**Introduction**

This protocol was prepared by the Senior Vascular Physiologist. The SVT guidelines were used in conjunction with our current lab practices.

Extracranial carotid duplex ultrasound examinations are carried out to assess for the presence disease within the arteries and the haemodynamic status of the common carotid arteries (CCA), external carotid arteries (ECA), internal carotid arteries (ICA) and the vertebral arteries.

**Common Indications**

1. Transient ischemic attacks (TIA)
2. Amaurosis fugax
3. Cerebrovascular Accident (CVA)
4. Carotid bruit
5. Follow up of known carotid stenosis
6. Post intervention follow up ie following carotid endarterectomy or carotid stenting
7. Trauma in the distribution of the carotid artery ie; suspected dissection, arteriovenous fistula, FMD
8. Pre-operative assessment for high risk patients ie coronary artery bypass surgery (CABG) and aortic valve replacement (AVR)
9. Evaluation of suspected subclavian steal syndrome
10. Pulsatile neck masses

**Limitations**

1. It may be difficult to visualise the vessels within the neck of patients who have had recent surgery and have surgical staples or dressings
2. Patients with short thick muscular necks
3. Calcified plaques within the arteries may cause acoustic shadowing which will limit Doppler and B-Mode imaging
4. Patients with high carotid bifurcations
5. Patients who are unable to lie flat due to pre-existing co morbidities such as chronic obstructive pulmonary disease (COPD)
6. Patients who are unable to transfer on to a bed due to lack of mobility
7. Patients who are unable to co-operate due to reduced cognitive functions such as Alzheimer’s or dementia

**Patient Pathway**

Carotid duplex scanning is an essential element of TIA and stroke patient pathways. Carotid surgery such as endarterectomy and stenting are usually the endpoint of this pathway.

**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 an appropriate clinical indication for carotid duplex scan. The referral should include details of the presenting symptoms.

**Patient Preparation**

No preparation is required. The examination is performed in the supine position. The patient will be instructed to rotate their chin away from the side of neck being assessed so sufficient access to the vessels can be achieved. The patient will be instructed to breathe normally and avoid speaking during the examination.

The examination should be fully explained to the patient and consent obtained. Patient name and date of birth must be confirmed. Relevant medical history should be taken prior to the examination. Such as:

* Presence of risk factors eg diabetes, hypertension, hypercholesterolemia
* Presence of cerebrovascular disease eg aphasia, dysphasia, paralysis etc

**Examination**

This is a bilateral scan. The Vascular Physiologist must record which side of the neck and which vessel is being interrogated on the image for example R CCA etc.

1. The patient will be asked to adjust or loosen their clothing around the neck to expose the neck area.
2. The Vascular Physiologist will insert tissue into the collar or neck of the patient's top, to prevent gel rubbing onto the clothes
3. The patient will be asked to turn their head away from the side being assessed to ensure maximum access to the vessels.
4. Apply ultrasound gel to the correct linear array transducer and select the Carotid programme on the Ultrasound machine
5. There will be constant adjustment of the different functions on the control panel throughout the exam to ensure optimal imaging and spectral analysis eg., depth, focus, gain, TGC, sample volume size, colour box, colour scale etc.
6. In the transverse plane in B-mode locate the CCA and slide the transducer down the neck as far as possible to locate the proximal CCA.
7. Slide the transducer towards the head, maintaining the CCA in the centre of the image, noting location and nature of plaque
8. Locate carotid bifurcation and note nature and location of plaque
9. Identify ICA and ECA and note presence of atheroma/plaque, measure the reduction in the lumen of the vessel using the calipers
10. Repeat steps 6-9 using Colour Doppler
11. In longitudinal plane locate CCA in BMode and slide transducer to the base of the neck
12. Locate plaque if any, move transducer upwards towards the bifurcation, recording any atheromatous changes
13. Note and record the presence and extent of atheroma at bifurcation, measure the length of the plaque and the longitudinal reduction in the AP lumen of the vessel using the calipers
14. Follow the ICA distally, recording any abnormality
15. Repeat steps 11-14 using Colour Doppler

**Doppler Interrogation**

Doppler information is obtained in the longitudinal plane using velocity domain. The Doppler sample volume must be placed in the centre of the patent vessel, with the angle cursor line aligned parallel to the vessel wall. The optimum Doppler angle is 60 degrees; however an angle of 45-60 degrees may be acceptable if the vessel is tortuous for example. Note: in the presence of a stenosis, the cursor line must be aligned parallel to the blood flow.

The colour box is also used to highlight vessel filling and any colour changes in particular colour aliasing may be indicative of increased flow velocities. Thus spectral analysis should be conducted in these areas of colour aliasing to establish any velocity abnormalities.

1. Doppler interrogation begins at the proximal CCA. Record the proximal CCA peak systolic velocity (PSV). Make note of the type of Doppler signal (peripheral type signal or normal doppler shift)
2. Walk the Doppler sample volume through the CCA and record the distal CCA PSV.
3. Examine the carotid bulb
4. Examine the ECA, document any plaque and measure the Peak systolic velocity.
5. Examine the ICA, document any plaque and measure the Peak systolic velocity and end diastolic velocity (EDV) throughout the ICA
6. Note the presence of spectral broadening.

**Vertebral Artery interrogation**

1. Locate the vertebral artery as proximal as possible
2. Colour is used to aid identification of the Vertebral artery and to assess its patency.
3. Note direction of flow and signal type.
4. If reverse flow is detected within a vertebral artery the ipsilateral subclavian artery should be assessed for patency, stenosis and direction of blood flow to confirm or out-rule subclavian steal syndrome.

**Interrogation of results - Stenosis Criteria of the NIVU.**

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| Less than 30% stenosis | Minimal spectral broadening, PSV of ICA less than 1.25 m/s |
| Less than 50% stenosis | Spectral broadening, PSV of ICA less than 1.25 m/s |
| 50-70% stenosis | PSV ICA greater than 1.25m/s (greater than 50% diameter stenosis) |
| 70-80% stenosis | ICA PSV 4 times greater than the distal CCA PSV |
| 80-90% stenosis | ICA EDV greater than 1.4 m/s |
| 90-99% stenosis | ICA EDV greater than 2.0 m/s |
| Sub optimal occlusion | Low velocity cephalad flow (trickle flow) |
| Total occlusion | No flow detected, peripheral signal in CCA |

**Reporting**

The report is a recording and interpretation of observations made during the assessment. It should be written by the Vascular Physiologist who performed the exam**.**

The Non-Invasive Vascular Unit has a standardised reporting system for each examination so that all Vascular Physiologists and clinicians alike can understand the report.

The report should include:

* Patient name, Medical Record Number, Date of examination, examination type, Vascular Physiologists initials.
* Which arteries have been assessed and record the presence or absence of disease
* PSV in the proximal and distal CCA
* PSV in the ECA
* PSV and EDV in the ICA at the point of highest velocity
* Qualitatively note the nature of the plaque eg calfcified, echolucent, irregular, smooth and include the length and anatomical position
* Percentage degree of stenosis
* Confirmation of patency and direction of flow within both vertebral arteries
* Any limitations encountered during exam for example calcified plaque causing acoustic shadowing
* Recommendations for further imaging in the event of a limited examination
* An appropriate amount of annotated images that represent the entire ultrasound examination in accordance with department protocol
* Any significant or unexpected findings should be recorded using the PACS peervue system
* The referring doctor/team must be contacted at time of examination referring them to the report findings in the patient’s chart so that a treatment plan can be developed or expedited.