ARTERIAL LEG DUPLEX ASSESSMENT (inc Stent F/U)

**The request should specify which leg/section of the leg requires scanning.**

**Scanning Protocol**

1. If recent ABPI’s have not been recorded, please perform if applicable.
2. Use the mid-range frequency linear probe for the leg unless the vessels are deep then use a lower frequency probe. Curvilinear probe for the aorto-iliac segment.
3. Start at the common femoral artery (CFA). Record velocities and waveforms from the CFA. Proximal Profunda artery (PFA) and superficial femoral artery (SFA). Record presence of any plaque in this area. Record Doppler waveforms from all 3 vessels and any evidence of any stenosis. Comment on AP diameter if applicable.
4. Scan throughout the SFA recording any areas of significant plaque and velocities from any areas of significant stenosis and occlusion.
5. Similarly scan throughout the popliteal artery and the trifurcation. Record a Doppler waveform from the mid popliteal artery and comment on AP diameter if applicable, record an image of the TPT. Record images documenting stenosis/significant plaque.
6. Scan throughout the calf arteries recording the Doppler waveforms from the ankle and any areas of significant plaque/stenosis. Use curvilinear probe if necessary.
7. Scan the bilateral iliac arteries using the curvilinear probe.
8. Scan the distal aorta (record AP outer to outer and inner to inner diameters in longitudinal) and throughout the common (CIA) and external iliac arteries (EIA). Record Doppler waveforms from the CIA, EIA and proximal internal iliac arteries again demonstrating areas of significant plaque/stenosis.
9. If a full length SFA occlusion is present or if extensive acute thrombus is noted have a quick look at the greater saphenous vein to assess it’s suitability for bypass and record diameters on the report form.
10. Record a minimum set of images to include Aorta, right and left CIA, EIA, IIA, CFA, SFA origin and PFA origin and then the relevant leg SFA, POPA, TPT, ATA, PTA and Peroneal. However, qualified staff may adapt the extent of the scan in certain cases e.g. clinical relevance or limitations such as rapid access referral or patient compliance).

**Grading Stenosis**

Grading a stenosis should predominately be undertaken using a ratio of the peak systolic velocity through the stenosis to the velocity taken just proximal to the stenosis in a normal segment and graded using the criteria below. This is particularly relevant where the stenosis is not the first in the arterial tree and hence inflow is reduced or in the presence of generalised high flow throughout.

However, professional judgement should be used for segments where a proximal velocity may not be considered a reliable baseline on which to determine the ratio (e.g. where calibre difference, angulation or significant branches are present – often a consideration in the aorto-iliac arteries where a stenosis is also likely the first stenosis in the arterial tree) in which case absolute velocities (as described below), in combination with the visible appearance of a stenosis and/or a distal velocity ratio may be more appropriate.

Absolute Velocities

* 200cm/s – 50% diameter reduction (dr)
* between 200-400cm/s are reported as 50-75% dr
* >400 cm/s are reported as >75% d.r.

Velocity Ratios

The corresponding velocity ratios for stenosis in vessels are used for

* x2 is 50% dr
* >2 but <4 is 50-75% dr
* x4 is 75% dr
* >4 is >75% dr

**Reporting**

* Don’t make reports too wordy, mark disease on relevant segments, with accurate depictions of waveforms at the aorta, iliacs, groin, knee and ankle level (as appropriate) and then add a summary if necessary to clarify previous interventions etc.

**FOR SFA STENT FOLLOW UPS:**

* Perform an arterial scan of the relevant segment including the artery proximal to the stent, within the stent and distal to the stent.
* Pay particular attention to velocities within the body of the stent.
* Report stenosis using velocity criteria above.
* Measure volume flow within the stent.

Reporting

* Draw the stent onto the diagrammatic report.
* Include waveforms in the segment scanned and report any significant stenosis. Report volume flow on the report.
* Add a summary of any previous intervention / further follow up
* Report on CRIS/PACS
* Arrange follow ups as per graft schedule (6 weeks, 3 months, 6 months and 1 year post-procedure).
* If significant stenosis is found, email results to the Vascular Surgeons and Radiologists.

**For Renal Pre-Transplant**

* Assess the aorto-iliac arteries, CFA, origins of SFA and profunda artery bilaterally
* Record waveforms and report any stenosis using velocity criteria above
* Report using arterial diagram form and ensure reports are clear for Renal surgeons to interpret.

**Endo Vascular Aortic Repair (EVAR)**

**Follow up Assessment Protocol**

**Technique**

1. Use the low frequency curvilinear abdominal probe. Start scanning in transverse view using B mode to gain information about the overall appearance of the aorta sac.
2. Locate the widest point by eye and use write zoom if applicable to enable a high-quality image to be taken. After freezing the image, use the trackball to scroll back through the cardiac cycle to find the maximum systolic diameter.
3. **If this is the first ultrasound scan** measure both anterior-posterior (AP) outer to outer wall (OTO) and inner to inner (ITI) diameters.
4. Record three separate images and take both OTO and ITI measurements on each image in both a longitudinal and transverse view.
5. **If this is not the first ultrasound scan** and a previous set of both outer to outer and inner to inner measurements exists, only measure inner to inner diameters as described below.
6. Using B-mode in a transverse scan plane, measure the maximum AP diameter of the AAA sac from the inner wall to inner wall, as per national guidelines. A minimum of 3 images should be recorded and measured.
7. Using B-mode in longitudinal plane, measure the maximum AP diameter of the AAA sac from the inner wall to inner wall. Ensure that the callipers are at right angles to the aortic wall, and that oblique measurements are not used. A minimum of 3 images need to be recorded and measured.
8. Accurately record the maximum of the 3 sizes obtained in longitudinal and transverse plane (NOT an average of the 3 sizes obtained).
9. If the aorta is eccentrically shaped and the medio-lateral diameter is larger than the AP, take this measurement too in the appropriate scan plane.
10. Use colour Doppler to establish patency of all limbs of graft.

Record an image of a spectral Doppler tracing of Aorta and both EVAR limbs as a minimum.

1. Use colour and power Doppler to look for leaks into the sac. Use a transverse view with a large box and low colour PRF and power Doppler, to examine the whole sac moving slowly from just above the proximal attachment site to below the distal extent of the EVAR (examining the distal CIA/proximal EIA). Any leaks visualised should be classified as follows:

**Ia** prox attachment leak

**Ib** dist attachment leak

**II** retrograde flow from lumbars/IMA

**IIIa** leak from between the components of the stent

**IIIb** leak from a hole in graft fabric

**IV** fabric porosity

**V** Endotension/no leak with increased sac size unknown cause

**Reporting**

Use CRIS/PACS to report EVAR results using departmental wording template which is standardised to network template for diameter measurements.

Report the transverse and longitudinal maximum measurements to 1 d.p on the report form.

A change in sac size of ± ≥0.5cm from the first post-op scan is considered a ‘real change’ and should be reported as increased/decreased from the first post-op scan. Any change <0.5cm should be concluded as ‘no significant change’. There is no need to describe anything within the range of ± <0.5cm being slightly increased/decreased as this can become confusing when reviewing reports later on.

**Significant Findings**

If an increase in sac size = or >0.5cm **compared to the first post-op scan** this would be considered significant or if a leak is seen, or a new limb occlusion please contact:

* The Vascular team
* Radiology
* The Generic EVAR Mailbox which is monitored by Southampton Vascular Team

as per red flag policy.

(Local agreement with Vascular/Radiology Consultants as to what constitutes a significant sac increase).

BYPASS GRAFT FOLLOW-UP PROTOCOL

**Preparation**

1. If there is a request form – check whether more than a standard scan is required. There may be a requirement to also fully assess inflow or outflow. Otherwise carry out a standard graft follow-up scan detailed below.
2. Check any previous scans, interventions etc. so that you are fully aware of the history of the relevant graft.
3. Measure the ABPI if appropriate/requested.. Do not place a blood pressure cuff over the distal anastomosis of a graft as it could occlude the graft. ABPIs may be inaccurate if measured when a patient has significant leg oedema or known calcified vessels. Use cling film/plastic apron to cover open wounds and be wary of painful ulceration.

**Technique**

1. Use the most appropriate probe (linear for most superficial grafts).
2. Check the inflow, including assessment of the CFA, PFA and SFA as appropriate and dependent on graft location. paying particular attention to the vessel just above the proximal anastomosis and record a Doppler waveform from this position and note any narrowing. Where good inflow cannot be established and particularly where inflow has changed from a previous assessment, extend the scan proximally to identify any source of haemodynamically significant disease.
3. Record the velocity through the anastomosis, adapting technique for any areas of turbulence, and look for any areas of narrowing.
4. Scan throughout the length of the graft in a longitudinal plane, assessing the colour flow for areas of narrowing or flow disturbance. (Set the PRF to approx half the velocity within the graft and adapt as necessary).
5. As you scan, record the Doppler waveform and velocity at intervals (e.g. proximal, mid and distal thigh). Record the maximum velocity in any areas of high velocity flow.

**Velocity criteria**

**<180cm/s is considered normal.**

**180 - 350cm/s suggests 50-75% diameter reduction (dr)**

**>350cm/s suggests >75% dr**

For a graft with a large lumen and/or low/high velocities throughout you may need to use velocity ratios:

**x2 suggest 50% dr**

**Between x2 to 4 suggest 50-75%d.r**

**>x4 suggest >75%dr**

1. Assess the distal anastomosis for narrowing; remembering that flow through a wide graft’s junction with a smaller calibre native vessel will have a velocity increase due to the difference in calibres, rather than to stenosis. In cases of significant calibre mis-match, you can compare the velocity in the ?stenosis to the velocity in a non-diseased portion of the outflow vessel. Look for evidence of any narrowing in B-mode too. Ensure that velocity measurements are consistent with the appearance of the anastomosis.
2. Record a Doppler waveform from the native vessel distal to the anastomosis and note any narrowing. Check the flow at the ankle if you think it would be appropriate (e.g. if the graft is occluded or threatened by severe stenoses or very low flow rates).
3. For in-situ grafts and grafts where operation technique is not known , re-scan throughout the length of the graft in a transverse plane. Use low colour PRF, looking for any side branches acting as fistulae, measure their diameter and assess their significance possibly measuring volume flows before and after the fistula.

1. For popliteal aneurysm bypass grafts, also measure the A-P diameter (outer to outer) of the aneurysm. If there is an increase in size or colour flow within the excluded aneurysm, assess the native vessels to see where the filling is coming from. Any significant increase in size (use professional judgement) should be urgently reported to the Consultant.
2. Minimally record spectral Doppler waveforms demonstrating inflow to graft, proximal anastomosis (PA) flow, proximal, mid and distal graft, distal anastomosis (DA) and outflow from graft. Also record images as appropriate demonstrating stenosis/significant narrowing.
3. **If there is a significant proximal stenosis take a Doppler waveform from the opposite groin, as you would do for an arterial Duplex, in view of possible future angioplasty via a contralateral approach**.

**Reporting**

1. Complete a diagrammatic paper report. Velocities only need to be added to the report if indicating areas of concern ie: graft stenosis or low velocity flow.
2. If there is a **significant** **stenosis** with **good flow distally** and the **graft does not** **appear immediately threatened email a copy of the report to the Vascular Surgeons and Vascular Nurse Specialists.**
3. Note any significant finding on the VAU follow-up schedule form.
4. Let the patient know that:

* You have found a narrowing in the graft
* You will alert the Vascular Surgeons
* they can expect to be contacted by the Vascular team who will decide whether an angioplasty is required.

1. If there is a **stenosis** which **may threaten the graft**, or **a recent** (from history) **graft** **occlusion:**

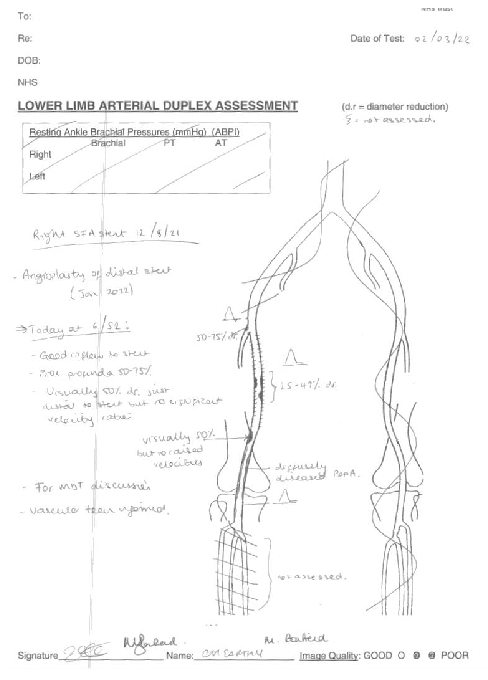
* **Keep the patient in the department.**
* **Contact the relevant Consultant/Registrar for advice.**

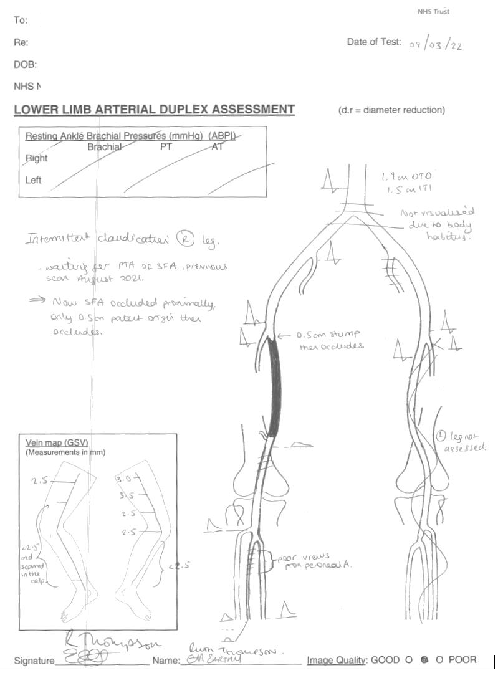
For longstanding occlusions, just inform the Consultant and Vascular Nurse specialist, as further follow-up would be inappropriate.

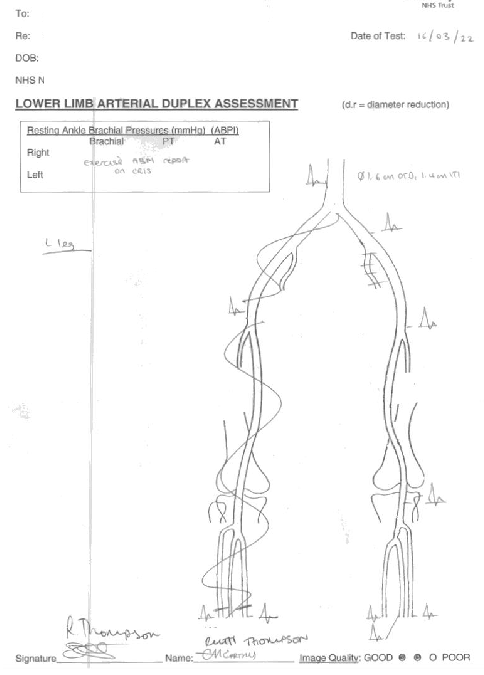
SCAN REPORTS

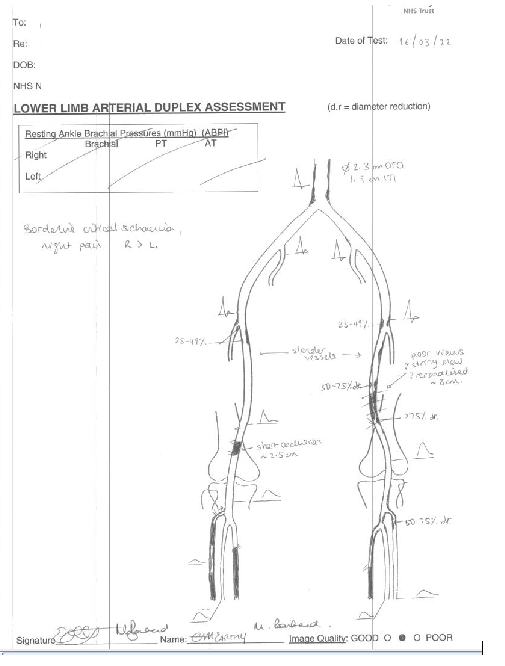


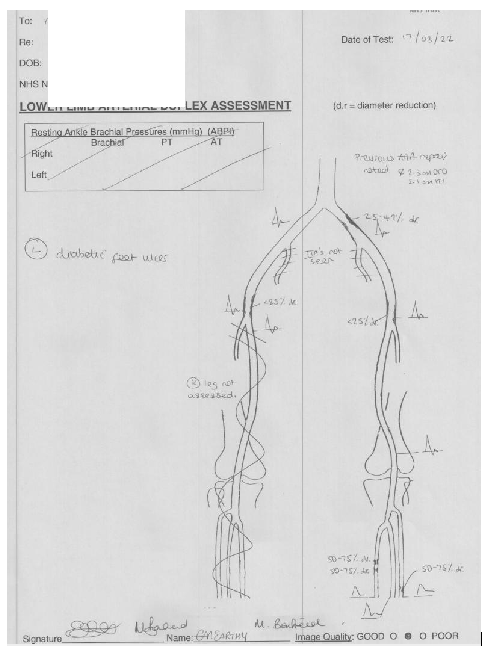


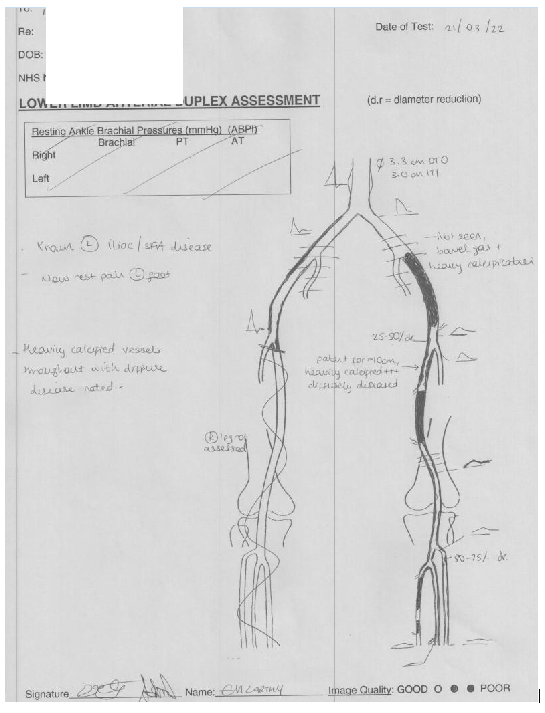












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