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| **Effective Date: 05.05.2020** |  | **Review Date:** | **2021** |

**DUPLEX OF CAROTID VERTEBRAL ARTERIES**

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# Purpose

Extracranial cerebrovascular Duplex ultrasound examinations are carried out to assess 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.

# Revision History

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| **Date** | **Revision No.** | **Change** | **Reference**  **Section(s)** |
| 24.07.2019 | 5 | General Update | Entire Protocol |
| 06.04.2020 | 6 | General Update | Entire Protocol |

# Persons Affected

All Vascular Laboratory Physiologists, Vascular Consultants, NCHD’s and Patients of the Vascular Laboratory

# Policy

The policy is to ensure that all Vascular Laboratory Clinical Staff are aware of and understand the protocol for Duplex Assessment of and the follow up of patients with carotid artery disease as appropriate.

# Definitions

Vascular Laboratory Physiologists (VP), Vascular Laboratory (VL), Patient Centre (PC), Common carotid artery (CCA, Internal carotid artery (ICA), External carotid artery (ECA), Vertebral Artery (VA), Transient ischemic attacks (TIA), Cerebrovascular Accident (CVA), Coronary Artery Bypass Graft (CABG), Peak Systolic Velocity (PSV), End diastolic Velocity (EDV), Non consultant hospital doctors (NCHD)

# Responsibilities

Vascular Physiologists, Vascular Consultants, Vascular Surgical Team and Vascular Administrating staff

# Procedures

**Carotid and Vertebral Artery Duplex Ultrasound Examination**

**Reference: Vascular Laboratory Practice Manuals Part 2**

**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, carotid stenting or bypass
* Trauma in the distribution of the carotid artery e.g. suspected dissection, arteriovenous fistula or pseudo aneurysm
* Pre-operative assessment for high risk patients e.g. Vascular Surgery, Patients undergoing coronary artery bypass surgery (CABG), Aortic Valve replacement, Orthopaedic Surgery or other surgeries when required by the pre op assessment clinic.
* 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

room functionality such as lay out and brightness.

**Equipment:**

* Regularly safety checked and maintained Duplex 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
* Examination couch should be height adjustable preferably electrical. The VP’s chair should provide good lumbar support, be height adjustable and allow for the VP to move close to the examination couch
* At all-times the examination room should be temperature controlled with adjustable lighting levels suitable for examination
* Suitable cleaning materials should be available in line with local and manufactures guidelines
* All ultrasound system should undergo regular service checks as provided by the Vendor of the system. A suitable log of these records should be maintained
* All ultrasound cables must be hooked up off the floor in the hooks required in each room, failing this the cables must be hooked off the floor onto the back of the ultrasound system (Picture 1 & 2 Below). It is the physiologist responsibility to ensure that the surrounding environment is safe for both themselves and the patient

A picture containing indoor, room, computer, desk

Description automatically generated

A close up of a computer

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*Picture 1.0 Machine Hook for Cables Picture 2.0 Ceiling Hook for Cables*

**Explanation of examination and patient history:**

The Physiologist 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 as appropriate
* Presence of cerebrovascular disease e.g. aphasia, dysphasic, paralysis etc.
* Verify that the requested procedure correlates with the patient’s clinical presentation

**Examination:**

**Reference: Vascular Laboratory Practice Manuals Part 2**

* 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 VP 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
* Using longitudinal plane with colour and spectral Doppler (angle of 40-60 degrees and parallel to the vessel wall), the extra cranial 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
* The anatomical location of any haemodynamically significant lesion should be documented. A significant stenosis is noted and graded appropriately following the standard widely accepted criteria laid out by Oats et al 2009. (Table 1.0) (See reporting Standards Folder for full Text)
* Plaque characteristics should also be documented, and the length of the lesion may also be documented
* In appropriate cases the diameter reduction measurements can be made on the B-mode image and documented in the report, 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)

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| **Velocity Criteria (cm/s)** | **ICA stenosis** |
| PSV ≤110 In the presence of Plaque | 0-29% |
| PSV 110-125 In the presence of Plaque | 30-49% |
| PSV >125 and ICA/CCA ratio <4 | 50-69% |
| PSV >125 and ICA/CCA ratio >4 or EDV >110cm/sec | 70-80% |
| PSV >125 and EDV ≥140 | 80-90% |
| PSV >125 and EDV ≥200 | 90-99% |
| No colour flow or Doppler signal | Occluded |
| **CCA/ECA Ratio** | **ECA Stenosis** |
| Doubling of velocities | >50% |
| Trebling of velocities | >75% |
| Four times velocities | >95% |

*Table 1.0 Criteria for Extracranial carotid artery duplex assessment (Oates et al, 2009)*

**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 VP 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 Physiologist.

The reporting should include:

* Which arteries have been assessed & record the presence/absence of disease
* The following four velocities:
* 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
* 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
* 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.

**Follow Up Procedures**

New Carotid Patients



>70%

50-69%

Out Patient

Inpatients

Suggest Vascular Surgical Referral

Please advise re follow up

No Further FU

Outpatients

Suggest Vascular Surgical Opinion

Recommend FU for 1 year – No FU ordered by VP

50-69%

<50%

>70%

Inpatients

Suggest Vascular Surgical Opinion

Recommend FU for 1 year – No FU ordered by VP

Follow up Patients

Vascular SOPD Please advise re follow up

FU in 1 Year

Under Vascular

Symptomatic

Contact Vascular Consultant

Asymptomatic   
vascular SOPD or suggest vascular surgical opinion as appropriate

Follow up in 18 months with SOPD

No Further FU

Follow up Yearly

>50% stenosis on contralateral side

Normal Contralateral Side

6 Months

Post op

6 Weeks

Post CEA