

## Vascular Laboratory Guidelines

### **Carotid Duplex Scan**

#### **Patient Preparation:**

Check patient's identification (2 forms of i.d)

Explain test procedure

Obtain verbal consent or implied consent (if patient gets undressed / lies down for scan)

Take relevant history from patient

Ask patient to undress as appropriate and remove jewellery if necessary.

#### **Scanner Preparation:**

The probes should be cleaned with Clinell wipes (green packet) after each patient. If a patient is infectious, all staff should follow the Trust's guidelines/policy on infection control. For infectious patients the cleaning of the ultrasound room should be done as outline in the form shown in appendix A. This form should be signed and kept in the department for audit purposes. The scanners and probes must be cleaned to the manufacturer's guidelines.

#### **Procedure:**

1. Scan ideally performed with the patient lying supine, the patient's head turned and the neck extended.
2. The accessible length of the common carotid artery (CCA), internal carotid artery (ICA), the proximal external carotid artery and a segment of the vertebral artery are examined using B-mode, colour flow imaging and spectral Doppler bilaterally. It is necessary to assess and compare the arteries on each side in order to account for any collateral flow effects.
3. The peak systolic velocity (PSV) and end diastolic velocity (EDV) should be recorded from the distal CCA (within 2cm of the bifurcation at a point where the vessel still has uniform diameter) and the ICA at the location where the highest PSV is seen.
4. The highest PSV in the diseased ICA will be seen at the point of tightest stenosis or in the jet immediately distal to the stenosis.
5. All velocity measurements should be made with the vessel in longitudinal section, the centre-line velocity measured and the correct Doppler gain.
6. The Doppler angle should be 45-60° with proper correction/calibration applied using the angle correction cursor. In the case of a tortuous vessel the cursor should be aligned to the tangent of curvature at the measurement point. In the case of the eccentric jet within a stenosis the angle cursor should be aligned to the jet.
7. For investigation of Carotid Body Tumour, often suggested by abnormal hormone levels or activity (i.e. catecholamines), image both carotid bifurcations. Note any

hypervascular formation seen nestled in or surrounding the bifurcation. If a mass is seen splaying the ICA and the ECA, but no colour flow signal is obtained, adjust the PRF to enable detection of any low velocity flow within the mass.

#### Criteria for classification of stenosis:

Percentage Stenosis (NASCET)	ICA PSV* (cm/s)	ICA EDV* (cm/s)	ICA <sub>PSV</sub> /CCA <sub>PSV</sub> <sup>*</sup>	ICA <sub>PSV</sub> /CCA <sub>EDV</sub> <sup>c+</sup> (St Mary's Ratio)
<50	<125 <sup>a</sup>	<40	<2 <sup>a</sup>	<8
50-59	>125 <sup>a</sup>	40-100	2-4 <sup>a</sup>	8-10
60-69				11-13
70-79				14-21
80-89	>230 <sup>a</sup>	>100	>4 <sup>a</sup>	22-29
>90 but less than near occlusion				>30
Near occlusion	>400 <sup>b</sup>	Variable	Variable	Variable
Occlusion	High, low-string flow	Variable	Variable	Variable
	No flow	Not applicable	Not applicable	Not applicable

- <sup>a</sup> Grant et al 2003
- <sup>b</sup> Filis et al 2002
- <sup>c</sup> Nicolaides et al 1996
- \* Primary Parameters, + Additional Parameters

Disease of less than 50% may be graded using the B-mode and colour flow imaging. An approximation of the diameter reduction may be given.

#### Limitations of the criteria:

1. Large plaques in large bulbs (e.g. >10mm diameter) but with a good residual lumen may still be a significant risk factor for embolic events. If this is the case then the bulb diameter and plaque thickness can be measured, noting that there is a good residual lumen.
2. An irregular heartbeat makes the velocity measurements less reliable. Where possible, the velocity should be measured on the second or subsequent cardiac cycle of a string of consecutive regular cycles.
3. Potential sources of variability in the ICA PSV:
  - a. Variation in the geometry of the bifurcation and the size of the bulb (Schulz and Rothwell, 2001a)
  - b. Variation in the vessel size that reflects body size (Schulz and Rothwell, 2001b)
  - c. Collateral flow effects (Henderson et al, 2000 and Ray et al, 2000)
  - d. Change in ICA flow over the menstrual cycle (Krejza et al, 2001)
  - e. Change with age and blood pressure (Spencer et al, 2001)
  - f. The physical parameters of the ultrasound machine (Hoskins 1999)

The effect of these factors on blood velocities in diseased vessels is mitigated by the use of velocity ratios.

4. Where there is bilateral zero or retrograde end-diastolic flow in the CCA (possible aortic valve disease) the St Mary's ratio should not be used.
5. Where there is bilateral reduction in diastolic flow, there may be reduced vessel wall compliance due to arteriosclerosis, the St Mary's ratio should not be used.
6. Where there is moderate to severe disease on one side and severe disease on the contralateral side, velocities tend to overestimate the stenosis on the less severe side as the vessel is acting as a collateral.
7. Inadequate visualisation – this should be recorded in the report and an alternative imaging modality recommended.
8. Unusual waveforms that may suggest inflow or outflow problems.

### **Report:**

The report should include velocity measurements made in the CCA and ICA which are used to quantify degree of narrowing using the criteria above. The location of atheroma should be noted. In the presence of >70% stenosis, the absence of a normal calibre patent ICA distal to the stenosis should be highlighted.

Written reports will be available on Rad Centre/PACS. Diagrams can be drawn in complex cases and where they add value to the report. These diagrams will be scanned onto electronic medical records (EMR). However General Practitioners (GP) cannot access EMR to review diagrammatical results, therefore, the scan results should be a written report on RADCentre/PACS.

If a >70% stenosis is identified during an inpatient scan, the referring doctor or ward should be informed. If a >70% stenosis is identified during an outpatient scan, a copy of the report or outcome should be emailed to the referring consultant.

If during the scan there is an incidental finding that is serious and unexpected then at the bottom of the report the following caption should be added: [ALERT]

### **Recommended images to be stored on PACS:**

- Spectral Doppler image of waveform velocities in bilateral CCA
- Spectral Doppler image of waveform in bilateral ECA
- Spectral Doppler image of waveform velocities in bilateral ICA
- Spectral Doppler image of waveform in bilateral vertebral artery
- If stenosis is present, store images of highest velocity detected within / post stenosis
- If stenosis is present, store B-mode and colour flow images of plaque

- Store images of any other relevant pathology detected
- Nb. In a one-stop clinic environment where time is limited, it may be difficult to record all of the above images

## References:

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- Grant, E.G., Benson, C.B., Moneta, G.L., Alexandrov, A.V., Baker, J.D., Bluth, E.L. et al (2003) Carotid artery stenosis: gray-scale and Doppler ultrasound diagnosis - society of radiologists in ultrasound consensus conference. *Radiology* **229**:340-346.
- Henderson, R.D., Steinman, D.A., Eliasziw, M. and Barnett, H.J. (2000) Effect of contralateral carotid artery stenosis on carotid ultrasound velocity measurements. *Stroke*; **31**: 2636-2640.
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- Krejza, J., Mariak, Z., Huba, M., Wolczynski, S. and Lewko, J. (2001) Effect of endogenous estrogen on blood flow through carotid arteries. *Stroke*; **32**: 30-36.
- Nicolaides, A.N., Shifrin, E.G., Bradbury, A., Dhanjil, S., Griffin, M., Belcaro, G. et al (1996) Angiographic and duplex grading of internal carotid stenosis: can we overcome the confusion? *J Endovasc Surg*; **3**: 158-165.
- Oates, C.P., Naylor, A.R., Hartshorne, T., Charles, S.M., Fail, T., Humphries, K., Aslam, M. and Khodabkhsh, P. (2009) Joint Recommendations for Reporting Carotid Ultrasound Investigations in the United Kingdom. *Euro J of Vasc and Endovasc Surg*; **37**: 251-261.
- Ray, S.A., Lockhart, S.J., Dourado, R., Irvine, A.T. and Burnand, K.G. (2000) Effect of contralateral disease on duplex measurements of internal carotid artery stenosis. *Br J Surg*; **87**: 1057-1062.
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- Spencer, E.B., Sheafor, D.H., Hertzberg, B.S., Bowie, J.D., Nelson, R.C., Carroll, B.A. et al (2001) Nonstenotic internal carotid arteries: effects of age and blood pressure at the time of scanning on Doppler US velocity measurements. *Radiology*; **220**: 174-178.

## Appendix A

### TERMINAL CLEAN CHECK-LIST FOR IMAGING DEPARTMENT

Area/Room to be cleaned:	
Requesters Name:	
Date of Request:	
Time of Request:	
Reason:	<b>MRSA/ C.DIFF</b>

1. Put on apron and gloves, and collect: disposal mop head and handle, yellow bucket, washing up bowl, Diffe Sachet, disposable paper roll / cloths. <b>Dilute 1Diffe Sachet per litre of Warm Water (Do not use Hot Water)</b>	Yes	No	N/A
2. Place used linen in a soluble pink/red bag tie it and put it inside a normal white laundry bag and seal it and put it in the dirty linen cupboard to await collection			
3. Should any disposable curtains be used in the room they should be removed and put in an orange clinical waste bag and sealed. The hooks should be cleaned with Diffe solution and when dry new disposable curtains put up.			
4. Clean hand high horizontal surfaces with Diffe Solution (include worktops, ledges, sinks, viewing boxes).			
5. Clean x-ray and ultrasound machinery/equipment.			
6. Clean x-ray table/ examination couch including hand set and leads if electric.			
7. Clean clinical equipment (include drip stands, trolleys), steps, doors and door handles using Diffe Solution.			
8. Fully wash floor and place mophead and cloths in orange clinical waste bag. Wipe mop handle and bucket and store dry.			
9. Remove rubbish in secured orange bags. Clean outside of rubbish bin.			
10. The equipment and room is not decontaminated until everything is dry so do not use until then.			

<b>Signature of Nurse/Radiographer in charge.....</b> <b>Date of Completion.....</b> <b>Time of Completion.....</b>	<b>REMEMBER</b> <b>ISOLATION CLEANS</b> <b>ARE ONLY CARRIED</b> <b>OUT USING YELLOW</b> <b>EQUIPMENT</b>
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Updated: Amanda Rhodes, Senior Sister – 5/8/16