

PHYSIOLOGICAL MEASUREMENT – SERVICE SPECIFICATIONS

Vascular Technology

Test : Ankle Brachial Pressure Index (ABPI) measurement and Pre and Post Exercise ABPI's.

ABPI:

This investigation uses a simple continuous wave hand held ultrasound machine or a duplex ultrasound scanner to measure the ratio of ankle blood pressure to brachial blood pressure in order to determine the degree of arterial compromise in the lower limb. ABPI's provide a reproducible and quantitative assessment of arterial disease of the whole of the leg above the ankle, but do not localize disease. It is one of the simplest and mostly frequently used tests to investigate for the presence and severity of arterial disease. However, more detailed information is obtained from a duplex examination, which images the arteries and assesses the flow within them.

ABPIs may be used to establish whether any arterial disease is present before more complex investigations are requested. Patients, who experience pain in the legs on walking (claudication) or have pain in the limbs at rest and/or ulceration are likely to require this investigation. This test is also used for monitoring the progression of disease or as part of the surveillance program following interventions such as a graft or stent. This test is often carried out in primary care, particularly for patients with leg ulcers.

Exercise testing:

This test involves recording the ABPI's before and after exercise. The fall in ABPI and recovery time give clinical information. Exercise tests are used to quantify the effects of physical exercise, as for some patients the resting ABPI's may be normal, but may fall following exercise. It is particularly useful for screening patients who experience pain on walking as there other disorders, such as spinal stenosis, that are cause similar symptoms.

PATIENT PATHWAY

ABPI and exercise test are important tests in the pathway of patients with suspected lower limb arterial disease and for monitoring progression of disease. They are used as part of surveillance programs to follow up patients who have had an intervention such as a graft or stent.

The measurement of ABPI's is an important test in the pathway of patients with legs ulcers. ABPI's are routinely measured before compression bandaging is prescribed^{1,2}. Compression applied to legs with arterial insufficiency could result in pressure damage, limb ischaemia and even amputation

REFERRAL

Clinical Indications

These include:

- Investigation or follow-up of patients with claudication, ischaemic rest pain, and/or ulceration.
- Assessment of patients with known arterial disease

- Pre-procedure (eg bypass graft, angioplasty and/or stent placement) baseline measurement
- Post procedure follow-up

Further information is given in the Society for Vascular Ultrasound guidelines for 'Lower extremity Arterial Duplex Evaluation'³.

Contraindications

- Patients with suspected or known acute deep venous thrombosis (DVT) or superficial thrombophlebitis
- Recent surgery, ulcers, casts or bandages that cannot or should not be compressed by pressure cuffs
- Patients who have had a therapeutic intervention (stent or graft) which extends into the lower calf.
- It should be noted that ABPIs may be less reliable in patients with diabetes or patients with known calcification of their arteries.

For exercise testing:

The following should be considered and maybe a contraindication:

- Chest pain of recent onset
- Previous myocardial infarction (MI) or coronary artery bypass graft (CABG)
- Evidence of shortness of breath
- Unsteadiness when walking
- Uncontrolled angina
- Hypertension (>200 mmHg systolic pressure)

Further information is given in the Society for Vascular Ultrasound (SVU) guidelines for 'Lower extremity Arterial Duplex Evaluation'³.

EQUIPMENT

Specification

A hand held continuous wave (CW) Doppler unit is required, which has a pencil probe of nominal frequency 8MHz, although a lower frequency probe may be helpful for patients who have oedematous legs. Headphones may also be helpful. Vascular Lab Procedures part III section 4.14⁴ gives further detail.

Maintenance

Equipment should be regularly safety-tested and regularly maintained in accordance with the manufacturer's recommendations. Further information is available from the British Medical Ultrasound Society (BMUS): 'Extending the provision of ultrasound services in the UK'⁵.

QA and Calibration

Quality assurance (QA) procedures should be in place to ensure a consistent and acceptable level of performance.

The IPEM report 70 (Testing of Doppler Ultrasound Equipment) contains extensive information relating to performance testing of Doppler equipment⁷. Further general guidance is available in VLP part I section D2.1⁴ and in the 'Guidelines for professional working standards: Ultrasound practice'⁸.

Set up procedures

The manufacturer's application guidelines should be followed, however there are very few controls on a hand held CW Doppler unit. The volume control needs to be adjusted to a level which enables the audible Doppler signal to be detected. Further guidance is given in VLP part III section 4.1⁴.

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 D1.2³. BMUS advises that users should refer to manufacturer's instructions for the cleaning and disinfection of probes and transducers and general care of equipment. It should be noted that ultrasound probes can be damaged by some cleaning agents and so manufacturer's specifications should always be followed. Where there are open ulcers the ulcerated area should be covered with plastic cling film to prevent contamination of the Sphygmomanometer cuff².

Accessory equipment:

A sphygmomanometer with cuffs for normal and large limbs is required. If the cuff is not the appropriate length for the girth of the leg, then artifacts in the pressure measurements can occur⁴.

Examination couches and scanning stools must be of an appropriate safety standard and ergonomic design to prevent injury, particular consideration should be given to reducing the risk of operator work related musculoskeletal disorders¹⁰.

In some units the exercise protocols requires the patient to walk a pre-measured distance (eg in a corridor). In other units additional equipment is used, such as a treadmill (which should allow at least a 10⁰ incline), a set of steps or an ergometer (where the patient pushes against a fixed resistance).

PATIENT

Information and consent

There is no legal requirement that written patient consent be obtained prior to an ABPI test. However, patients should be fully informed about the nature and conduct of the examination so that they can give verbal consent. VLP III 3.2⁴ gives guidance on the explanation of the test. It is desirable that this information is provided in written format and is given prior to their attendance. This information should also be verbally explained to the patient when they attend for the investigation.

Suggestions of additional information to include is given at:

www.bmus.org/publications/pu-patientinfo.asp

VLP part IV sections 3 and 3.1⁴ gives further information. 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.1⁴. This should include any symptoms or history of lower limb arterial disease and details of any previous interventions (eg angioplasty, stent insertion or bypass graft).. Specific guidance for history taking for ABPI tests is given in VLP part IV section 3.3⁴. For exercise testing any history of heart attack or angina should be carefully considered before the patient is considered fit for any exercise protocol. The referring clinician should have assessed the patients suitability for this investigation. Further guidance is given VLP III section 3.3⁴ and in the (SVU) guidelines for 'Lower extremity Arterial Duplex Evaluation'³. The Royal College of Nursing also gives guidance in 'Nursing management of patients with leg ulcers'⁹.

Preparation

No specific preparation is required for measuring ABPIs and exercise testing. However, the patient should be rested for 15 minutes before making resting measurements, in order that consistent baseline pressures can be made⁴.

Access will be required to the patient's ankle and arms. This test may be difficult in patients with leg ulcers or open wounds. Sterile dressings or cling film will allow blood pressure cuffs to be placed over these sites and for measurements to be made².

Further detailed guidance is given in VLP part III section 3.1⁴.

ENVIRONMENT

As well as in hospital clinics and wards, ABPI's may be carried out in primary care, including in a patient's own home. A quiet room/area is required to ensure the patient is as relaxed as possible. This will help reduce fluctuations in blood pressure. If the room is too cold, the arteries may constrict and be difficult to locate.

The Powys Local Health Board document 'A Protocol for the safe measurement of ankle brachial pressure index (ABPI) using a hand held Doppler '² gives further information.

If an exercise test is to be carried out, the environment should be suitable for this and risk factors should have been assessed. It is essential an emergency call system is in place and is easily accessible.

Further general guidance on the environment is given in the BMUS document⁵.

PROCEDURE

ABPI

The patient should be supine. The sphygmomanometer cuff is applied to each arm above the elbow. The brachial artery should be located with the probe of the handheld Doppler unit. The cuff should be inflated to 20-30 mmHg above the last audible pulse and then slowly deflated. The pressure at which the pulse returns should be recorded. This should be repeated for the other arm. The cuffs should be removed and placed around each ankle. For each ankle the pressure from the posterior tibial and dorsalis perdis artery should be recorded. An ABPI is calculated for each leg by dividing the highest ankle pressure by the highest brachial pressure. Further detail is given by Caruana⁶.

Exercise Test

Following the measurement of resting ABPIs, the cuffs are usually left on the ankles to allow the post exercise pressures to be measured quickly. The patient is then asked to walk on the treadmill (alternatives include walking a measured distance up and down a corridor or using a device such as an ergometer). On completion of exercise, the ankle pressure measurements should be repeated. This should be carried out as quickly as possible starting with the symptomatic leg or the leg with lowest resting ABPI. The arm pressure (using the arm with the highest pressure before exercise) is then remeasured. Measurements may be repeated to document the recovery time.

Protocol

This is outlined above and detailed guidance on the protocols that should be used for both resting ABPIs and exercising testing is given in VLP III section 5⁴.

Particular attention should be given to using appropriate size cuffs and to their positioning. The bladder of the cuff should be positioned over the artery to be compressed otherwise artefactually high pressures may be recorded.

It is important to note the contraindications for these tests. A cuff should not be inflated over a graft, graft anastomosis or stented area as this may compromise patency.

A range of exercise protocols are used dependent on the availability of equipment such as a treadmill. It is important that the protocol within each unit is standardised and clearly documented and that this includes an assessment of risk factors.

Documentation

ABPI

The systolic blood pressures measured from both arms should be documented. For each ankle, the highest ankle pressure measured should be recorded. ABPIs are calculated as outlined above and should be documented for each ankle pressure measured.

The Powys Local Health Board document 'A Protocol for the safe measurement of ankle brachial pressure index (ABPI) using a hand held Doppler'² gives further information.

Exercise test

A range of exercise protocols are used and it is important that the type and duration of the exercise is documented. The time of onset of any symptoms brought on during

exercise should be recorded. The details of any symptoms should be noted. The pressures measured post exercise should be recorded.

All documentation should be done in accordance with the locally agreed protocol. All documentation should have patient identification, examination date, organisation and department identification.

Further explanation and guidance is given in section 4 of the UKAS Guidelines⁸.

INTERPRETATION & REPORT

Criteria

The normal value for a resting ABPI is between 1.0 and 1.4⁴. Where atherosclerosis is present, the index will be reduced with the decrease reflecting the severity of the disease. Although, the ABPI is an indicator of disease severity, it does not give information relating to the location of the disease. Further detailed information is given in VLP III section 6.1⁴.

Further information is also given by Vowden et al¹.

Care should be taken when interpreting ABPI measurements, where the ankle pressures are significantly high (>1.4). This is common for patients with diabetes and also for many renal patients. Artefactually high pressures are recorded when the vessel walls are rigid and incompressible (due to calcification).

In the absence of disease, the post exercise ABPI will remain the same at the pre exercise index or show a slight increase. In the presence of disease, the index will drop in proportion to the severity of disease.

Minimum report content

The report should record all of the pressure measurements made as well as the calculated ABPIs.

The exercise report should include the resting ABPIs measurements as above. Additionally, the type and duration of exercise should be given. The time of onset of any symptoms and their location must be included. The pressures measured post exercise should be included.

The report should be 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.

Further guidance on report content and reporting procedures is given in VLP I section E2 and 3⁴.

The report should be signed by the practitioner carrying out the test. Where a computer generated reporting system is used, such as those used in radiology departments, the verification and authorisation procedure should be followed.

WORKFORCE

A variety of staff may carry out these investigation including medical and nursing staff, hospital and community nurses, specialist sonographers and clinical vascular scientists. All staff carrying out these investigations should have successfully completed training with practical assessment of competency.

Education and training requirements

Although these are relatively simple investigations, it is essential that the workforce has the appropriate competencies and underpinning knowledge. Training programs should include a practical assessment of competency and it is important that competency is maintained following the completion of training. Advice should be obtained from the local vascular scanning department. Staff who have completed full SVT accreditation (AVS) (www.svtgbi.org.uk/Accreditation/Accreditation_Doc.pdf) will have completed full training and assessment of ABPI and exercise measurements.

'The nursing management of patients with leg ulcers', (RCN Clinical Practice Guidelines 2006)⁹, gives further information relating to the importance of formal training. This document notes that unless formal training has been undertaken, these measurements can be unreliable and that reliability is considerably improved for highly trained operators.

Training must include an understanding of the reliability of ABPI measurements in patients who have conditions, such as diabetes, where pressures may be artefactually high. It should include an understanding of where specialist referral may be appropriate.

The Powys Local Health Board document 'A Protocol for the safe measurement of ankle brachial pressure index (ABPI) using a hand held Doppler'² gives further details about the level of training including the need for practical assessment. British Medical Ultrasound Society gives recommendations on training⁵.

Regulation

Many of the staff carrying out these investigations will already hold registration: A voluntary register is also held by the SVT.

- (i) Registered on the SVT Voluntary Register
- (ii) UK Registered Physicians on the General Medical Council (GMC) Specialist Register
- (ii) Registered Clinical Scientist or Radiographer with Health Professions Council (HPC)
- (iii) Registered nurses with the Nurses and Midwifery Council

It is important that both staff and employers are aware that ultrasonography is not currently a regulated profession and that not all healthcare science groups are currently registered.

However, there is a move towards statutory regulation of all healthcare science groups in the future. There is currently a 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 (http://www.sor.org/public/ult/ult_search.php).
- (iii) Medical, surgical and nursing staff should follow the requirements outlined for maintenance of skills.

AUDIT, SAFETY & QA

Safety

The provider should be aware of the guidelines for the safe use of ultrasound equipment produced by the Safety Group of BMUS. In particular, they should be aware of ultrasound safety precautions related to vascular scanning. These are outlined in VLP section D1.1⁴. All staff should be aware of local safety rules and resuscitation procedures.

To minimise the risk of work related musculoskeletal disorders, all equipment must be of appropriate safety standard and ergonomic design. Advice can found at:

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

The Society and College of Radiographers (SCoR) 'Prevention of Work Related Musculoskeletal Disorders in Sonography'¹⁰ gives clear guidance on this issue.

QA and Audit

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

VLP part I section D 2⁴ gives guidance which covers all these areas. The BMUS document⁵ and UKAS Guidelines⁸ also give guidance. Equipment QA is covered in more detail in the equipment section of this document.

REFERENCES:

¹ 'Doppler assessment and ABPI: Interpretation in the management of leg ulceration' Vowden P and Vowden K (2001) www.worldwidewounds.com/2001/march/vowden/doppler-assessment-and-abpi.html

² 'A Protocol for the safe measurement of ankle brachial pressure index (ABPI) using a hand held Doppler ultrasound', Powys Local Health Board at www.wales.nhs.uk/sites3/docopen.cfm?orgid=501&ID=39672&A69F94C5-1143-E756-5C446B4710EDBF7E

³ 'Vascular Technology Performance Guidelines. Lower Limb Extremity Arterial Duplex Examination.' Society for Vascular Ultrasound 2009.

⁴ 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

⁵'Extending the provision of ultrasound services in the UK' BMUS 2003

⁶'The validity, reliability, reproducibility and extended utility of ankle to brachial pressure index in current vascular surgical practice.' Caruana MF, Bradbury AW, Adam DJ. Eur J Endovasc Surg 2005 29(5) 443-51.

⁷'Testing of Doppler Ultrasound Equipment' IPEM report 70 1994

⁸'Guidelines for professional working standards: Ultrasound practice' UKAS 2007

⁹'The nursing management of patients with leg ulcers' Clinical Practice Guidelines RCN 2006

¹⁰'Prevention of Work Related Musculoskeletal Disorders in Sonography' Society and College of Radiographers 2007

Websites:

www.18weeks.nhs.uk

www.rcr.ac.uk

www.bmus.org

www.svtgbi.org.uk

www.case-uk.org

www.ipem.ac.uk

www.hpc-uk.org

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