



THE SOCIETY FOR
VASCULAR TECHNOLOGY OF
GREAT BRITAIN AND IRELAND

Vascular Technology Professional Performance Guidelines

Extracranial Cerebrovascular Duplex Ultrasound Examination

Introduction

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 sonographers and other interested parties. It can be used in conjunction with local protocols agreed between sonography, renal and / or vascular departments. It may be used in part or in its entirety with suitable additions made by local policy implementors, and should be read in combination with the following SVT guidelines when setting up a carotid artery scanning service:

- Vascular Ultrasound Service Specifications¹⁰

In addition, the SVU publicationⁱ provides detailed indications for carotid artery Duplex investigations.

Suggestions for improving 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 performing this examination include:

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- 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 Limits

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.

Patient Pathway

Carotid duplex scanning will be utilised and apply to TIA and stroke patient pathways. Carotid surgery or stenting is a possible endpoint of this pathway and should be undertaken within two weeks of the TIA. Therefore, if this diagnostic test is appropriate it should be carried out urgently, preferably within 24 hours of the onset of symptoms. This could be provided in a one stop TIA clinic. Guidance is given by the Department of Health². Guidance is also given by the Royal College of Physicians (RCP) Clinical Effectiveness Unit: 'National clinical guidelines for stroke'³.

Patient Referral

A suspected neurological event (stroke, TIA or amaurosis fugax) that may have resulted from an embolic event arising from atherosclerotic disease at the carotid bifurcation is the most appropriate clinical indication for a carotid duplex scan. There are other less common indications such as a pulsatile mass in the neck.

The referral should include details of the presenting symptoms.

Patient Preparation

No specific preparation is required. Good access will be required to the patient's neck. The patient will need to maintain the desired head position and not to talk during the scan.

Explanation of Examination

The person 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 its 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, hypertension, 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 and lie or sit with their neck extended. The patient may be asked to turn the head away from the side being assessed to ensure 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 ulcerated⁴.

Using longitudinal plane with colour and spectral Doppler (angle of 45-60°)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.⁵ The joint recommendations document⁵ also gives detailed information on how velocity measurements should be made, including control settings such as Doppler gain and the placement of the velocity cursor in order to make measurements consistent.

It is recognised that ultrasound scanning is operator dependent and recording of images may not fully represent the entire examination. Recording of images should be done in accordance with a locally agreed protocol. Images that document the findings of the investigation are appropriate. Any stored images should have patient identification, examination date, organisation and department identification. Further explanation and guidance is given in section 2.6 of the SCOR/BMU guidelines⁶ and SVT image storage guidelines⁷.

The anatomical location of any haemodynamically significant lesion should be documented.

Haemodynamically significant stenoses are diagnosed 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		>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 assessment⁵

The additional criteria parameter Internal Carotid Artery end diastolic velocity (ICA_{EDV})⁸ may be considered useful:

<50% <40cm/sec

50-69% 40-100cm/sec

>70% but less than near occlusion >100cm/sec

Near Occlusion variable

Plaque characteristics should also be documented and the length of the lesion may also be documented.^{8,9,10}

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 and should be according to the NASCET method⁵. 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 person undertaking the examination and viewed as an integral part of the whole examination.

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

The report should include:

- Which arteries have been assessed & record the presence/absence of disease
- The following four velocities⁵:
 - 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 NASCET⁵
- 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 Guidelines⁷.

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.

The Joint Working Group⁵ recommended the use of a proforma reporting form that includes an illustrative diagram. The report should also include incidental findings including, carotid dissection, carotid body tumour, carotid aneurysm and carotid tortuosity. Confirmation of patency and direction of flow in both vertebral arteries should also be included. Any limitations of the scan must be included in the report. The carotid artery consensus document⁵ also gives additional guidance on report content. SCOR/BMU guidelines⁶ give more general guidance on reporting and report content.

REFERENCES:

- ¹ Society for Vascular Ultrasound Vascular Technology Professional Performance Guidelines Extracranial Cerebrovascular Duplex Ultrasound Evaluation 2011 www.svunet.org
- ² 'Implementing the National Stroke Strategy – An Imaging Guide' May 2008 <http://www.bnms.org.uk/other-guidelines/doh-publication/department-of-health-publications.html>
- ³ National clinical guidelines for stroke fifth edition prepared by the intercollegiate stroke working party 2016 <https://www.rcplondon.ac.uk/guidelines-policy/stroke-guidelines>
- ⁴ 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
- ⁵ Oates CP et al., Joint Recommendations for Reporting Carotid Ultrasound Investigations in the United. https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=2ahUKEwjVuu6E173eAhXEBsAKHU-kAwcQFjAAegQIBxAC&url=https%3A%2F%2Fwww.bmus.org%2Fstatic%2Fuploads%2Fresources%2FRecommendations_for_reporting_Carotid_Investigations.pdf&usg=AOvVaw3CiN2I9QvJKBbV6vrFUqsV
- ⁶ Society and College of Radiographers and British Medical Ultrasound Society: Guidelines for professional ultrasound practice December 2015 www.sor.org/learning/document-library
- ⁷ Society for Vascular Technology Professional Standards Committee Image Storage Guideline April 2012 <https://www.svtgbi.org.uk/professional-issues/>
- ⁸ '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
- ⁹ 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
- ¹⁰ Bock RW et al Carotid plaque morphology and interpretation of the echolucent lesions. Diagnostic vascular ultrasound. Edward Arnold, London, pp 225–236 1992

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