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All Sites	VAS-DP-7	Kelly Swagell	
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Upper limb arterial ultrasound		Dec 2021	1.1

Scope & purpose

Duplex ultrasound examination is used to assess the arteries of the upper limb (Brachiocephalic / Subclavian to hand) to determine the location and severity of vascular disease (occlusive and aneurysmal).

Common indications for the performance of this examination include:

- Exercise induced pain, ischemic rest pain, gangrene or ulceration
- Post-surgical intervention follow-up e.g. angioplasty
- ? aneurysm
- ? false aneurysm
- Assessment of arterial trauma
- For Raynaud's syndrome

Personnel

Clinical vascular scientists (CVS), including trainees.

Principles / performance characteristics

The aims of this scan are to determine the presence, location and severity of vascular disease (occlusive and aneurysmal).

Service users & background

Patients with a suspected peripheral arterial, aneurysmal or embolic disease may be referred as part of their work up, in conjunction with other imaging modalities. This diagnostic investigation aims to establish if peripheral arterial, aneurysmal or embolic disease is a possible cause for their symptoms and the patient's amenability for surgical intervention.

There are few contraindications for upper limb arterial duplex ultrasound; however, limitations may include the following:

- Raised BMI
- Severe oedema / swelling
- Dressings, casts, open wounds, staples, haematoma etc.
- Acoustic shadowing
- 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
- IV or catheters that limit visualisation of vessels
- Patient discomfort
- Bone; A short segment of the subclavian vein cannot be examined as it moves under the clavicle

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).

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Ultrasound gel to provide a couplant between transducer and patient.

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.

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 store room.

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 upper limb arterial 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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Upper limb arterial ultrasound procedure (ref 1 and 2)

	Preceding document: <i>VAS-MP-6 Patient management</i>
1.	<p>The examination may be unilateral or bilateral, dependent upon clinical symptoms.</p> <p>The patient is asked to remove their clothing to expose the upper limb wrist to neck. The patient can be examined supine or in an upright position sat in a chair.</p>
2.	<p>The following appropriate techniques should be used to evaluate the upper limb arterial system:</p> <ul style="list-style-type: none"> • B-mode should be used to image the artery and assess for aneurysmal dilation and vessel contents e.g. atheromatous plaque • Spectral Doppler should be used to determine direction of flow, stenotic flow (see table 1 for grading criteria), absence of flow and peak systolic velocity • Colour Doppler should be used to assess for the presence/absence of flow and aid the correct positioning of spectral Doppler when quantifying stenoses <p>The machine controls should be optimised continually throughout the scan to obtain the best image to aid with diagnosis.</p> <p>Evaluation of the following arteries, with a recording of the peak systolic velocity and waveforms, should be included:</p> <ul style="list-style-type: none"> • Brachiocephalic artery (Right) • Subclavian artery • Axillary artery • Brachial artery • Radial artery • Ulnar artery
	Subsequent documents: <i>VAS-MP-6 Patient management, VAS-MP-1 Results processing</i>

Reporting

The diagrammatic report is a record and interpretation of observations made during the upper limb arterial 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:

- Which arteries have been assessed commenting on the presence/absence of flow and PSVs and waveforms
- The position of any lesions should be drawn
- The approximate peak systolic velocity ratio (PSVR) and % stenoses for significant stenoses
- Any limitations e.g. difficult examination due to body habitus

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Table 1: Arterial velocity grading criteria.

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

Vs = Highest PSV at site of stenosis, Vp = pre-stenosis PSV (ref 3).

If synthetic grafts, stents or patches are present they should be drawn with dashes on sides of the artery or graft.

All diameter measurements to be documented in centimetres.

Ensure appropriate, efficient referral of critical ultrasound results to the referring clinical team are made prior to the patient leaving the department.

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

References

1.	VAS-ED-5. Vascular Technology Professional Performance Guidelines Arterial Duplex Ultrasound Examination.
2.	VAS-ED-23. SVU - Professional Performance Guidelines Upper Extremity Arterial Duplex (2019).
3.	Thrush, A. and Hartshorne, T. (2010). Vascular Ultrasound: How, why and when, 3rd edn, Elsevier Limited: London (p138).