

Guidance

Extracranial Carotid and Vertebral Artery Duplex Examination Guidance

1 Scope

Local

2 Purpose

To provide guidance on how to perform an extracranial carotid and vertebral duplex examination using current evidence.

3 Definitions

CCA – Common carotid artery

CVS – Clinical Vascular Scientist

ECA – External carotid artery

ICA – Internal carotid artery

SA – Subclavian artery

SVT – Society for Vascular Technology of Great Britain and Ireland

VA – Vertebral artery

Vs/Vp – Peak velocity ratio: The peak systolic velocity across the stenosis (Vs) is divided by the velocity just proximal to the stenosis (Vp).

4 Introduction

Extracranial carotid and vertebral duplex ultrasound examinations are carried out to assess for the presence of pathology and the haemodynamic status of the CCA, ECA and ICA.

5 Undertaken by (staff groups)

A CVS who is accredited via the SVT or a trainee who has successfully passed the departmental competency assessment in performing and interpreting extracranial carotid and vertebral artery duplex examinations.

6 Clinical equipment list

Duplex ultrasound scanner with both linear and curvilinear transducers. A low and high frequency probe should be available.

7 Limitations

- Patients with short thick muscular neck.
- Limited visualisation of the vessels due to post-surgical oedema, haematoma, surgical stapes, dressings etc.
- Heavy calcification may obscure the lumen.

8 Chaperones

Chaperone posters are displayed in patient waiting areas advising patients that they may bring a friend or relative into the room with them or request a formal chaperone. All patients have the right to a chaperone if they request one.

As per trust and SVT chaperone guidance documents (see associated documents), it is mandatory to have a formal or informal chaperone present when scanning children under 18. It is mandatory to have a formal chaperone present for patients:

- with communications needs or learning difficulties
- who are intoxicated with drugs or alcohol
- who are unconscious
- where English is not their first language
- who are vulnerable for other reasons not stated.

9 Method

The patient is positioned supine on the couch.

The following arteries should be evaluated, using **B-mode, Colour and Spectral Doppler**:

- CCA. Include the origin on the right, scan as far as can be seen proximally on the left.
- ICA.
- ECA.
- VA.
- In the presence of reversed or partially reversed VA flow the SA should be examined.

Vessels should be examined in transverse and longitudinal planes. Scan through the CCA to the carotid bifurcation including the ICA and the ECA origin. The ICA should be followed as far distally as possible, noting any disease and paying particular attention to the ICA origin. This process is repeated using B-mode in the longitudinal plane, noting and reporting the characteristics of the plaque (echogenicity and surface).

In a longitudinal plane, using colour and spectral Doppler, waveforms are recorded at the CCA, ECA and ICA.

Velocities must be measured in and around any stenosis. Angle correction is made in line with flow, ensuring that the angle is $\leq 60^\circ$ and $\geq 45^\circ$. If there is a haemodynamically significant stenosis in the ICA, the highest velocity measurement is used to determine the degree of stenosis (see Section 10.0)

If significant disease is present in the ICA, the distal extent should be assessed and reported, i.e. *"Distally the ICA is fully patent"*. If no clear vessel can be seen beyond the stenosis, alternative imaging modalities may be required to confirm the endpoint of disease. In cases where the indices do not agree or are borderline, then both +/-50% and +/-70% grading can be used.

In the presence of a large bulb (>1cm), 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).

For a CCA stenosis the peak velocity ratio (V_s/V_p) should be used to grade disease with a >2-fold velocity increase from adjacent measurements indicating a >50% stenosis.³

If there is a haemodynamically significant stenosis in the ECA the highest velocity measurement is recorded on the report and an estimate of degree of stenosis made.

For non- significant disease in the CCA, ECA and ICA, an estimate should be made using b-mode and colour Doppler.

The VA should be examined to identify direction of flow, if retrograde flow or partially reversed flow is identified, the proximal SA should be imaged to look for stenosis indicating subclavian steal.

10 Interpretation

10.1 Stenosis interpretation:

PERCENTAGE STENOSIS (NASCET)	ICA _{PSV} (cm/sec)	PSV RATIO ICA _{PSV} / CCA _{PSV} (cm/sec)	PLAQUE ESTIMATE *
Normal	< 125	< 2.0	None
1 - 29%	< 125	< 2.0	1 - 29%
30 - 49%	< 125	< 2.0	30 - 49%
50 - 69%	> 125	2.0 - 4.0	≥ 50%
70 – 89%	> 230	> 4.0	≥ 50%
≥90 but less than near occlusion	> 400	> 5.0	Severe
Near occlusion	High, low - string flow	Variable	Near Occlusion
Occlusion	No flow	n/a	Visible, no detectable lumen

Table from Oates et al.¹

10.2 Plaque characterisation²:

- Type I – Echolucent plaque
- Type II – Heterogeneous plaque, predominantly echolucent
- Type III – Heterogeneous plaque, predominantly echogenic
- Type IV – Echogenic plaque
- Type V – Unclassified due to poor visualisation or calcification

11 Images

The following images should be recorded as a minimum:

- Right and left CCA spectral trace with velocity
- Right and left ICA spectral trace with velocity
- Right and left ECA spectral trace with velocity
- Vertebral artery with colour flow indication direction

12 Reporting

A report should be completed and signed on Epic within 24 hours. This will be sent to the referring source and a copy is saved in the imaging section of the patient's chart. The report should include:

- PSV and EDV from the CCA, ICA and ECA
- Plaque characteristics if present (echogenicity and surface)
- Diagram (if significant stenosis)
- Percentage stenosis (NASCET) by velocity criteria
- Direction of flow in the VA
- Any limitations
- Any incidental findings, such as a dissection or aneurysm

Any urgent findings should be communicated to the requesting Doctor immediately.

13 Monitoring compliance with and the effectiveness of this document

Key standards to be monitored:

- That CVS perform extracranial carotid and vertebral duplex examinations in line with this guidance

This will be monitored and carried out by CVS by:

- Departmental audits
- Peer review
- Attending MDT meetings
- Attending vascular surgery audit meetings
- Patient satisfaction surveys

The lead CVS is responsible for overall compliance and follow up of any actions identified.

14 References

1. Oates, C. P. *et al.* (2009). Joint Recommendations for Reporting Carotid Ultrasound Investigations in the United Kingdom. *EJVES* 37(3), 251-261.
2. Langsfield, M., Gray-Weale, A.C., Lusby, R.J. (1989). The role of plaque morphology and diameter reduction in the development of new symptoms in asymptomatic carotid arteries. *Journal of Vascular Surgery* [e-journal]. Available at: [https://www.jvascsurg.org/article/0741-5214\(89\)90471-0/fulltext](https://www.jvascsurg.org/article/0741-5214(89)90471-0/fulltext)

3. Thrush, A. & Hartshorne, T. (2010). *Peripheral Vascular Ultrasound How, Why and When* (3rd Edition). London: Elsevier Churchill Livingstone.

15 Bibliography

Cole, S. E. A. (Ed.) (2001). *Vascular Laboratory Practice - Part II Extra and Intracranial Arterial Assessment*. York: Institute of Physics and Engineering in Medicine.

Society of Vascular Technology of Great Britain and Ireland, Professional Standards Committee (2012). *Vascular Technology Professional Performance Guidelines - Extracranial Cerebrovascular Duplex Ultrasound Examination*. Website; <http://www.svtgbi.org.uk/assets/Uploads/Professional-Issues/Carotid-Protocol-PSC-Final-Draft-Oct-2012.pdf>

16 Associated documents

Cambridge University Hospitals NHS Foundation Trust, 2016. *Chaperones: Requirement for use of chaperones*. [online] Cambridge University Hospitals NHS Foundation Trust. Available at: <http://merlin/Pages/Results.aspx?k=chaperone%20policy>

Professional Standards Committee, 2012. *SVT Chaperone Guidelines*. [online] Society for Vascular Technology of Great Britain and Ireland. Available at: <https://www.svtgbi.org.uk/professional-issues/>

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Department of Vascular Surgery

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