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All Sites	VAS-DP-5	Kelly Swagell	
Title		Version Date	Version Number:
EVAR ultrasound		Dec 2021	1.2

Scope & purpose

Duplex assessment for patients who have undergone an endovascular aneurysm repair. The purpose of performing a duplex ultrasound examination is to detect expansion of the residual aneurysm sac, the presence and nature of any endoleaks, and the patency of the grafts.

Common indications for the performance of this examination include:

- Post-EVAR assessment
- Routine EVAR surveillance
- Post-surgical intervention follow-up e.g. post limb extension / angioplasty or endoleak repair
- Patency and functionality of crossover graft
- False aneurysm/fluid collection(s) at access site(s)

Personnel

Clinical vascular scientists (CVS), including trainees.

Principles / performance characteristics

The aims of the scan are to:

- Identify the aorta and endovascular arterial repair
- Document the maximum external anterior-posterior (AP) and right-left (RL) diameters of the aortic sac
- Document the presence of endoleaks
- Classify the nature of the endoleak if present
- Document the PSV and waveform and any visible lesions: atheroma/thrombus/dilatations

Service users & background

Patients who have been referred for this scan have undergone endovascular stent placement due to the presence of an abdominal aortic aneurysm (AAA). This is with the intention of excluding the aneurysm sac to prevent further expansion and rupturing of the aneurysm, which could be fatal (ref 1)

There are few contraindications for post-EVAR duplex ultrasound assessment; however, limitations may include the following:

- Bowel gas
- Raised BMI
- Severe oedema/swelling
- Dressings, casts, open wounds, staples, haematoma etc.
- Acoustic shadowing
- Patients who are unable to lie flat
- Patients who are unable to cooperate due to reduced cognitive functions e.g. Alzheimer's or dementia and through involuntary movements
- Examinations undertaken at the patient's bedside may be limited due to equipment and room dimensions
- Patient discomfort

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Facilities, equipment & special supplies

Duplex ultrasound machine with both linear and curvilinear transducers available. There should be a selection of transducers delivering a wide range of frequencies (high and low).

An abdominal or vascular pre-set should be selected on the machine.

The examination couch should be height adjustable. The CVS's chair should provide good lumbar support, be height adjustable and allow for the CVS to move close to the examination couch.

Ultrasound gel to provide a couplant between transducer and patient.

Cleaning materials should be available in line with local and manufacturer's guidelines. These are available either in each procedure room or located in the laboratory storeroom.

Calibration

Across all sites annual calibration and safety checks of the ultrasound equipment are performed by Clinical Engineering (Trust contract with GE Healthcare).

Quality control

Second opinions from vascular scientist colleagues are requested routinely if clarification is sought.

Trainee vascular scientists have all EVAR scans checked until they are signed off by a senior colleague for competency.

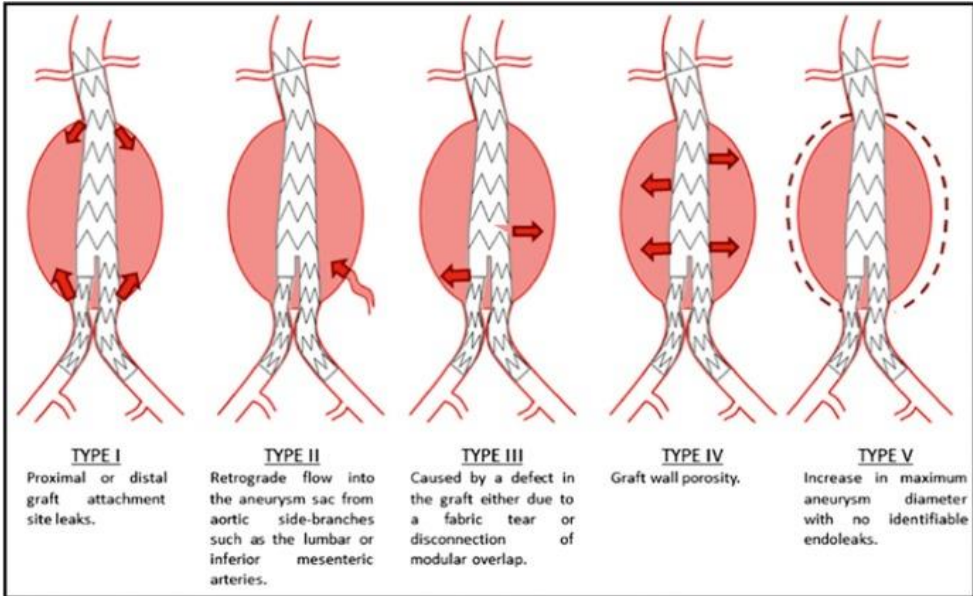
Environmental & safety controls

Infection control procedures followed in accordance with Trust infection control and risk assessment policies – Please see 'Personal Protective Equipment (PPE) for infection prevention and control' policy, 'Hand Hygiene' policy and 'Staff Risk Assessments' which are all available through the Trust Intranet.

Tristel wipes are for cleaning the ultrasound machines and probes after patient use. Universal Clinell wipes are for cleaning all other equipment. Where high risk infection presents or post-op wounds are present use probe covers with sterile gel or Tegaderm dressings, in addition to routine cleaning.

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EVAR ultrasound procedure (ref 1)

	Preceding document: <i>VAS-MP-6 Patient management</i>
1.	<p>Patient preparation:</p> <p>The patient is asked to remove their clothing to expose the abdomen and is ideally examined in the supine position.</p>
2.	<p>The following techniques should be used to evaluate the aorto-iliac system and their stented component:</p> <ul style="list-style-type: none"> B-mode should be used to image the EVAR graft, its position and location and the size of the residual aneurysm sac. Three measurements of the residual sac from outer wall to outer wall should be taken from separately acquired images. Document measurements in the anterior-posterior and right-left planes for each acquired image. Spectral Doppler should be used to determine waveforms within the main body and each limb of the graft; assessing for any twisting, kinking or deformity of the graft; direction of flow, stenotic flow and absence of flow. Colour Doppler should be used to assess for the presence/absence of flow within the stent graft limbs, to detect endoleaks and aid position of spectral Doppler when quantifying stenoses. To assess for the presence of endoleaks examine the residual aneurysm sac in both transverse and longitudinal planes to assess for the presence/absence of flow within the residual aneurysm sac. Colour Doppler parameters must be set using the most sensitive settings to detect low flow within the aneurysm sac.  <p>Figure 1: Diagrammatic representation of endoleak types (ref 2).</p>
3.	<p>Evaluation of the following arteries (PSV and waveforms), using colour and spectral Doppler, should be included:</p>

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	<ul style="list-style-type: none"> • Aorta • Common iliac artery (CIA) • Proximal Internal iliac artery (IIA) • External iliac artery (EIA) • Common femoral artery (CFA) • Crossover graft if applicable <p>The machine controls should be optimised continually throughout the scan to obtain the best image to aid with diagnosis.</p>														
4.	<p>A significant narrowing should be graded using the following criteria as a guide:</p> <p>Table 1: Arterial velocity grading criteria.</p> <table> <tr> <th>Peak Systolic Velocity Ratio (Vs/Vp)</th><th>Reported stenosis</th></tr> <tr> <td>< 2</td><td><50% stenosis</td></tr> <tr> <td>2</td><td>~50% stenosis</td></tr> <tr> <td>2.1-3.9</td><td>50-74% stenosis</td></tr> <tr> <td>4</td><td>~75% stenosis</td></tr> <tr> <td>>4</td><td>>75% stenosis</td></tr> <tr> <td>No flow detected</td><td>Occluded</td></tr> </table> <p>Vs = Highest PSV at site of stenosis, Vp = pre-stenosis PSV (ref 3).</p>	Peak Systolic Velocity Ratio (Vs/Vp)	Reported stenosis	< 2	<50% stenosis	2	~50% stenosis	2.1-3.9	50-74% stenosis	4	~75% stenosis	>4	>75% stenosis	No flow detected	Occluded
Peak Systolic Velocity Ratio (Vs/Vp)	Reported stenosis														
< 2	<50% stenosis														
2	~50% stenosis														
2.1-3.9	50-74% stenosis														
4	~75% stenosis														
>4	>75% stenosis														
No flow detected	Occluded														
	<p>Subsequent documents: VAS-MP-6 Patient management, VAS-MP-1 Results processing</p>														

Reporting

The diagrammatic report is a record and interpretation of observations made during the EVAR duplex ultrasound examination; it should be written by the CVS undertaking the examination.

The report should include correct patient demographics, date of examination, examination type, the name and status of the CVS and any clinical history deemed relevant.

The report should include:

- Presence/absence of endoleak(s), including location and endoleak type (ref 2 and 4):

Table 2: Endoleak Types (ref 2 and 4)

Endoleak Type	Description
Type Ia Ib	Proximal (a) or distal (b) limb attachment leak
Type II	Patent branch ?lumbar or IMA vessel involvement
Type III	Graft fabric tear or modular limb connection failure

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Type IV	Sac increase due to graft porosity
Type V	Sac increase due to endotension

- Residual aneurysm sac diameter and the method of measuring the aneurysm diameter should be written on the report. The three anterior-posterior and right-left (APxRL) diameters should all be noted. The method of measuring should also be written as such: Maximum outer diameter, APxRL.
- All diameter measurements to be documented in centimetres, to one decimal place
- Patency of stent/limb(s) and any significant pathology, including crossover graft if applicable.
- The peak systolic velocity readings and waveforms from the aorto-iliac stents, iliac and common femoral arteries,
- Any other incidental findings, e.g. false aneurysm, haematoma, arterio-venous fistula, intimal flaps, dissection etc.
- Any limitations e.g. difficult examination due to body habitus, bowel gas, calcification etc.
- The diagram should note the characteristics of the EVAR stents i.e. tortuosity, distal limits. The EVAR stents should be drawn as tubes with dashes on sides of the tube. Where possible draw the shape of the endoleak on the report and include the PSV and flow direction.

If an endoleak is detected that has not been seen previously, or there is a significant increase in sac size (over 1cm per year), inform the clinical team before the patient leaves the department, if appropriate.

Any incidental findings should be documented and further imaging recommended when clinically appropriate.

References	
1.	VAS-ED-7. Vascular Technology Professional Performance Guidelines Endovascular Aneurysm Repair (EVAR) Duplex Ultrasound Examination (2021).
2.	Kassam, T. (2017). Follow up CT angiography post EVAR: Endoleaks detection, classification and management planning. <i>The Egyptian Journal of Radiology and Nuclear Medicine</i> . 48:3:621-626
3.	Thrush, A. and Hartshorne, T. (2010). <i>Vascular Ultrasound: How, why and when</i> , 3rd edition, Elsevier Limited: London (pg. 138)
4.	VAS-ED-20 NICE guideline [NG156] Abdominal aortic aneurysm: diagnosis and management (2020).