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| **DOCUMENT CONTROL PAGE** | | |
| **Title** | **Title:** Lower limb Arterial Duplex  **Version: 3**  **Reference Number:** LLA003 | |
| **Supersedes** | **Supersedes:** LLA002 | |
| **Minor**  **Amendment** | **Notified to: CMFT CVS**  Date: April 2020  Significant changes:   * 3 forms of ID, How patients get results, suggested images * Perform a Duplex if: * ABPI<0.9 and waveforms suggest fem pop disease (and patient has already been on exercise programme) * ABPI<0.4 and waveforms suggest fem pop disease * Patient has tissue loss and waveforms suggest fempop disease   17/09/2020: Refer to Infection control policy (MY)  Report using diagram report and upload to PACS (MY)  08/12/21: Popliteal entrapment (MY) | |
| **Author** | **Originated/Modified by: Toni Cooper**  Designation: Clinical Vascular Scientist | |
| **Ratification** | **Ratified by: H Edlin**  Date of ratification: 14/4/20 | |
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**Reasons for performing the test:**

Duplex scanning the lower limb arteries provides anatomic and physiologic information directly from sites of arterial disease.

The location and extent of arterial lesions, status of the inflow and quality of the distal run-off vessels are determined so that decisions can be made regarding the need for arteriography and the most appropriate interventional approach.

**Perform a Duplex if:**

**ABPI<0.9 and waveforms suggest fem pop disease (and patient has already been on exercise programme)**

**ABPI<0.4 and waveforms suggest fem pop disease**

**Patient has tissue loss and waveforms suggest fempop disease**

**Pedal arteries if distal bypass being considered**

**Equipment used:**

* Colour Duplex scanner
* Hand held continuous wave Doppler
* Blood pressure cuff
* Sphygmomanometer

Service and quality control test are carried out by supplier/christie hospital

**Consumables required:**

* Ultrasound gel
* Tissues
* Paper roll for the couch

**Patient preparation:**

Ensure that the patient is correctly identified using 3 forms of ID – these are usually name, date of birth and first line of address (this can also include wrist band ID)

Identify yourself and ensure the patients are at ease by explaining the test to be carried out is a safe and painless procedure. Ensure patient can understand and they consent to the procedure, offering an interpreter if one has not already been arranged. Obtain relevant clinical history to ensure correct test has been ordered, adapting the test performed to the patients symptoms and clinical findings (discuss with senior member of staff).

**Procedure**

Thigh Arteries

7-4 MHz linear array transducer is used combined with optimal settings on the duplex machine to assess peripheral arteries.

Patient lies supine and the limb to be scanned is externally rotated at the hip, knee slightly bent and the foot turned outwards.

The common femoral artery (CFA) is visualised in the groin and followed proximal to the inguinal ligament. The waveform on the CFA is analysed at this point, if waveform reduced then proceed to assess Iliac artery and aorta if required.

The CFA is then traced distally until the profunda femoris (DFA) and superficial femoral arteries (SFA) are identified. The SFA is traced through the adductor canal. Colour flow is optimised to highlight areas of flow disturbances, which can then be interrogated using spectral Doppler to assess severity of the lesion.

Patient either lies supine with leg flexed at the knee ~30° or patient may lie prone.

The popliteal artery is identified behind the knee and traced proximally to ensure that the full length of the artery through the adductor canal is visualised and assessed

Peak systolic velocity readings and waveform shapes from spectral Doppler are recorded throughout CFA, DFA, SFA and popliteal artery.

If an area of stenosis is identified, a peak systolic velocity reading is taken immediately proximal to, and at the narrowest point of the diseased section. Colour/power and spectral Doppler assessments are used to decide whether the disease is a stenosis or complete occlusion. The diseased length and location is recorded and any obvious collateral vessels are noted.

Calf Arteries – scanned only on request of the consultant

7-4 MHz linear array transducer or 5-2 MHz curvilinear array transducer is used combined with optimal settings on the duplex machine to assess peripheral arteries.

Patient supine with headrest of the couch elevated to 45° and the lower limb is externally rotated at the hip, knee slightly bent and the foot turned outwards.

Starting at the ankle, the posterior tibial artery is identified posterior to the medial malleous and is traced proximally. The peroneal artery is visualised deep to the posterior tibial artery and both can be assessed through the length of the calf in this plane to the tibio-peroneal trunk.

Dorsalis pedis and Anterior tibial artery is identified on the anterior-lateral aspect of the ankle and traced to the upper calf to the distal popliteal artery.

Peak systolic velocities and waveform shapes from spectral Doppler are recorded from all calf arteries at the ankle, proximal calf, at each of the run-off artery origins and at any site of stenosis.

Diameter measurements should also be taken to guide optimum location of anastomosis site (minimum diam 1mm)

Popliteal Entrapment – perform only on request

Perform resting ABPI +/- exercise ABPI depending on symptoms. (see separate protocol).

Patient may lie prone on examination couch or stand for this assessment. Use linear array transducer, locate the popliteal artery and obtain waveform at rest. Then keep transducer at the distal popliteal artery in longitudinal view. Ask patient to perform plantar and dorsi-flexion, assess and record for any waveform changes or raised velocities caused by compression of artery.

Images:

Patency and waveforms at the CFA, PFA origin, Prox, Mid and Distal SFA and Prox and distal Pop A.

Patency and waveforms at the TPT

Any stenosis showing length and spectral trace pre and at this site.

If calf arteries are requested: Prox, Mid and Distal AT, PTA, DPA and Peroneal A patency and spectral trace

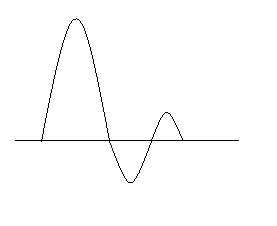
If specifically requested: calf artery patent luminal diameter, length of patent segment and PSV at this site. Any stenosis.

Any other pathology

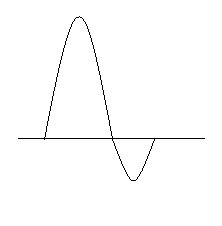
Results

Spectral Doppler waveform characteristics

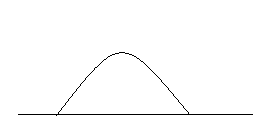
Triphasic waveform - normal flow



Biphasic waveform - abnormal or loss of last component due to increasing age



Monophasic waveform - disease present proximal to pulse point



The absolute value of PSV does provide a good indication of disease but is affected by cardiac output and proximal disease, therefore the peak systolic velocity ratio (PSVR) is used instead as it is more accurate in grading disease and is not affected by cardiac function, proximal disease, peripheral resistance and vessel compliance.

The PSVR is calculated by dividing the maximum peak systolic velocity at the site of stenosis by the maximum peak systolic velocity proximal to the stenosis.

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| PSVR = | max PSV at stenosis site  max PSV proximal to stenosis |

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| PSVR (Vs/Vp) | % stenosis |
| <2.0 | 0-50 |
| 2.0 - 3.0 | 50 - 74 |
| > 3.0 | 75 - 99 |
| Absence of flow | 100 |

*Peripheral Vascular Ultrasound. How, Why and When. A, Thrush and T Hartshorne*

IMPORTANT

If patient has no pedal pulses or you feel that the patient requires a medical opinion, let a senior member of staff know, keep the patient in the department whilst someone speaks with a member of the Vascular team.

Write on report that you have sought advice from the vascular team and what the outcome was.

At the end of the test inform the patient that the consultant will give them their results at their next visit.

In-patients:

File report in notes under investigations and write in the case history that the test has been performed and where the results are filed, signing and dating your entry.

**Pitfalls**

* Obesity may produce suboptimal views of the areas of interest, which result in an inconclusive examination.
* Presence of arterial calcification causes acoustic shadowing to occur therefore visualisation and quantification of stenosis becomes difficult.
* Extensively oedematous legs can be difficult to scan as oedema manifests as fluid between the interstitial spaces creating a marbled effect on the image and placing the vessels further away from the transducer.
* Cardiac arrhythmia affects the spectral Doppler waveform and rapid atrial fibrillation can completely destroy the usual flow characteristics.

**Report**

The reporting should include:

Which arteries have been assessed commenting on the presence/absence of flow

The anatomical position and length of any occlusions or stenoses e.g. x cm in length stating y cm above the medial femoral condyle

Comment whether disease appears chronic or acute.

The anatomical position and size of any aneurysms

Any limitations e.g. difficult examination due to body habitus

An appropriate number of annotated images that represent the entire ultrasound

examination - in accordance with local protocols and SVT Image Storage Guidelines (1)

Where possible a pictorial report is preferred by the clinicians. Ensure diagram report is labelled and annotated of the vessels assessed. Diagram report should be uploaded onto PACS.

**Patient and staff safety**

* Use output powers quoted by the manufacturer and in accordance to ALARA / AIUM criteria.
* Infection control: see latest Vascular Lab Infection control and working practices policy

**Equality Impact Assessment**

**References & Bibliography**

1. Society for Vascular Technology Professional Standards Committee Image Storage Guideline April 2012
2. Peripheral Vascular Ultrasound. How, Why and When. A, Thrush and T Hartshorne

Society for Vascular Ultrasound Vascular Technology Professional Performance Guidelines