**Introduction**

This protocol was prepared by the Senior Vascular Physiologist. The SVT guidelines were used in conjunction with our current lab practices.

Duplex Ultrasound is used to detect expansion of the residual aneurysm sac, the presence of endoleaks and the patency of the graft and its limbs.

**Common Indications**

1. Initial post EVAR assessment (usual only if patient has low tolerance to contrast)
2. Routine EVAR surveillance
3. Post surgical intervention follow up for example post limb extension
4. Patency and functionality of femoral femoral crossover graft
5. Query pseudoaneurysm or fluid collection at access site

**Limitations:**

1. Obesity
2. Dressings/open wounds
3. Patient unable to lie flat
4. Bowel gas within the abdomen
5. Stoma/colostomy bags
6. Patient discomfort

**Patient Preparation**

No preparation is required. The patient is not required to fast prior to the duplex ultrasound.

The examination should be fully explained to the patient and consent obtained. Patient name and date of birth must be confirmed. Relevant medical history should be taken prior to the examination from previous notes and from the patient. Such as:

* Previous extent of aneurysmal dilation
* Type of device, i.e., aorto uni-iliac with crossover graft, bi-iliac or fenestrated graft
* History of previous treatment e.g. angioplasty or embolisation
* Results of other relevant diagnostics such as recent CT exams

**Examination**

1. The patient is asked to remove or open their upper body clothing so the abdomen is exposed. The patient’s dignity and privacy should be maintained at all times.
2. The patient is examined in the supine position.
3. Gel must be applied to the curvilinear low frequency probe and the EVAR programme selected on the Duplex machine
4. There will be constant adjustment of the different functions on the control panel throughout the exam to ensure optimal imaging and spectral analysis eg., depth, focus, gain, TGC, sample volume size, colour box, colour scale etc
5. The Vascular physiologist must place the curvilinear probe below the diaphragm and image the proximal abdominal aorta in transverse using B-Mode.
6. Using the callipers the proximal abdominal aorta should be measured in both transverse and in the longitudinal plane to out rule aneurysmal dilation of the Aorta proximal to the EVAR graft.
7. In Transverse B-Mode the type of EVAR graft (uni-iliac/bi-iliac), its location and the size of the residual aneurysm sac should be documented. The Vascular Physiologist must record the largest aneurysmal portion of the sac by documenting the outer wall AP and transverse diameter accurately using the callipers.
8. In the longitudinal plane record the outer wall longitudinal AP diameter of the largest aneurysmal portion of the abdominal aortic sac. This can be a more accurate representation if the aorta is a tortuous vessel
9. In the transverse plane and the longitudinal plane Colour Doppler is used to assess the presence/absence of flow within the stent graft and its limbs.
10. In the Transverse plane using Colour Doppler and a low colour scale assess the residual sac for the absence/presence of flow external to the stent graft lumen. If flow is present within the sac, identify the origin of flow if possible. Pay particular attention to the proximal and distal stent graft for Type Ia and Type Ib leaks.
11. Using Spectral Doppler assess if the flow within the aneurysmal sac is of high/low flow velocity.
12. In the longitudinal plane spectral Doppler can be used to obtain waveforms within the main body of the graft and its limbs, determine increase in velocities secondary to kinking or deformity of the limbs and to confirm absence of flow.
13. In the Transverse Plane locate the distal EVAR limbs within the iliac arteries. Record if the limbs are flush with the iliac artery walls and documenting the outer wall AP and transverse diameter accurately using the callipers.
14. In the longitudinal plane record if the limbs are flush with the iliac artery walls using colour Doppler and document direction of blood flow.
15. If the iliac arteries are aneurysmal record the largest aneurysmal portion of the iliac sac by documenting the outer wall AP and transverse diameter accurately using the callipers.
16. Document patency of the external iliac arteries and/or the presence of a stent.

**Femoral femoral crossover grafts**

1. Using the low frequency curvilinear probe identify the common femoral artery in BMode and assess the artery for aneurysmal dilation and atheromatous changes.
2. Select the high frequency linear array probe and select the arterial programme on the Duplex Machine.
3. Apply gel to the probe.
4. With BMode assess the common femoral artery for aneurysmal dilation and the presence of plaque.
5. Using colour doppler assess for the presence/absence of flow, any colour aliasing may be indicative of increased velocities
6. Using spectral Doppler demonstrates direction of blood flow and record the PSV along the vessel. Note: in the presence of a stenosis, the cursor line must be aligned parallel to the blood flow.
7. In transverse and BMode document the femorofemoral graft proximal anastomosis site
8. In transverse and using Colour Doppler document the femorofemoral graft proximal anastomosis site
9. Using Spectral Doppler record the PSV within the CFA approximately 1cm proximal to the femfem proximal anastomosis site
10. Record the PSV of the proximal anastomosis site. If the velocity doubles and in the presence of atheroma/plaque a greater than 50% stenosis is detected. If the velocity quadruples a greater than 70% stenosis is detected. Note: If the velocity doubles in the absence of plaque this may be secondary to tortuosity of vessel or compliance of vessel and must be documented as such.
11. Measure the length of the plaque and the longitudinal reduction in the AP lumen of the proximal anastomosis site using the callipers
12. In the transverse plane using BMode identify the Fem fem graft and document any collections surrounding the graft
13. In longitudinal using Colour Doppler and Spectral Doppler record peak systolic velocities and direction of flow throughout the fem fem graft
14. Identify the distal anastomosis site, documenting any increase in PSV and/or stenosis at the distal anastomosis site.
15. In the Transverse Plane using BMode assess the common femoral artery for aneurysmal dilation and the presence of plaque
16. In the longitudinal plane using Colour Doppler and Spectral Doppler document patency and direction of flow within the CFA, superficial artery and profunda femoris artery. Record PSV of all three vessels and quantify any stenosis which may be present.

**Reporting**

The report is a recording and interpretation of observations made during the assessment. It should be written by the Vascular Physiologist who performed the exam**.**

The Non-Invasive Vascular Unit has a standardised reporting system for each examination so that all Vascular Physiologists and clinicians alike can understand the report.

The report should include:

* Patient name, Medical Record Number, Date of examination, examination type, Vascular Physiologists initials.
* Residual aneurysm sac diameter and the method of measuring aneurysm sac diameter. For example maximum AP outer wall diameter, maximum transverse outer wall diameter AND/OR maximum longitudinal AP outer wall diameter.
* Patency of stent/limbs
* Presence/absence of endoleak, including location and endoleak type (Refer to EVAR Assessment learning outcomes for descriptors).
* Patency of Fem Fem graft and any documented stenosis.
* Any incidental findings for example pseudoaneurysm, haematoma, dissection, liver cysts, identifiable abdominal mass, ascites, collections around the Fem fem graft.
* Any limitations for example difficult/limited examination due to patient body habitus, bowl gas etc
* Recommendations for further imaging in the event of a limited examination
* An appropriate amount of annotated images that represent the entire ultrasound examination in accordance with department protocol
* Any significant or unexpected findings should be recorded using the PACS peervue system
* The referring doctor/team must be contacted at time of examination referring them to the report findings in the patient’s chart so that a treatment plan can be developed or expedited.