These guidelines describe current local practice. They are intended to be an aid to best practice rather than to beprescriptive.

Carotid and Vertebral Artery Duplex Protocol

**Patient Identification**

Ask the patient their full name, date of birth and\or address and check that these correlate with the request form (OUH Identification Policy Nov 2012).

If the patient is unable to communicate these details clearly, check inpatient wristband or ask accompanying relative/carer to confirm identity.

**Patient Dignity**

Ensure that the scanning environment is private and ensure the patients’ dignity at all times. Always ask permission from the patient for other people to watch the scan including medical students and other health professionals.

**History**

Take a brief history to ascertain relevant facts that will help support and direct the investigations such as date and duration and description of symptoms. If a stroke or TIA is suspected, ask the patient to point to the relevant side affected.

**Explanation of Investigation**

The scanning procedure and purpose of the scan should be explained to the patient in a clear and concise manner.

**Consent**

Patients must consent to the scan (see ORH trust policy for Consent to Examination or Treatment, June 2012). By attending an appointment it is assumed the patient is consenting to have a scan but this must be confirmed verbally. Discontinue scan if requested to do so.

**Patient position**

Ask patient to lie supine with head slightly tilted back rotated away from side being examined.

# Examination

**B Mode**

With the 9-3MHz linear array transducer, locate the common carotid artery (CCA) at the base of the neck. Follow the CCA, internal carotid artery (ICA) and external carotid artery (ECA) up the neck.

Examine the carotid arteries in a longitudinal and transverse plane. Image the vessels from several directions as necessary to best demonstrate any calcification or plaque, in particular at the carotid bifurcation.

**Colour and Pulsed Doppler**

* Repeat the process of assessing the vessels using Colour Doppler visualizing as proximally and distally as possible.
* Obtain Doppler waveforms in the distal CCA (1-2cm from bifurcation), ICA and ECA and at sites where pathology is seen or suspected, ensuring the highest velocities obtainable at each site are recorded. Peak systolic velocity (PSV) and end diastolic velocity (EDV) should be measured. The extent of disease in the carotid arteries, especially the internal carotid artery, should be noted, as well as the morphology of plaques, possible dissections and any ulceration or unusual appearance. Where major disease is seen in the proximal ICA, an assessment of the size and patency of the distal ICA should be made. The CCA reference velocity measurements should be taken from approx 1-2cm proximal to the bifurcation provided no significant disease is present at this location.
* Also comment on the level of bifurcation in the neck, length of plaque and presence of a patent distal vessel in any surgically significant diseased vessels.
* All velocity measurements should normally be made with a Doppler angled of 600 or between 45 and 60 degrees1.
* Locate and obtain a waveform from the vertebral artery and note the direction of flow.
* If flow is retrograde or partially retrograde to the CCA flow, obtain a waveform from the subclavian artery and assess for proximal disease i.e. subclavian steal. Note any abnormal flow signals/velocities.

# Examination Report

Complete the attached electronic report form colouring in any disease on the diagram.

**Percentage Stenosis**

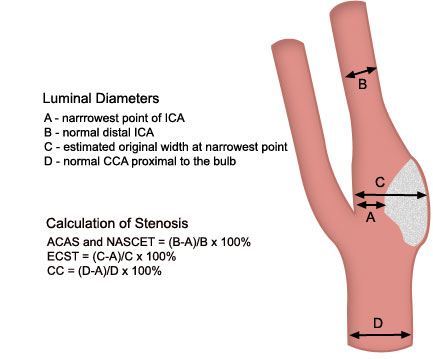
Where possible, the ‘Joint Recommendations for Reporting Carotid Ultrasound Investigations in the United Kingdom’ should be used as the primary method of calculating a >50% ICA stenosis as per the table below. However, if an acceptable correlation cannot be obtained between the peak systolic velocity and one or more velocity ratios then the following may be used –

* A combination of peak systolic velocity and visual assessment using B-mode and colour Doppler.
* Calliper measurements using strict NASCET criteria.

The method used must be clearly stated on the report.

For ICA stenoses <50% that are not clearly supported by velocity ratios as shown on the table, visual assessment or calliper measurements of diameter reduction can be used as per the diagrams below. The method used must be indicated on the report as these measurements do not follow NASCET criteria.

# Assess percentage stenosis in the internal carotid artery (ICA) using the table overleaf. If unsure, take measurements of the clear vessel lumen and the residual diameter within the stenosis to aid assessment of the degree of stenosis (diameter reduction) using NASCET criteria.



NASCET = B-A x 100%

B

Report a 65% stenosis as per local protocol i.e. **≥65% if PSV ≥180.**

In the presence of a significant stenosis with severe contralateral disease or occlusion, the report should explain that any elevated velocities present may be due to this side acting as a collateral pathway which may lead to elevated disease predictions.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Diameter Reduction** | **PSV** | **EDV** | **PSVICA/**  **PSVCCA** | **St Mary’s ratio**  **PSVICA/**  **EDVCCA** | **Oxford General Comments** |
| 0-29 | <100 | <40 | <3.2 |  |  |
| 30-49 | 110-130 | <40 | <3.2 | <8 |  |
| 50-59 | >130 | <40 | <3.2 | 8-10 |  |
| 60-69 | >130 | 40-110 | 3.2-4.0 | 11-13 | ≥65% if PSV ≥180 |
| 70-79 | >230 | 110-140 | >4.0 | 14-21 | ≥70% if PSV ≥230,  EDV may vary |
| 80-89 | >230 | >140 | >4.0 | 22-29 | ≥80% if PSV ≥300,  EDV generally ↑  85% if PSV >400 |
| >90 | >400 | >140 | >5 | >30 | 90% if PSV >500 |
| 96-99 | “STRING FLOW” | |  |  |  |
| 100 | NO FLOW | |  |  |  |

**Total Occlusion and Sub-occlusion**

Total occlusion may be reported when no flow is observed on colour flow image and no Doppler waveform can be detected. The CCA may demonstrate no flow during diastole.

If the vessel is patent but with very poor trickle flow, a sub-occlusion should be reported.

In the case of a total occlusion of the CCA the direction of flow in ECA-ICA should be noted. (It may be retrograde in the ECA). Settings should be adjusted accordingly to assess low flow.

**Plaque Morphology**

Describe plaque morphology using Gray-Weale classifications3 but using the following wording:

## Smooth

* Irregular
* echolucent
* echogenic
* Mixed
* Ulcerated

**Tortuous Carotid Artery**

Note if vessels are tortuous or kinked. Where there is a ‘hairpin loop’ (180º turn on itself), this should also be reported. If these significantly impact on flow, this should be reported.

**Additional Information**

Note incidental findings, e.g. enlarged thyroid, splayed carotid arteries. If a carotid body tumour or aneurysm is detected note the size, position and extent.

**Scan Confidence**

# Report confidence of scan results:

4-5/5 clear scan

3/5 difficult scan - may require repeat scan or alternative imaging

1-2/5 very difficult scan, unable to obtain views

State in the report if the scan was suboptimal

**Additional trainee requirements**

In addition to the above, trainees will be expected to practice and demonstrate the following steps

1. Start the scan with a preliminary mapping of the vessels and any disease in B-mode and colour Doppler by,

* Imaging the CCA, bifurcation, ICA and ECA in B-mode both longitudinally and in transverse.
* Imaging the CCA, bifurcation, ICA and ECA with colour Doppler both longitudinally and in transverse.
* Call for assistance if the preliminary assessment suggests a >50% stenosis.

1. Image the subclavian arteries and assess for any proximal disease using colour Doppler and spectral Doppler.

# Patient Management

**Normal**

If normal scan or <50% ICA stenosis – send letter to the referring doctor and GP.

If very soft plaque or thrombus is seen this should be reported to the referring consultant for urgent consideration. Occasionally a 55% stenosis may be considered for surgery.

**Abnormal** (symptomatic >50% stenosis)

Send a copy of the report and referral letter to the vascular consultant on call for the coming weekend.

**Significant disease** (more than 65% stenosis)

If asymptomatic, send a report to referring physician and also to the vascular consultant on call for the weekend.

If the patient has been symptomatic recently (within last thirty days), contact vascular team to see patient:

1. Call or bleep registrar on call for day, on behalf of consultant on call for weekend

If no reply:

1. Registrar for Consultant on call for weekend.
2. Consultant on call for that day.
3. If unable to contact a member of the vascular team, arrange for patient to be seen at next outpatient clinic and leave copies of report for appropriate Consultant and Registrar.

**Pre-Carotid Endarterectomy**

All patients have a repeat scan within 24 hours prior to carotid endarterectomy to check patency of internal carotid artery, assess extent of stenosis, calibre of the distal vessel and mark the bifurcation. High or low bifurcations are noted.

**References**

1 Oates, CP, Naylor AR, Hartshorne, T et al. Joint Recommendations for Reporting Carotid Ultrasound Investigations in the United Kingdom

2 Sidhu PS, Allan PL. Ultrasound assessment of internal carotid artery stenosis. *Clin Radiol.* 1997;52:656.

3 Gray-Weale AC, Graham JC, Burnett JR, Bryne K, Lusby RJ. Carotid artery atheroma: comparison of preoperative B-mode ultrasound appearance with carotid endarterectomy specimen pathology. *J Cardiovasc Surg.* 1988;2:676–681.



**Jackie Walton Vascular Studies Unit (VSU)**

*Professor Halliday, Clinical Director Klaus Bond, Chief Vascular Scientist*

NAME

DoB

HOSP. NUM.

**Carotid Artery Duplex Scan Report**

Date

Referring Doctor

Plaque type

Imaging quality =

(1/5=poor, 5/5=high)

**Summary Right**

|  |  |  |  |
| --- | --- | --- | --- |
| **Right Carotid** | | | |
| (cm/s) | **peak systolic** | **end diastolic** |
| **CCA** |  |  |
| **ICA** |  |  |
| **ECA** |  |  |
| **Vertebral** |  | |

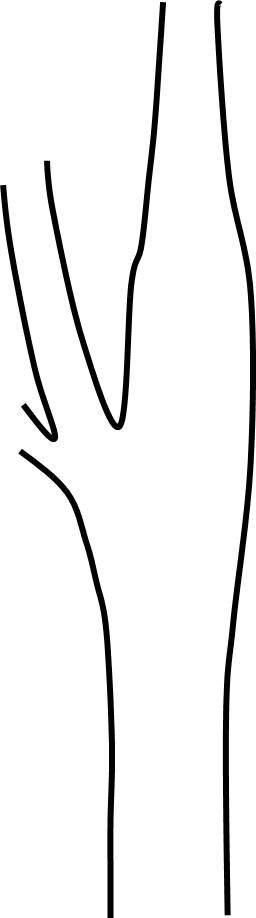
|  |  |  |  |
| --- | --- | --- | --- |
| **Left Carotid** | | | |
| (cm/s) | **peak systolic** | **end diastolic** |
| **C****CA** |  |  |
| **I****CA** |  |  |
| **E****CA** |  |  |
| **Vertebral** |  | |

Plaque type

Imaging quality =

(1/5=poor, 5/5=high)

**Summary Left**



CCA

ICA

ECA



CCA

ICA

ECA

Symptoms

**R ICA:**

**Grading method=**

**L** **ICA:**

**Grading method=**

***Plaque type-***

*E=Echogenic*

*M=Mixed Echogenic*

*S=Soft echolucent*

*C=calcified*

*I=irregular*

*U=Ulcerated*

Scanned by:

