

PHYSIOLOGICAL MEASUREMENT – SERVICE SPECIFICATIONS

Vascular Technology

Test : Carotid Duplex

This investigation uses ultrasound to image and assess flow in the extracranial part of the carotid arteries. The ultrasound probe is used to scan the neck to look for restrictions in flow caused most commonly by fatty deposits (plaque), or by thrombus or dissection of the vessel wall. There is potential for part of the plaque to disintegrate with debris then being carried by the blood flow into the brain or the circulation of the eye (embolisation). Symptoms are variable and patients may suffer a stroke, transient ischaemic attack (TIA) or sudden loss of vision in one eye (amaurosis fugax).

Key guidance about the use of this test is given in Department of Health Implementing the National Stroke Strategy – An Imaging Guide published in May 2008¹.

A Joint Working Group was formed between the Vascular Society of Great Britain and Ireland, and the Society for Vascular Technology of Great Britain and Ireland to make recommendations about this test in order to standardise practice across the United Kingdom. These recommendations are given for the acquisition and interpretation and reporting of the data in a recently published paper: 'Joint recommendations for reporting carotid ultrasound investigations in the United Kingdom'². This is a key document for anyone involved in carotid Duplex scanning. Its recommendations have been endorsed by: The British Medical Ultrasound Society, The Royal College of Physicians, The Society and College of Radiographers, The Society for Vascular Technology of Great Britain and Ireland, The United Kingdom Association of Sonographers and The Vascular Society of Great Britain and Ireland.

PATIENT PATHWAY

Carotid duplex scanning will be utilised and apply to TIA and stroke patient pathways. Carotid surgery or stenting is a possible endpoint of this pathway and should be undertaken within two weeks of the TIA. Therefore, if this diagnostic test is appropriate it should be carried out urgently, preferably within 24 hours of the onset of symptoms. This could be provided in a one stop TIA clinic. Guidance is given by the Department of Health¹. Guidance is also given by the Royal College of Physicians (RCP) Clinical Effectiveness Unit: 'National clinical guidelines for stroke'³

REFERRAL

Clinical Indications

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 the most appropriate clinical indication for a carotid duplex scan. There are other less common indications such as a pulsatile mass in the neck.

Contra indications

None applicable, although adequate access to the neck is required.

EQUIPMENT

Specification

A high resolution imaging ultrasound duplex scanner which has colour, power and pulsed Doppler modalities is required. Midrange (covering nominal frequencies of 4-7MHz) and high frequency (covering nominal frequencies of 10-15MHz) flat linear array transducers (probes) should be available. There should be facilities to record images/measurements. The Royal College of Radiologists (RCR) has more detailed technical standards for ultrasound equipment⁴. The vascular and extracranial carotid specifications are given on pages 15 to 17 of this document. The Joint Working Group gave recommendations on the equipment specification and in particular on the need for the ultrasound scanner to be capable of making accurate measurements of velocity². It should be noted that a range of relatively low cost portable scanners is now available, not all of which will be suitable for vascular work.

It is important that the duplex scanner is of ergonomic design as explained in the health and safety section to minimise the risk of operator work related musculoskeletal disorders¹⁴.

Maintenance

Equipment should be regularly safety-tested and regularly maintained in accordance with the manufacturer's recommendations. Further information is available from BMUS: 'Extending the provision of ultrasound services in the UK'⁶.

QA and Calibration

Quality assurance (QA) procedures should be in place to ensure a consistent and acceptable level of performance of all modalities of the duplex scanner. Such procedures are likely to be set up with involvement from Medical Physics Departments or service engineers as they require specialist skills and will require both imaging and flow phantoms.

Detailed guidance on the QA of the imaging modality of duplex scanning is contained in the IPEM report 102 (Quality Assurance of Ultrasound Imaging Systems)⁷. The IPEM report 70 (Testing of Doppler Ultrasound Equipment) contains extensive information relating to performance testing of the pulsed and colour Doppler modalities of duplex scanners⁸.

Further general guidance is available in VLP part I section D2.1⁵ and in the United Kingdom Association of Sonographers (UKAS) 'Guidelines for professional working standards in ultrasound practice'¹⁰.

Set up procedures

An appropriate probe should be selected. All duplex control settings should be set to defaults appropriate for a carotid investigation. Equipment manufacturer will normally provide appropriate default carotid settings. Detailed guidance on the appropriate control settings for carotid scanning is given in the VLP part II section 4.2⁵.

Infection control

There are no nationally agreed standards for vascular ultrasound scanning but local infection control policies should be in place and extensive guidance is given in the VLP part I section D1.2⁵. It should be noted that ultrasound probes can be damaged by some cleaning agents and so manufacturer's specifications should be followed. Sterile ultrasound gel and sheaths should be available and used in appropriate cases.

Accessory equipment:

Examination couches and scanning stools must be of appropriate safety standard and ergonomic design to prevent injury, particular consideration should be given to reducing the risk of operator work related musculoskeletal disorders. Further explanation is given in the health and safety section of this document.¹⁴.

PATIENT

Information and consent

There is no legal requirement that written patient consent be obtained prior to a carotid duplex examination. However, patients should be fully informed about the nature and conduct of the examination so that they can give verbal consent. VLP II 3.2⁵ gives guidance on the explanation of the test. It is desirable that this information is provided in written format, is given prior to their attendance and is reviewed by the person undertaking the scan at the time of attendance. Suggestions of additional information to include are given on:

- (i) www.bmus.org/publications/pu-patientinfo.asp
- (ii) www.rcr.ac.uk/docs/patients/worlddocs/leafletus5.doc

The Vascular Society and Circulation Foundation (www.circulationfoundation.org.uk) have jointly produced information leaflets which provide further information to patients.

Clinical history

The written referral for the investigation should contain relevant clinical history. But this information should be verified and clarified for any discrepancies as explained in VLP part I section E.1⁵. Specific guidance for history taking for carotid scans is given in VLP part II section 3.3⁵

Preparation

No specific preparation is required as explained in VLP part II sections 3.1⁵. Good access will be required to the patient's neck. The patient will need to maintain the desired head position and not to talk during the scan.

ENVIRONMENT

Preferentially a private room (or curtained off area in a larger multi scan bay unit) is required to carry out the scan. This should be dark, with no natural light entry, and dimmer switch lighting. Air conditioning is required due to heat production from the scanning equipment. The ultrasound manufacturer should supply appropriate guidance on air conditioning

requirements. Further general guidance on the environment is given in the BMUS document⁶.

On occasion, carotid scans may also need to be carried out in other localities eg in theatre, theatre recovery or at the patient's bedside. These scans may be somewhat limited due to poor environmental conditions.

PROCEDURE

Both sides of the neck should be examined. The ultrasound transducer (probe) is positioned on the neck. The transducer is manipulated to obtain images of the carotid vessels from several different planes. The common, internal and external carotid arteries should be imaged to visualise any areas of atheroma. The vertebral artery should be imaged to confirm patency and direction of flow.

Protocol

The Joint Working Group recommended measurements to be taken². A local protocol should be set up in accordance with these recommendations. This protocol should be agreed with referring clinicians. It is important to follow the sequence of events outlined in the protocol to avoid missing important information. The joint recommendations document² also gives detailed information on how these measurements should be made, including control settings such as Doppler gain and in the placement of the velocity cursor in order to make measurements consistent. The document recommends that an angle of 45-60° should be used when making velocity measurements as this will ensure errors in measurements are kept below 10%.

Documentation

The Joint Working Group recommended that, as a minimum, the peak systolic (PSV) and end-diastolic velocities (EDV) in both the distal common carotid artery (CCA) and in the ICA at the location where the highest PSV is seen should be routinely measured and recorded². From these four measurements the indices recommended in the document may be calculated and another operator repeating the examination may confirm the findings or detect a variation.

Any stored images should have patient identification, examination date, organisation and department identification. Further explanation and guidance is given in section 3 of the UKAS Guidelines¹⁰.

INTERPRETATION & REPORT

Criteria

This has been an area of contention and it important that all operators are aware of the issues. In particular all operators should understand the differences between NASCET¹² (North American Symptomatic Carotid Endarterectomy Trial) and the ECST¹³ (European Carotid Surgery Trial) measurements.

Lower grade disease (<50% stenosis) is classified as non significant disease. A direct measurement of the residual lumen diameter may be made from the B-mode image, where there is doubt as to whether the disease is significant.

For higher grade narrowing (>50% stenosis) velocity measurements should be used. The Joint Working Group gave clear and detailed recommendations on the use of grading criteria from the 4 velocity measurements made². To summarise, the Joint Working Group recommended the use of the following diagnostic criteria: a) peak systolic velocity in the internal carotid artery (ICAPSV); b) peak systolic ICA to peak systolic CCA ratio or Peak Systolic Velocity Ratio (PSVR); and c) peak systolic ICA to end-diastolic CCA ratio, often referred to as the St Marys ratio, with grading in deciles; diagnostic confidence being gained where two or more of the measures are in agreement.

Minimum report content

The Joint Working Group recommended the use of a proforma reporting form that includes an illustrative diagram of the right and left carotid anatomy². This enables an immediate visual indication of disease severity and location to be seen. The report should at minimum document the recommended measurements and contain a diagnostic report. This should describe the status of the right and left common carotid arteries and the extracranial part of the internal and external carotid arteries. The report should also include incidental findings including, carotid dissection, carotid body tumour, carotid aneurysm and carotid tortuosity. Confirmation of patency and direction of flow in both vertebral arteries should also be included. Any limitations of the scan must be included in the report. The carotid artery consensus document¹¹ and VLP part II section 6⁵ give guidance on report content. The UKAS guidelines section 1.6¹⁰ give more general guidance on reporting and report content.

The report should be signed and dated and made available to the referring clinician in a timely manner. But any urgent findings should be brought to the attention of the referring clinician immediately.

WORKFORCE

It is well recognised that ultrasound diagnosis is operator-dependent, and it is essential that the workforce has the appropriate competencies and underpinning knowledge. This is achieved by ensuring the workforce has followed recognised education and training routes. This applies to both medically and non-medically qualified individuals.

Education and training requirements

All staff carrying out and reporting investigations should have successfully completed one of the following education and training routes:

- (i) Full SVT accreditation (AVS)
(www.svtgbi.org.uk/Accreditation/Accreditation_Doc.pdf)
- (ii) Post graduate qualification in ultrasound imaging from a Consortium for Accreditation of Sonographic Education (CASE) accredited course with successful completion of a vascular module which has included clinical competency in colour duplex imaging of the carotid and vertebral arteries. A list of CASE accredited courses can be found at www.bmus.org/case/case-courses01.asp
- (iii) Radiologists, medical and surgical staff should have successfully followed the RCR

recommendations for training in vascular scanning to level 2 competencies in extracranial vessels (Ultrasound training recommendations for medical and surgical specialties. BFCR(05)2 www.rcr.ac.uk/docs/radiology/pdf/ultrasound.pdf)

Regulation

It is important that both staff and employers are aware that although ultrasonography is not currently a regulated profession, there is a move towards statutory regulation of all healthcare science groups in the future. Current statutory or voluntary registration includes:

- (i) Registered on the SVT Voluntary Register
- (ii) UK Registered Physicians on the General Medical Council (GMC) Specialist Register
- (iii) Registered Clinical Scientist with Health Professions Council (HPC)
- (iv) Registered on the National Voluntary Register for Sonographers held by the Society & College of Radiographers (SCoR)

Maintaining Competence

It is important that scanning competence is maintained by all personnel performing this investigation either by performing a minimum number of scans each year or through a CPD scheme. Criteria for ensuring continuing competence are set by the professional bodies.

Details are available on:

- (i) www.svtgbi.org.uk/Accreditation/Accreditation_Doc.pdf
- (ii) www.rcr.ac.uk/docs/radiology/pdf/ultrasound.pdf
- (iii) www.sor.org/public/educpd/cpd_policy.htm

Continuing Professional Development (CPD)

Staff must undertake continuing professional development, to keep abreast of current techniques and developments, and to renew and extend their skills.

- (i) SVT accredited staff must maintain their accreditation by meeting the CPD requirements of the SVT. (www.svtgbi.org.uk/Accreditation/Accreditation_Doc.pdf)
- (ii) Staff with a post graduate qualification in ultrasound imaging should meet the CPD requirements of SCoR registration (www.sor.org/public/educpd/cpd_policy.htm)
- (ii) Medical and surgical staff should follow the requirements outlined for maintenance of skills as well the need to include ultrasound in their ongoing CME. (www.rcr.ac.uk/docs/radiology/pdf/ultrasound.pdf)

AUDIT, SAFETY & QA

Safety

The provider should be aware of ultrasound safety precautions related to vascular scanning. These are outlined in VLP section D1.1⁵.

All staff should be aware of local safety rules and resuscitation procedures.

Sonographers are at risk of work related musculoskeletal disorders. To minimise this risk the scanner and its control panel, the examination couch and scanning stool must be of appropriate safety standard and ergonomic design. Regular risk assessments should be

carried out. Advice can found at:

www.svtgbi.org.uk/Resources/Health_and_Safety/health_and_safety.html.

A recently published document by the Society and College of Radiographers (SCoR) 'Work related stress guidance for health and safety representatives'¹⁴ gives clear guidance on this issue. Further information is also available from BMUS: 'Extending the provision of ultrasound services in the UK'⁶.

QA and Audit

There are no specific requirements but a mechanism of audit/quality control to ensure patients continue to receive the expected level of diagnostic accuracy should be in place.

QA and audit programs should cover:

- Equipment performance
- Patient service
- Quality of investigation

The Joint Working Group gives advice on the use of audit on performance and reporting². In particular to ensure that different individuals obtain consistent results on the same machine and that different machines within a department also give consistent results. A consistent reporting style and vocabulary should be maintained between operators.

VLP part I section D 2⁵ gives guidance which covers these areas. The BMUS document⁶ and UKAS Guidelines¹⁰ also give guidance. Equipment QA is covered in more detail in the equipment section of this document.

References:

- ¹ 'Implementing the National Stroke Strategy – An Imaging Guide' May 2008 published by Department of Health
- ² 'Joint recommendations for reporting carotid ultrasound investigations in the United Kingdom' Oates CP et al Eur J Vasc Endovasc Surg 2009 37: 251-261.
- ³ 'National clinical guidelines for stroke' prepared by the intercollegiate stroke working party June 2004 and published by the Clinical Effectiveness Unit of the Royal College of Physicians
- ⁴ 'Standards for Ultrasound Equipment' Royal College of Radiologists 2005
- ⁵ Vascular Laboratory Procedures published by the Institute of Physics in Engineering and Medicine on behalf of the Society of Vascular Technology for Great Britain and Ireland
- ⁶ 'Extending the provision of ultrasound services in the UK' BMUS 2003
- ⁷ 'Quality Assurance of Ultrasound Imaging Systems' IPEM report 102 2010
- ⁸ 'Testing of Doppler Ultrasound Equipment' IPEM report 70 1994
- ⁹ 'Measurement of maximum velocity using duplex ultrasound systems.' Hoskins PR. Br. J. Rad. 1996 69: 172-177.
- ¹⁰ 'Guidelines for professional working standards in ultrasound practice' UKAS 2001
- ¹¹ 'Carotid artery stenosis: grey-scale and Doppler ultrasound diagnosis – Society of Radiologists in Ultrasound Consensus Conference' Grant EG et al Radiology 2003; 229: 340- 346.
- ¹² 'Beneficial effect of carotid endarterectomy in symptomatic in symptomatic patients with high grade stenosis'. North American Symptomatic Carotid Endarterectomy Trial Collaborators. 1991; N Eng J Med 32: 445- 453

- ¹³ 'MRC European Carotid Surgery Trial: interim results for symptomatic patients with severe (70-90%) or with mild (0-29%)carotid stenosis'. European Carotid Surgery Trialists' Collaborative Group. 1991; Lancet 339: 1235-1243
- ¹⁴ 'Work related stress guidance for health and safety representatives' Society and College of Radiographers 2007

Websites:

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