

**Medical Engineering & Physics**  
**PMS**  
**Carotid Duplex**

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**Introduction and scope:**

The presence and severity of disease of the extracranial arteries is assessed in order to plan therapy. Referral criteria are for patients with symptoms of cerebrovascular disease (stroke, transient ischaemic attacks or amaurosis fugax), carotid bruits, known risk of vascular disease, pre CABG or Tx workup.

**Responsibilities:**

Test staff: scientific or technical staff trained in vascular duplex scanning.

**Equipment:**

Duplex scanner with broadband linear array transducer.

**Method:**

Initial scanning is performed in a transverse plane in B-mode from the origin of the CCA (looking at the proximal subclavian where possible) to the bifurcation and distally, as far as the ICA and ECA can be followed. This is then repeated with colour flow imaging in transverse. Note any disease. In a longitudinal plane, flow waveforms of the CCA (mid-distal CCA), ECA and ICA (2-6cm beyond the bulb) are recorded and peak systolic and end diastolic velocities are measured in the CCA and ICA. Locate the vertebral artery and obtain a flow waveform. Note any abnormality in the direction or shape.

If disease is located, measure velocities pre stenosis and within stenosis. For lesions <50% B-mode with or without colour flow is used to measure the diameter reduction in the plane of greatest stenosis. When measuring velocities the Doppler angle should be 60 degrees or less and parallel with the flow of blood. Identify plaque characteristics (smooth, irregular, homogeneous, heterogeneous, calcified). For lesions (>50%) in the ICA, use velocity measurements as a guide to the degree of stenosis where appropriate.

On patients with poor access, or who are moving excessively, it is acceptable to not record velocities if genuinely not possible, and describe any plaque on its colour and b-mode appearance.

**When grading ICA stenosis use the Kings College Hospital velocity criteria, in table 1.. If suspicious that the velocity and ultrasound appearance of a stenosis do not match, also use the joint recommendation criteria, in table 2. If any of the ratios are used, the CCA measurements should be made within 2cm of the carotid bifurcation.**

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**Table 1: Kings College Hospital Criteria**

Diameter reduction % ECST	Peak systolic velocity (m/s)
>50%	>1.25 m/s
>60%	>1.8 m/s
>70%	>2.3 m/s
>80%	>3.0 m/s
>90%	>3.8 m/s

**Table 2: Diameter reduction velocity criteria (Oates et al):**

Percentage Stenosis (NASCET)	Internal carotid peak systolic velocity cm/sec	Peak systolic velocity ratio $ICA_{PSV} / CCA_{PSV}$	St Mary's ratio <sup>c</sup> $ICA_{PSV} / CCA_{EDV}$
<50	<125 <sup>a</sup>	<2 <sup>a</sup>	<8
50-59	>125 <sup>a</sup>	2-4 <sup>a</sup>	8-10
60-69			11-13
70-79	>230 <sup>a</sup>	>4 <sup>a</sup>	14-21
80-89			22-29
>90 but less than near occlusion	>400 <sup>b</sup>	>5 <sup>b</sup>	>30
Near occlusion	High, Low – string flow	Variable	Variable
Occlusion	No flow	Not applicable	Not applicable

<sup>a</sup> Grant et al

<sup>b</sup> Filis et al

<sup>c</sup> Nicolaides et al

### Reporting:

The findings should be reported on the CRIS system. The findings should cover velocities, plaque stenosis percentage and image description.

Inform vascular surgeons of significant findings.

### Suggested images:

- Representative waveform and PSV and EDV measurements from CCA.
- Representative waveform and PSV and EDV measurements from ICA.
- Representative waveform from ECA.
- Representative waveforms from Vertebral artery.
- Images of other significant pathology reported on.
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**Inspection criteria:**

Complete CRIS database patient tested/DNA/rebooked.

**References:**

**Bluth EI et al.: Carotid duplex sonography; a multicenter recommendation for standardized imaging and Doppler criteria. Radoigraphics 6; 487-506 1988**

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**Deane C: PgC Carotid vascular course notes. Kings College Hospital, 2001**

**Filis et al: Duplex ultrasound criteria for defining the severity of carotid stenosis. Ann Vasc Surg 2002 ; 16: 413-21**

**Grant et al: Carotid artery stenosis:grayscale and Doppler ultrasound diagnosis – society of radiologists in ultrasound consensus conference. Radiology 2003; 229:340-6**

**King=s College Hospital angiography and Duplex comparison studies.**

**Nicolaides et al: Angiographic and duplex grading of internal carotid stenosis: can we overcome confusion? J endovasc Surg 1996:3 :15/-65**

**Oates et al: Joint Recommendations for Reporting Carotid Ultrasound Investigations in the United Kingdom. European Society for Vascular Surgery 2009; 37, 251-261**

**Zwiebel WJ: Introduction to Vascular Ultrasonography. 4th edition WB Saunders Philadelphia 2000.**