THE SOCIETY FOR VASCULAR TECHNOLOGY OF GREAT BRITAIN AND IRELAND

Vascular Technology Professional Performance Guidelines

Extracranial Cerebrovascular Duplex Ultrasound Examination

This guideline was prepared by the Professional Standards Committee (PSC) of the Society for Vascular Technology (SVT) as a template to aid the clinical vascular scientist/vascular sonographer and other interested parties. This guideline may be used in part or in its entirety with suitable additions made by local policy implementers.
Suggestions for improvement of this guideline are welcome and should be sent to the Chair of the PSC – see www.svtgbi.org.uk for current Chair details.

Purpose

Extracranial cerebrovascular Duplex ultrasound examinations are carried out to assess for the presence of pathology and the haemodynamic status of the common carotid artery (CCA), internal carotid artery (ICA) external carotid artery (ECA) and vertebral artery.

Common Indications

Common indications for performance of this examination can include:

- Transient ischemic attacks (TIA)
- Amaurosis fugax
- Carotid bruit
- Cerebrovascular Accident (CVA)
- Follow-up of known carotid stenosis
- Post intervention follow-up e.g. carotid endarterectomy, stent or bypass
- Trauma in the distribution of the carotid artery e.g. suspected dissection, arteriovenous fistula or pseudoaneurysm
- Pre-operative assessment for high risk patients e.g. coronary artery bypass surgery (CABG)
- Pulsatile neck masses
- Evaluation of suspected subclavian steal syndrome

Contraindications and Limitations

Contraindications for extracranial cerebrovascular duplex ultrasound are few; however, some limitations exist and may include the following:

- Patients with short, thick muscular necks
- Patients who have had recent surgery, ultrasound visualisation may be limited due to oedema, haematoma, surgical staples, dressings etc.

- Calcified plaque may cause acoustic shadowing limiting Doppler and B-mode image assessment.
- Patients who are unable to lie flat due to pre-existing co-morbidities e.g. chronic obstructive pulmonary disease (COPD) and arthritis – although these patients may be able to tolerate being examined seated in a chair or with the head of the bed raised
- Patients who are unable to cooperate due to reduced cognitive functions e.g. Alzheimer's or dementia and through involuntary movements
- Examinations undertaken portably at the patient's bedside maybe limited due to equipment and room dimensions.

Equipment:
Regularly safety checked and maintained Duplex Doppler ultrasound machine with imaging frequencies of 5.0MHz or greater; Doppler frequencies of at least 3.0MHz and linear array transducer/s with colour Doppler capability[1].
Examination couch should be height adjustable preferably electrical. The CVS's chair should provide good lumbar support, be height adjustable and allow for the CVS to move close to the examination couch[2 3].
The examination room should be temperature controlled with adjustable lighting levels suitable for examination[2].
Suitable cleaning materials should be available inline with local and manufactures guidelines[1].

Explanation of examination and patient history:
The CVS undertaking the examination should:
- introduce themselves
- confirm the patient's identity e.g. full name and date of birth
- explain why the examination is being performed and give an indication of the test's duration
- give an explanation of the procedure and it's duration – consideration should be made to the age and mental status of the patient
- obtain verbal consent for the examination
- obtain a pertinent relevant medical history from the patient and/or notes
    - Presence of risk factors e.g. diabetes, hypertensions, hypercholesterolemia etc
    - Presence of cerebrovascular disease e.g. aphasia, dysphasic, paralysis etc.
    - Results of other relevant diagnostics
- Verify that the requested procedure correlates with the patient's clinical presentation

Examination:
The patient is asked to adjust their clothing to expose the neck area. The patient is examined in the supine position with their head/neck positioned in such a manner that allows the CVS maximum access to the vessels to be examined. The patient's dignity and privacy should be maintained at all times.
The standard examination should examine bilaterally the arterial supply to the head encompassing the common carotid artery (CCA), carotid bifurcation, external carotid artery (ECA) and internal carotid artery (ICA) to its most accessible distal extracranial segment. The vertebral artery should be identified to confirm direction of flow. In the presence of reversed or partially reversed flow the subclavian artery should be examined.
The CCA, carotid bifurcation, ECA and ICA are identified in B Mode using the transverse plane and longitudinal plane; B-mode can be used to classify echogenicity of any plaque and the surface characteristics e.g. irregular, smooth or ulcerated[4 5 6].

Using longitudinal plane with colour and spectral Doppler (angle of 40-60^0)[5], the extracranial carotid arteries should be assessed for any areas for velocity increase or turbulence from the CCA to the distal ICA and the vertebral artery.
Peak systolic velocities (PSV) and end diastolic velocities (EDV) should be measured and documented for a minimum of the CCA and ICA. Direction of flow must also be documented in the vertebral artery.[8]
The anatomical location of any haemodynamically significant lesion should be documented. A significant stenosis is noted by using the standard criteria:

Percentage Stenosis (NASCET)	Internal carotid peak systolic velocity cm/sec	Peak systolic velocity ratio ICA $_{PSV}$ /CCA $_{PSV}$	St Mary's Ratio ICA $_{PSV}$ /CCA $_{EDV}$
<50	<125	<2	<8
50-59	>125	2-4	8-10
60-69			11-13
70-79	>230	>4	14-21
80-89			22-29
>90 but less than near occlusion	>400	>5	>30
Near occlusion	High, low - string flow	Variable	Variable
Occlusion	No flow	Not applicable	Not applicable

Table 1. Criteria for Extracranial carotid artery duplex assessment[8]

The additional criteria parameter Internal Carotid Artery end diastolic velocity (ICA $_{EDV}$)[7] may considered useful:
<50% <40cm/sec
50-69% 40-100cm/sec
>70% but less then near occlusion >100cm/sec
Near Occlusion variable

Plaque characteristics should also be documented and the length of the lesion may also be documented.[8]
Diameter reduction measurements can be made on the B-mode image, however these will be dependent on appropriate gain selection and choice of imaging plane. Diameter measurements made in the bulb should be made using the NASCET method to correlate with the velocity criteria used, (unless clearly stated as being ESCT measurements).

Reporting:
The report is a recording and interpretation of observations made during the extracranial carotid arterial duplex ultrasound examination; it should be written by the CVS undertaking the examination and viewed as an integral part of the whole examination[5].

The report should include correct patient demographics; date of examination; examination type and the name and status of the CVS.

The reporting should include:

- Which arteries have been assessed & record the presence/absence of disease
- The following four velocities[5]:
  - PSV & EDV in the CCA 1-2cm below the bifurcation
  - PSV & EDV in the ICA at the point of highest velocity
- Qualitatively note the nature of the plaque e.g. calcified, echolucent, irregular, smooth etc, the length and anatomical position
- Percentage degree of stenosis and calculation method used i.e. ECST or NASCET[9]
- Any limitations e.g. calcified plaque causing acoustic shadowing
- An appropriate number of annotated images that represent the entire ultrasound examination - in accordance with local protocols and SVT Image Storage Guidelines[10]

Referral of critical ultrasound results should be made to the referring consultant or appropriate medical/surgical team (as per local protocol) prior to the patient being discharged so that treatment plans can be developed, enforced or expedited accordingly.

RESOURCES:

Society for Vascular Ultrasound Vascular Technology Professional Performance Guidelines Extracranial Cerebrovascular Duplex Ultrasound Evaluation 2011 www.svunet.org

American Institute of Ultrasound in Medicine Practice Guideline for the Performance of an Ultrasound Examination of the Extracranial Cerebrovascular System 2011 www.aium.org

Australasian Society for Ultrasound in Medicine Policies and Statements D17 Extracranial Cerebrovascular Ultrasound www.asum.com.au

REFERENCES:

[1] Physiological Measurement – Service Specifications Vascular Technology Test: Carotid Duplex www.svtgbi.org.uk

[2] Guidelines for Professional Working Standards Ultrasound Practice United Kingdom Association of Sonographers (UKAS) October 2008 www.sor.org/learning/document-library

[3] The Causes of Musculoskeletal Injury Amongst Sonographers in the UK Society of Radiographers, June 2002 www.sor.org/learning/document-library

[4] de Bray J M, Baud J M, Dauzat M 1997 Consensus concerning the morphology and the risk of carotid plaques. Cerebrovascular Disease 7: 289–296

[5] European Carotid Plaque Study Group 1995 Carotid artery plaque composition – relationship to clinical presentation and ultrasound B-mode imaging. European Journal of Endovascular Surgery 10: 23–30

[6] Bock RW et al Carotid plaque morphology and interpretation of the echolucent lesions. Diagnostic vascular ultrasound. Edward Arnold, London, pp 225–236 1992

[7] Carotid artery stenosis: grey-scale and Doppler ultrasound diagnosis – Society of Radiologists in Ultrasound Consensus Conference' Grant EG et al Radiology 2003; 229: 340-346

[8] Oates CP et al., Joint Recommendations for Reporting Carotid Ultrasound Investigations in the United Kingdom, Eur J Vasc Endovasc Surg (2008), http://www.bmus.org/policies-guides/CarotidRecommendationsPublishedPaperCO.pdf

[9] National Institute for Health and Clinical Excellence Stroke Diagnosis and initial management of acute and transient ischaemic attack (TIA) July 2008 www.nice.org.uk

[10] Society for Vascular Technology Professional Standards Committee Image Storage Guideline April 2012 http://www.svtgbi.org.uk/assets/Uploads/News--PI/Final-SVT-Image-Storage-Guidelines-April-2012-PDF.pdf

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