information-governance-review>

<sup>5</sup> Thrush and Hartshorne (2010) Vascular Ultrasound: How, why and when. 3rd Edition. Churchill Livingstone Elsevier, UK

<sup>6</sup> Pozniak and Allan (2014) Clinical Doppler Ultrasound. 3rd Edition. Churchill Livingstone Elsevier, UK

<sup>7</sup> Sensier, Y., Hartshorne, T., Thrush, A., Nydahl, S., Bolia, A. and London, N.J.M., 1996. A prospective comparison of lower limb colour-coded duplex scanning with arteriography. *European journal of vascular and endovascular surgery*, 11(2), pp.170-175.



<sup>8</sup> Cossman, D.V., Ellison, J.E., Wagner, W.H., Carroll, R.M., Treiman, R.L., Foran, R.F., Levin, P.M. and Cohen, J.L., 1989. Comparison of contrast arteriography to arterial mapping with color-flow duplex imaging in the lower extremities. *Journal of vascular surgery*, 10(5), pp.522-529.

<sup>9</sup> Zwiebel & Pellerito (2005) Introduction to Vascular Ultrasonography. 5th edition. Elsevier Saunders, Philadelphia.

#### **Other resources:**

Halliday, A. and Bax, J.J., 2018. The 2017 ESC guidelines on the diagnosis and treatment of peripheral arterial diseases, in collaboration with the European Society for Vascular Surgery (ESVS). *European Journal of Vascular and Endovascular Surgery*, 55(3), pp.301-302.

Conte, M.S., Bradbury, A.W., Kolh, P., White, J.V., Dick, F., Fitridge, R., Mills, J.L., Ricco, J.B., Suresh, K.R., Murad, M.H. and Aboyans, V., 2020. Global Vascular Guidelines on the Management of Chronic Limb-Threatening Ischemia (vol 58, pg 1, 2019). *European Journal of Vascular and Endovascular Surgery*, 59(3), pp.492-493.