

Clinical Protocol

LOWER LIMB ARTERIAL DUPLEX

SETTING	Vascular Science Unit
FOR STAFF	Clinical Vascular Scientists
PATIENTS	All patients referred for a lower limb arterial duplex

INTRODUCTION

A lower limb arterial duplex is a B mode, colour and spectral Doppler examination of the arteries of the lower limb from aorta to ankle. The aim is to determine the location and extent of any arterial disease in order to guide treatment. The investigation can identify atherosclerotic disease (stenosis or occlusion), aneurysmal disease, dissection or vasculitis.

This protocol should be read in combination with the Vascular Science generic protocol which covers preparation, patient communication, environment, equipment, workforce, health & safety, infection control and equality & diversity.

NICE GUIDELINES

NICE guideline CG147 (2012) and NICE CKS peripheral arterial disease (2019) relates to the diagnosis and treatment of peripheral arterial disease. They state:

- Assess people with suspected peripheral arterial disease by measuring the ankle brachial pressure index (ABPI). This should be undertaken by an experienced operator using validated equipment [1].
- Offer duplex ultrasound as first-line imaging to all people with peripheral arterial disease for whom revascularisation is being considered [2].
- Offer contrast-enhanced magnetic resonance angiography to people with peripheral arterial disease who need further imaging (after duplex ultrasound) before considering revascularisation [2].
- Offer computed tomography angiography to people with peripheral arterial disease who need further imaging (after duplex ultrasound) if contrast-enhanced magnetic resonance angiography is contraindicated or not tolerated. [2].
- If critical or acute limb ischemia is suspected a patient should have emergency assessment by a vascular specialist [1].

REFERRAL PATHWAY

Referrals can be made by vascular consultants, vascular nurse specialists and podiatrists for patients with clinical suspicion of lower limb arterial disease. Referrals may also be received from other doctors within the trust following discussion with the vascular team.

Referrals are triage by Vascular Scientists. Where possible an ABPI should always be carried out prior to a full duplex. If the ABPI is normal a clinical decision can be made by the Vascular Scientist whether to progress with a full duplex.

CLINICAL INDICATION

Common indications for a lower limb arterial duplex are:

- Intermittent claudication
- Ischemic rest pain
- Critical limb ischemia
- Gangrene
- Ulceration
- Post-surgical intervention follow-up (e.g. angioplasty, graft or stent patients)
- Suspicion of aneurysm, false aneurysm or arteriovenous fistula

CONTRAINDICATIONS

There are no known major contraindications for lower limb arterial duplex ultrasound. [insert SVT reference]

LIMITATIONS

Limitations to lower limb arterial assessment include:

- Bowel gas
- Stoma bag
- Heavily calcified arteries
- Obesity or lower limb swelling
- Open wounds or ulceration
- Dressings
- Uncooperative patients
- Patient discomfort
- Poor patient mobility or existing co-morbidities resulting in a sub-optimal patient position (eg. examination performed with the patient in a chair or upright position)
- Examinations undertaken portably at the patient's bedside maybe limited due to equipment and room dimensions

EQUIPMENT SPECIFICATION

For accessory equipment, maintenance, QA, calibration and ultrasound safety please refer to the generic vascular Science protocol.

GE Logic 9 ultrasound machines are used for lower limb duplex assessment. The 1-5MHz curvilinear transducer is routinely used for aortoiliac vessels or large limbs. The 5-9MHz linear array transducer is routinely used for the femoral to run-off vessels. The lower extremity arterial pre-set should be used as standard.

All equipment has regularly safety checks and maintenance.

PREPARATION

For test preparation applicable to all assessments please refer to the generic vascular Science protocol.

PATIENT COMMUNICATION

For patient arrival and waiting time, introduction, information and consent please refer to the generic vascular Science protocol.

Clinical history and presenting Symptoms

The written referral for the investigation should contain a relevant clinical history. This should be confirmed and clarified with the patient prior to the starting the examination. A relevant lower limb arterial duplex clinical history should be taken including:

- Presenting symptoms – location, character, onset, duration, frequency, severity and progression
- Does anything relieve or worsen symptoms
- Does the patient get leg pain when walking (if this is not the presenting complaint)
- Does the patient have any leg ulceration/discholouration
- If indicated ask the patient to confirm previous intervention including date, anatomical location, hospital site

Relevant risk factors

Assess the patient's relevant risk factors to include:

- Smoking history
- Hypertension
- Ischemic heart disease
- Diabetes

STANDARD OPERATING PROCEDURE

Please see the lower limb arterial duplex SOP

An ABPI assessment should be performed prior to lower limb arterial assessment, please refer to the ABPI VSU clinical protocol and SOP.

REPORTING

The lower limb arterial duplex is reported on CRIS and the vascular science database. The standardised CRIS report should be used wherever possible (see appendix 1). Additional comments can be added when necessary. A schematic is also completed and uploaded to CRIS, patient folder and NBT transfer folder (see appendix 2).

All reports should include:

- Type of scan 'LOWER LIMB ARTERIAL DUPLEX'
- Symptoms and relevant clinical history (as stated above)
- Relevant risk factors (as stated above)
- Clinical report – see below
- Name of Vascular Scientist performing scan
- VSU end of report statement
- VSU contact phone number

Clinical report

Following the criteria set out in table 1, the absence of disease or, if present, the type of disease with reporting comments, the peak systolic velocity (PSV) and the waveform (tri/bi/mono) for each of the following arteries should be reported:

- Aorta
- Common iliac artery (CIA)
- Internal iliac artery (IIA) (origin)
- External iliac artery (EIA)
- Common femoral artery (CFA)
- Profunda femoris artery (PFA)
- Superficial femoral artery (SFA)
- Popliteal artery (POPA)
- Tibial peroneal trunk (TPT)
- Posterior tibial artery (PTA)
- Peroneal artery (PA)
- Anterior tibial artery (ATA)

Example: SFA (mid): 3cm 50-75% STENOSIS (PSVR 3, PSV 280cm/s, mono)

Table 1. Reporting criteria

Type of disease	Reporting comments
No disease	<ul style="list-style-type: none"> • Normal
Atherosclerotic disease, but <50% stenosis	<ul style="list-style-type: none"> • Location of disease (proximal, mid or distal) • Nature of disease <ul style="list-style-type: none"> ○ Mild /moderate/severe ○ Irregular/smooth ○ Calcified ○ Calcified plaque ○ echolucent/homogenous
Atherosclerotic disease, but >50% stenosis	<ul style="list-style-type: none"> • Degree of stenosis – using the grading criteria in table 2 • Length of stenosis • Location of stenosis (proximal, mid or distal) • Peak Systolic Velocity Ratio (PSVR) • If appropriate, the nature of disease <ul style="list-style-type: none"> ○ Irregular/smooth ○ Calcified/echolucent/homogenous
Occlusion	<ul style="list-style-type: none"> • Proximal to distal extent • Acute or chronic (if able to determine) • Presence of collateral vessels
Aneurysm	<ul style="list-style-type: none"> • Maximum inner-to-inner transverse and longitudinal anterior-posterior diameter measurement (to 1 decimal place)
Dissection	<ul style="list-style-type: none"> • Proximal to distal extent
Poor views/unable to visualise	<ul style="list-style-type: none"> • Reason for poor views/unable to visualise
Not assessed	<ul style="list-style-type: none"> • Reason for not assessing

- Any limitations or low confidence measurements should be clearly stated in the report
- Any incidental findings should be documented, reported and acted upon appropriately
- A summary of the lower limb assessment should be included at the end of the report

Table 2. Grading criteria

	Degree of stenosis	Peak systolic velocity ratio (PSVR)
Minimal-Mild	<50%	<2:1
Mild-Moderate	~50	2:1
Moderate	50%-75%	>2 but <4
Severe	>75%	>4:1 ratio
Trickle flow	Sub-occlusion	Very low flow Pre-occlusive vessel
Occluded	Occluded	No Doppler signal, Colour or Power Doppler

Urgent findings

If an outpatient presents with acute limb ischemia the vascular consultant on call should be contacted immediately after the scan and informed of the results of the Duplex scan.

If an outpatient patient presents with acute tissue loss, ulceration or rest pain email the referring consultant and BBW vascular network marking for urgent review - nbn-tr.bbwvascularnetwork@nhs.net.

If an inpatient presents with evidence of critical or acute limb ischemia, acute tissue loss or ulceration the referring clinician (if not an vascular consultant) should be informed of the results and advised to contact vascular surgery at NBT immediately if this has not already been done so.

RELATED DOCUMENTS AND PAGES

Lower limb arterial Standard Operating procedure

ABPI clinical protocol

ABPI standard operating procedure

Vascular Science generic protocol

Bristol, Bath and Weston Vascular Network Standard Operating Procedures for Clinical Vascular Scientists

Table A

REFERENCES	<ol style="list-style-type: none"> 1. NICE CKS: Peripheral arterial disease 2. NICE: Peripheral arterial disease: diagnosis and management. Clinical guideline [CG147]
RELATED DOCUMENTS AND PAGES	<p>Lower limb arterial Standard Operating procedure</p> <p>ABPI clinical protocol</p> <p>ABPI standard operating procedure</p> <p>Vascular Science generic protocol</p>
AUTHORISING BODY	Vascular Science
SAFETY	Please refer to the Vascular Science Unit Health and Safety policy
QUERIES AND CONTACT	<p>Vascular Science Unit</p> <p>A225</p> <p>Bristol Royal Infirmary</p> <p>Upper Maudlin Street</p> <p>Bristol, BS2 8HW</p> <p>Tel: 0117 342 7530</p> <p>Email: VSU@UHBristol.nhs.uk or uhb-tr.vascular-science@nhs.net</p>

Appendix 1 – Report Template

Phrase: UAILBND	<p>LOWER LIMB ARTERIAL DUPLEX:</p> <p>SYMPTOMS:</p> <p>Aorta D.Dcm</p> <p>RIGHT/LEFT SIDE</p> <p>CIA</p> <p>IIA (origin)</p> <p>EIA</p> <p>CFA</p> <p>PFA (origin)</p> <p>SFA (proximal)</p> <p>SFA (mid)</p> <p>SFA (distal)</p> <p>POP</p> <p>TPT</p> <p>PTA</p> <p>ATA</p> <p>PER</p> <p>SUMMARY RIGHT/LEFT LEG:</p> <p>Scanned by:</p> <p>CIA Common iliac artery, EIA External iliac artery, IIA Internal iliac artery, CFA Common femoral artery, PFA profunda femoral artery, SFA Superficial femoral artery, POP Popliteal artery, TPT Tibio-peroneal trunk, ATA Anterior tibial artery, PTA Posterior tibial artery, PER Peroneal artery.</p> <p>Any queries please contact Vascular Science on 0117 34 27530.</p>
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Appendix 2 - Schematic

Vascular Science A226

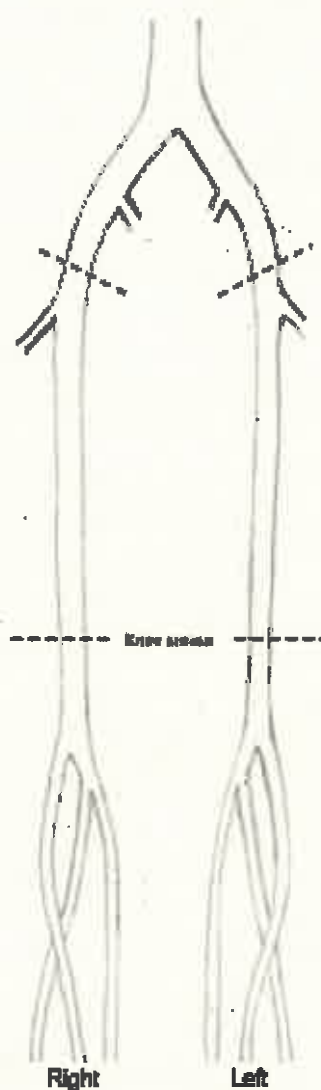
Lower Limb Arterial Duplex Ultrasound Report

Full written report and images are available on CRIBACEPACS

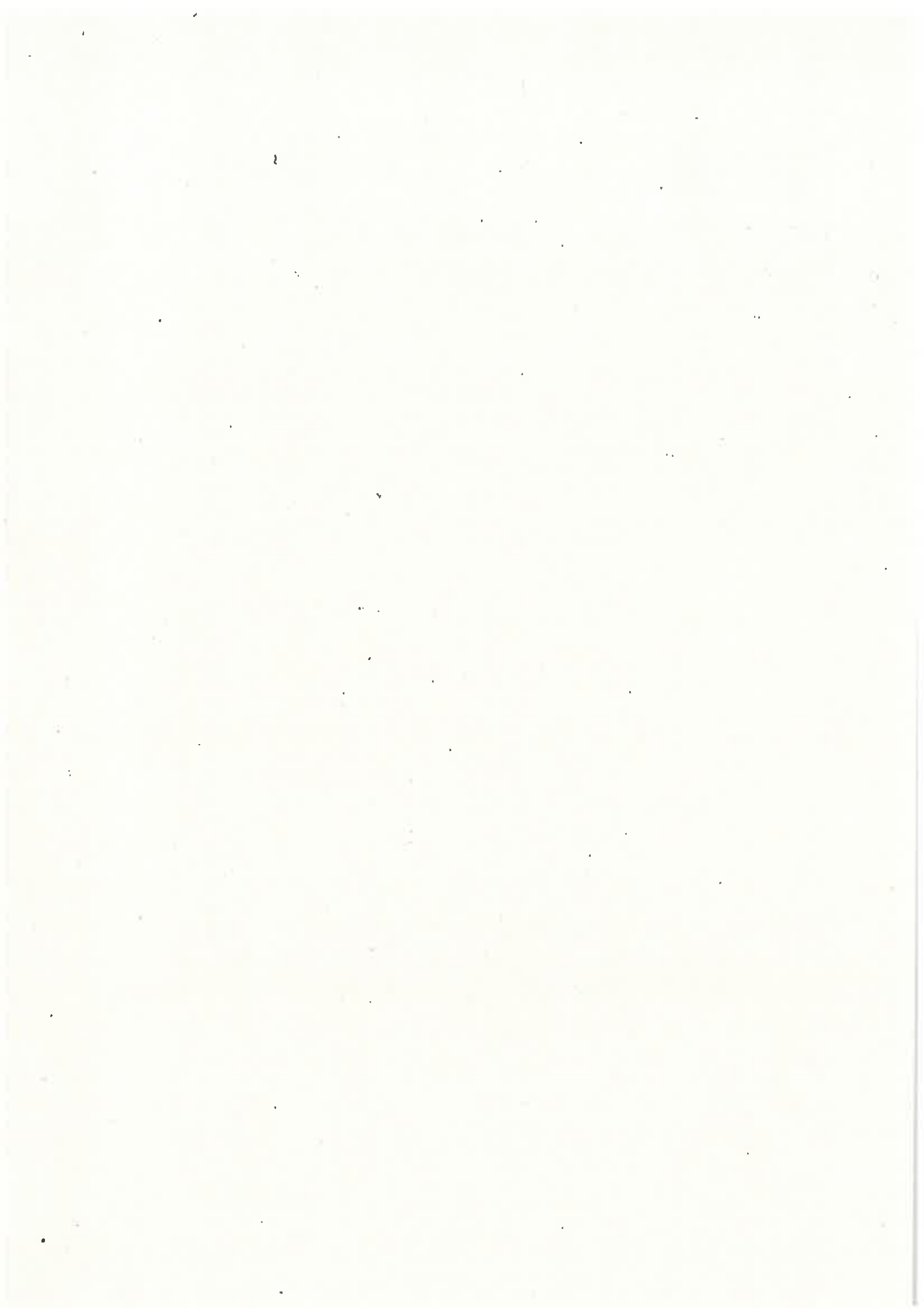


University Hospitals Bristol
NHS Foundation Trust

Name		Referrer	
NHS number		Vascular Scientist	
T number			
Date of Birth		Date of Scan	



Vascular Science A226, Bristol Royal Infirmary, Marlborough Street, Bristol, BS2 8HW.
Tel: 0117 34 27630. Email: vsu@uhonhs.uk or uth-lr-vascular-studies-unit@nhs.net



Clinical Protocol

UPPER LIMB ARTERIAL DUPLEX

SETTING	Vascular Science
FOR STAFF	Clinical Vascular Scientists
PATIENTS	Patients referred for an upper limb arterial duplex

INTRODUCTION

An upper limb arterial duplex is a B mode, colour and spectral Doppler examination of the arteries of the upper limb from supra-clavicular to the wrist. The purpose is to determine the location and extent of any arterial disease in order to guide treatment. The investigation can identify atherosclerotic disease (stenosis or occlusion), aneurysmal disease, dissection or vasculitis.

This protocol should be read in combination with the Vascular Science generic protocol which covers preparation, patient communication, environment, equipment, workforce, health & safety, infection control and equality & diversity.

REFERRAL PATHWAY

Referrals can be made by vascular consultants and vascular nurse specialists for patients with clinical suspicion of upper limb arterial disease. Referrals may also be received from other doctors within the Trust following discussion with a vascular consultant.

Referrals are triaged by a clinical vascular scientist.

CLINICAL INDICATION

Common indications for an upper arm arterial Duplex are:

- Intermittent claudication
- Ischemic rest pain
- Critical limb ischemia
- Gangrene
- Ulceration
- Absent pulses
- Post arterial catheter insertion / use of arterial catheter
- Post-surgical intervention follow-up (e.g. angioplasty, graft or stent patients)
- Suspicion of aneurysm, false aneurysm or arteriovenous fistula
- Poor Allens test and planned radial free flap

CONTRAINDICATIONS

There are no known major contraindications for upper limb arterial duplex ultrasound.

LIMITATIONS

Limitations to upper limb arterial assessment include:

- Heavily calcified arteries
- Obesity or upper limb swelling
- Open wounds or ulceration
- Dressings
- Uncooperative patients
- Patient discomfort
- Poor patient mobility resulting in a sub-optimal patient position (eg. patient unable to external rotate their arm)
- Examinations undertaken portably at the patient's bedside maybe limited due to equipment and room dimensions

EQUIPMENT SPECIFICATION

For accessory equipment, maintenance, QA, calibration and ultrasound safety please refer to the generic vascular Science protocol.

A sphygmomanometer, blood pressure cuff and hand held continuous wave Doppler with an 8MHz or 5MHz probe are used for taking the arm blood pressure.

GE Logic 9 ultrasound machines are used for upper limb duplex assessment. The 5-9MHz linear array transducer is routinely used for upper limb assessment. The 1-5MHz curvilinear transducer can be used for large limbs and the hockey stick probe used for assessment of superficial structures. The upper extremity arterial (UEA) pre-set should be used as standard.

All equipment has regularly safety checks and maintenance.

PREPARATION

For test preparation applicable to all assessments please refer to the generic vascular Science protocol.

PATIENT COMMUNICATION

For patient arrival and waiting time, introduction, information and consent please refer to the generic vascular Science protocol.

Clinical history and presenting Symptoms

The written referral for the investigation should contain a relevant clinical history. This should be confirmed and clarified with the patient prior to the starting the examination. A relevant upper limb arterial duplex clinical history should be taken including:

- Presenting symptoms – location, character, onset, duration, frequency, severity and progression
- Does anything relieve or worsen symptoms
- Does the patient get pain in their arm at rest (rest pain)
- Does the patient have any ulceration/discolouration of the limb
- If indicated ask the patient to confirm previous intervention including date, anatomical location, hospital site

Relevant risk factors

Assess the patient's relevant risk factors to include:

- Smoking history
- Hypertension
- Ischemic heart disease
- Diabetes

STANDARD OPERATING PROCEDURE

Please follow see the upper limb arterial duplex SOP

REPORTING

The upper limb arterial duplex is reported on CRIS and the vascular science database. The standardised CRIS report should be used wherever possible (see appendix 1). Additional comments can be added when necessary. A schematic can also be completely and uploaded to CRIS, patient folder and NBT transfer folder (see appendix 2).

All reports should include:

- Type of scan 'UPPER LIMB ARTERIAL DUPLEX'
- Symptoms and relevant clinical history (as stated above)
- Clinical report
- Name of Vascular Scientist performing scan
- VSU contact phone number

Clinical report

The systolic brachial pressure and brachial waveform should be reported for both arms.

Following the criteria set out in table 1, the absence of disease or, if present, the type of disease with reporting comments, the peak systolic velocity (PSV) and the waveform (tri/bi/mono) for each of the following arteries should be reported:

- Brachiocephalic artery
- Subclavian artery
- Axillary artery
- Brachial artery
- Ulnar artery

- Radial artery

Example: Brachial (mid): 3cm 50-75% STENOSIS (PSVR 3, PSV 280cm/s, mono)

Table 1. Reporting criteria

Type of disease	Reporting comments
No disease	<ul style="list-style-type: none"> • Normal
Atherosclerotic disease, but <50% stenosis	<ul style="list-style-type: none"> • Location of disease (proximal, mid or distal) • Nature of disease <ul style="list-style-type: none"> ○ Mild /moderate/severe ○ Irregular/smooth ○ Calcified ○ Calcified plaque ○ echolucent/homogenous
Atherosclerotic disease, but >50% stenosis	<ul style="list-style-type: none"> • Degree of stenosis – using the grading criteria in table 2 • Length of stenosis • Location of stenosis (proximal, mid or distal) • PSVR • If appropriate, the nature of disease <ul style="list-style-type: none"> ○ Irregular/smooth ○ Calcified/echolucent/homogenous
Occlusion	<ul style="list-style-type: none"> • Proximal to distal extent • Acute or chronic (if able) • Presence of collateral vessels
Aneurysm	<ul style="list-style-type: none"> • Maximum inner-to-inner transverse and longitudinal anterior-posterior diameter measurement (to 1 decimal place)
Dissection	<ul style="list-style-type: none"> • Proximal to distal extent
Poor views/unable to visualise	<ul style="list-style-type: none"> • Reason for poor views/unable to visualise
Not assessed	<ul style="list-style-type: none"> • Reason for not assessing

Table 2. Grading criteria

	Degree of stenosis	Peak systolic velocity ratio (PSVR)
Minimal-Mild	<50%	<2:1
Mild-Moderate	~50	2:1

Moderate	50%-75%	>2 but <4
Severe	>75%	>4:1 ratio
Trickle flow	Sub-occlusion	Very low flow Pre-occlusive vessel
Occluded	Occluded	No Doppler signal, Colour or Power Doppler

- Any limitations or low confidence measurements should be clearly stated in the reported
- Any incidental findings should be documented, reported and acted upon appropriately
- A summary of the upper limb assessment should be included at the end of the report

Urgent findings

If an outpatient presents with acute limb ischemia the vascular consultant on call should be contacted immediately after the scan and informed of the results of the Duplex scan.

If an outpatient patient presents with acute tissue loss, ulceration or rest pain email the referring consultant and BBW vascular network marking for urgent review - nbn-tr.bbwwascularnetwork@nhs.net

If an inpatient presents with evidence of critical or acute limb ischemia, acute tissue loss or ulceration the referring clinician (if not an vascular consultant) should be informed of the results and advised to contact vascular surgery at NBT immediately if this has not already been done so.

RELATED DOCUMENTS AND PAGES

Upper limb arterial Standard Operating procedure
Vascular Science generic protocol

Table A

REFERENCES	
RELATED DOCUMENTS AND PAGES	Upper limb arterial Standard Operating procedure Vascular Science generic protocol
AUTHORISING BODY	Vascular Science
SAFETY	Please refer to the Vascular Science Unit Health and Safety policy
QUERIES AND CONTACT	Vascular Science Unit A225 Bristol Royal Infirmary Upper Maudlin Street Bristol, BS2 8HW Tel: 0117 342 7530 Email: VSU@UHBristol.nhs.uk or uhb-tr.vascular-science@nhs.net

Appendix 1 – Report Template

Phrase: UARTEAAN
VSU arm artery
normal

UPPER LIMB ARTERIAL DUPLEX:

RIGHT SIDE

Brachial artery pressure: Tri ++ PS mmHg

Brachiocephalic artery:

Subclavian artery: TRI/BI/MONO PS cm/s

Axillary artery: TRI/BI/MONO PS cm/s

Brachial artery: TRI/BI/MONO PS cm/s

Ulnar artery: TRI/BI/MONO PS cm/s

Radial artery: TRI/BI/MONO PS cm/s

LEFT SIDE

Brachial artery pressure: Tri ++ PS mmHg

Subclavian artery: normal TRI/BI/MONO PS cm/s

Axillary artery: normal TRI/BI/MONO PS cm/s

Brachial artery: normal TRI/BI/MONO PS cm/s

Ulnar artery: normal TRI/BI/MONO PS cm/s

Radial artery: normal TRI/BI/MONO PS cm/s

SUMMARY RIGHT ARM: No significant arterial disease

SUMMARY LEFT ARM: No significant arterial disease

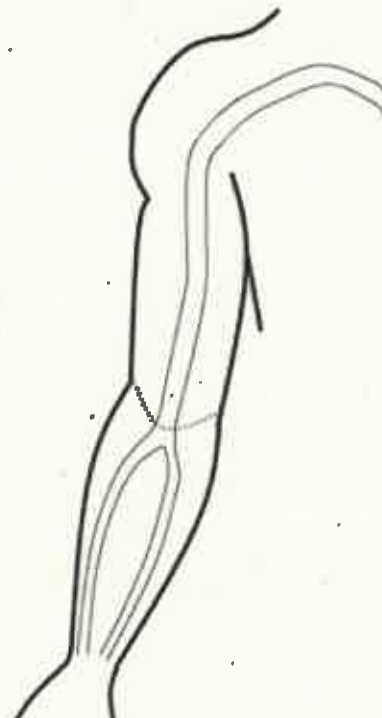
Scanned by:

Any queries please contact Vascular Science on 0117 34 27530

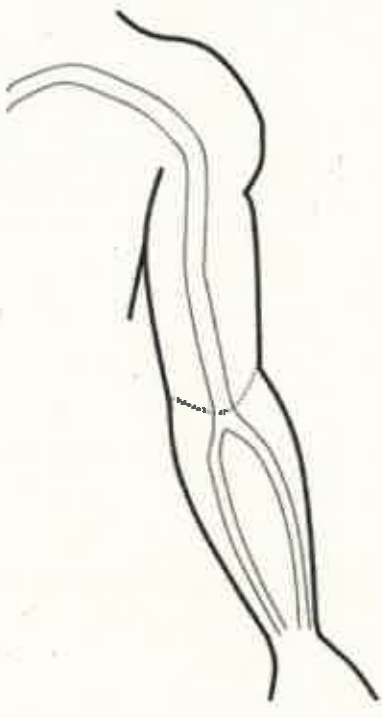
Appendix 2 - Schematic

Vascular Science A225		NHS	
Upper Limb Arterial Duplex Ultrasound Report		University Hospitals Bristol	
Full written report and images are available on CRIS/ICE/PACS		NHS Foundation Trust	
Name		Referrer	
NHS number		Vascular Scientist	
T number			
Date of Birth		Date of Scan	

Right Arm



Left Arm



Vascular Science A225, Bristol Royal Infirmary, Marlborough Street, Bristol, BS2 8HW.
Tel: 0117 34 27330. Email: vasc@uhbristol.nhs.uk or ubh-tr-vascular-studies-unit@nhs.net