VASCULAR ASSESSMENT
MASTERCLASS
SESSION 1

– Principles of Doppler ultrasound
– Selection of Equipment
– Ankle Brachial Index (ABI)

SESSION 2

– Doppler waveforms and sounds
– Toe pressures & Toe Brachial Index (TBI)
– Venous Assessment
– Neuropathic Assessment
Aims & Objectives of Session 1

- Rationale
- The principles of Doppler Ultrasound
- Selection of equipment
- Preparation of the patient
- Measuring and calculating ABI
- Interpretation of the results
- Re-examination
- Factors affecting the ABI
- Summary and conclusion
Rationale

The Ankle Brachial Index (ABI)

• Most widely used, non-invasive, method of diagnosing peripheral arterial disease (PAD).
• Universally advocated as the screening tool of choice in current PAD guidance:
  • ESC: European Society of Cardiology, 2012
  • ACCF/AHA: American College of Cardiology/American Heart Association, 2011
  • SVT: Society for Vascular Technology of Great Britain and Ireland, 2010
  • TASC: Transatlantic Inter-Society Consensus document, 2007
Rationale

**Uses of the Ankle Brachial Index (ABI)**

1. **Confirm or refute suspected PAD**
   
i.e. for patients reporting exertional leg pain or for those with cold, painful feet/legs.

2. **Wound Care**

   Assists in determination of lower limb wound aetiology.

   Current guidelines universally advocate that patients presenting with a leg ulcer should undergo bilateral ABI measurement at first presentation by trained staff (*Wounds UK, 2013; SIGN, 2010; RCN, 2006*).

   Determines suitability of compression therapy: arterial insufficiency, as indicated by an ABI ≤ 0.8, is generally considered a contraindication to compression.
Uses of the Ankle Brachial Index continued

3. Cardiovascular Risk Assessment

- ABI ≤ 0.9 has been shown to be associated with 3-6 fold increased risk of death from cardiovascular causes in multiple longitudinal studies. (Fowkes et al. 2008)

- Guidelines now recommend screening specified patient groups for PAD to enable the identification of high cardiovascular risk and subsequent instigation of risk reduction strategies. (ACCF/AHA, 2011; TASC II, 2011)

- “Failure to diagnose PAD is a missed opportunity to address cardiovascular risk factors and reduce cardiovascular death and mortality”. (Department of Health, 2013)
Why Use Doppler

**Pulse Palpation**
- Dependent on experience of clinician
- Can be affected by underlying systolic blood pressure
- Studies show that it has poor sensitivity for diagnosing PAD (as low as 17% in some studies) and poor specificity for ruling it out.
- Dorsalis pedis pulse is absent, unilaterally or bilaterally, in 4 – 12% of healthy individuals (*Beutner et al., 2012*)

- Up-to two thirds of patients with PAD in the community have no symptoms (*Tendera et al., 2011*) - symptom based questionnaires, such as the Edinburgh Claudication Questionnaire, are therefore of limited use.

- The ANKLE BRACHIAL INDEX is therefore recommended by all current PAD guidelines.

- BP measurement at the ankle using a stethoscope is difficult and inaccurate (*Takahashi et al., 2005*) – the use of a Doppler is therefore the current gold standard for ABI measurement.

- Doppler waveforms should also be reviewed when arterial calcification is suspected – see Section 2
Doppler Frequencies

- Ultrasound has to travel through varying depths of tissue:
  e.g. 2mm for finger or toe down to 8cm for a deep lying vessel.

The rule of thumb is:

- The **LOWER** the frequency
- The **DEEPER** the optimum range
- The **LARGER** the transducer head
Huntleigh Doppler's Range of Probe Sizes

**EZ8XS:** The Easy8 8MHz High Sensitivity Doppler probe incorporates Wide Beam technology to allow easy location of the vessel. It is also easier to maintain vessel contact during inflation & deflation.

**VP4XS:** A 4MHz High Sensitivity Doppler probe for detection of deep lying vessels.

**VP5XS:** A 5MHz High Sensitivity Doppler probe for oedematous limbs and deep lying vessels. The ideal probe as an adjunct to the Easy 8 for ABPI measurements.

**VP8XS:** An 8MHz High Sensitivity Doppler probe for easier detection of peripheral vessels and calcified arteries.

**VP10XS:** A 10MHz High Sensitivity Doppler probe for detecting smaller vessels in specialist superficial applications.

**EZ8XS and VP5XS are recommended for ABI measurement**
Selection of Equipment

- Dopplex® DMX, Dopplex® SD2 or Dopplex® D900

- Correct probe transducer; 8MHz and 5MHz (SVT, 2012)

- Correct size BP cuff (American Heart Association, Aboyans et al., 2012)

- Appropriate ultrasound gel (Kenney, 1997)

- Dopplex® DR5 software for documentation if required
Preparation of the Patient

• Explain and reassure patient of the procedure

• The patient should refrain from smoking for at least 10 minutes prior to the test

  *(Yatako & Gardener, 1999)*

• Ensure ambient temperature of the room is comfortable,
  *(SVT, 2012)*

• Remove any tight clothing from both arms and stockings socks etc. from legs

• Cover any open lesions with an impermeable dressing or clear film,
  *(Aboyans et al., 2012)*

• Rest the patient in the supine position for at least 10 minutes,
  *(American Heart Association: Scientific statement for the measurement and interpretation of the ABI – Aboyans et al., 2012)*
Sounds of normal artery

Sounds of normal vein
REMEMBER
The Doppler probe needs to be in line and 45 degrees to the vessel, facing the heart.
Arteries of the Foot

Which pulses should be assessed?

- All guidelines concur that at least 2 pulses should be assessed for each foot.
- Normally these are: (i) posterior tibial, (ii) dorsalis pedis or anterior tibial.
- However, NICE guidance recommends that they should always include the peroneal pulse as this may be the only one present in some people, particularly those with diabetes (NICE, 2012).
Ankle Pressures – Dorsalis Pedis
Ankle Pressures – Posterior Tibial

It is important to identify and follow the protocol set by your individual hospital/clinic/health center.
How to Calculate the ABI

**ABI calculations**
- Highest ankle systolic pressure (for each leg)
- Highest brachial systolic pressure

**Right ABI**
- Brachial: 145
- Posterior Tibial: 80
- Dorsalis Pedis: 85
- ABI: $\frac{85}{150} = 0.57$

**Left ABI**
- Brachial: 150
- Posterior Tibial: 120
- ABI: $\frac{120}{150} = 0.80$

*Normal ABI ratio is equal or greater than 1.00 but not greater than 1.3 (check local policy)*
How to Calculate the ABI

\[
\frac{\text{Highest ankle systolic pressure}}{\text{Highest brachial systolic pressure}} = \frac{85}{150}
\]
**Interpretation of the ABI**

<table>
<thead>
<tr>
<th>ABI Range</th>
<th>Description</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABI &gt; 1.0 - 1.3</td>
<td>Unlikely to be arterial in origin</td>
<td>Apply compression therapy</td>
</tr>
<tr>
<td>ABI = 0.8 - 1.0</td>
<td>Mild peripheral disease</td>
<td>Apply compression therapy with caution</td>
</tr>
<tr>
<td>ABI = 0.5 - 0.8</td>
<td>Significant arterial disease</td>
<td>Do not compress - refer to specialist</td>
</tr>
<tr>
<td>ABI &lt; 0.5</td>
<td>Severe arterial disease</td>
<td>Do not compress - refer urgently to vascular specialist.</td>
</tr>
<tr>
<td>ABI &gt; 1.3*</td>
<td>Measure toe pressures or refer to specialist</td>
<td>Measure toe pressures or refer to specialist</td>
</tr>
</tbody>
</table>

* may vary according to local protocols.
There is limited evidence on the rates of PAD progression and on the cost-effectiveness of repeat measurement of the ABI in different patient groups (Mohler, 2012).

However, NICE states “Ideally, Doppler studies should be repeated every 6–12 months or earlier if clinically indicated. Follow local policies, if available” (NICE: Clinical Knowledge Summaries, 2016).

In the event of leg ulcer recurrence, Doppler assessment should be repeated; do not presume it is of the same origin.
Factors Affecting the Accuracy of the ABI

<table>
<thead>
<tr>
<th>Condition</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Diabetes</td>
<td>Calcification of arteries → artefactually elevates ABI</td>
</tr>
<tr>
<td>2. Renal Disease</td>
<td>Calcification/inappropriate investigation due to BP fluctuation</td>
</tr>
<tr>
<td>3. Rheumatoid Arthritis</td>
<td>Vasculitic pain and calcification</td>
</tr>
<tr>
<td>4. Arteriosclerosis</td>
<td>Hardening of arteries → artefactually elevates ABI</td>
</tr>
<tr>
<td>5. Cardiac Arrhythmias</td>
<td>Difficult to assess sounds and pinpoint return of blood flow/systolic pressures</td>
</tr>
<tr>
<td>6. Peripheral Oedema</td>
<td>Artefactual elevation of ABI</td>
</tr>
<tr>
<td>7. Lipodermatosclerosis (associated with venous insufficiency)</td>
<td>Artefactual elevation of ABI</td>
</tr>
</tbody>
</table>

NB. Calcification is also associated with advancing age
### Factors Affecting the Accuracy of the ABI

<table>
<thead>
<tr>
<th>Factor</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inadequate preparation i.e. room temperature</td>
<td>Vaso constriction</td>
</tr>
<tr>
<td>Patient and clinician anxious and unrelaxed</td>
<td>Resulting in increased blood pressure</td>
</tr>
<tr>
<td>Incorrect positioning of patient (i.e. not supine)</td>
<td>Falsely elevated ankle pressures</td>
</tr>
<tr>
<td>Inappropriate gel</td>
<td>Interference due to air bubbles</td>
</tr>
<tr>
<td>Incorrect size of sphyg cuff</td>
<td>Incorrect pressure measurements</td>
</tr>
<tr>
<td>Inappropriate Doppler probe</td>
<td>Ultrasound cannot penetrate to depth of vessel</td>
</tr>
<tr>
<td>Incorrect position of Doppler probe over vessel</td>
<td>Incorrect pressure measurements</td>
</tr>
</tbody>
</table>
Factors Affecting the Accuracy of the ABI

- Excessive pressure on vessel during procedure
- Collapses vessels

- Releasing sphyg cuff too rapidly
- Risk of missing systolic pressure point

- Prolonged inflation of the cuff/re-inflation
- Hyperemic effect on limb

- Mid procedure/repeated inflation (Vowden, 2012)
- Hyperemic effect on limb

- Moving Doppler probe during measurement
- Incorrect pressure measurement

- Inexperience of the procedure (Anderson, 1995)
- Practical skill requiring assessment by peers
Contra-Indications

When should you **NOT** undertake an ABI?
A Doppler ABI **should not** be undertaken if the patient has any of the following:

- SUSPECTED DEEP VEIN THROMBOSIS
- CELLULITIS
- PATIENT NON-COMPLIANCE
Summary

- Use appropriate probes and ultrasound gel (SVT, 2012)
- Use appropriate sized cuffs should be used (British Hypertension Society, 2004)
- 10 minute resting period (Aboyans et al., 2012)
- Position patient supine (Aboyans et al., 2012)
- Remove dressings (Aboyans et al., 2012)
- Measure both Brachial pressures (Aboyans et al. 2012)
- Measure two pedal pressures per foot – include peroneal pulse if patient has or suspected of having diabetes (NICE, 2012)
Summary

- Calculate ABI using highest ankle/highest brachial pressure
  \((NICE, \ 2012; \ AHA: \ Aboyans \ et \ al., \ 2012)\)
- Factors affecting the accuracy of ABI to be considered \((NICE, \ 2012)\)
- Repeat ABI every 6-12 months, or sooner if symptoms change \((NICE, \ 2012)\)
- Use ABI as part of a holistic approach to vascular assessment \((Vowden, \ 2012)\)
Conclusion

• There are now more reasons than ever to measure the ABI. *(Davies & Williams, 2016)*

• “The Doppler ABI must be used in conjunction with a comprehensive medical assessment”. *(Aboyans et al., 2012)*

• Systems should be in place to monitor standards and the outcomes of ABI measurements. *(NICE, 2012)*
Why measure pressure in both arms and take the highest reading?
This ensures that the systolic pressure is closest to the systemic pressure, especially if arterial disease is present.
How many pedal pulses do you measure?
A minimum of two arteries on each foot e.g. Dorsalis Pedis or Anterior Tibial and Posterior Tibial or Peroneal. (NB. Always include peroneal for diabetics / suspected diabetics)
Why do you use the higher of the two measurements in the foot?
This will determine whether there is adequate blood flow to the foot from one of the arteries.
Which ABI values allow you to apply compression therapy?
Values between 0.8 & 1.3 providing the holistic patient assessment has also ruled out arterial insufficiency.
Question

Which probes should you use to take ABI measurements?
We recommend an EZ8XS probe for general use and a VP5XS for obese patients and oedematous limbs.
Problems associated with Doppler ABI measurement

- Difficult to locate vessels
- Difficult to maintain vessel contact during inflation and deflation
- A reasonable knowledge of anatomy is required
- Typical average time for ABI is 11mins + 15-20mins rest
- Clinicians must be trained and monitored (local guidelines)
- Doppler ABIs taken by junior doctors disagreed with vascular technicians by >30%
  This improved to 15% after formal training.
Dopplex Ability – Automatic ABI System

HUNTLEIGH
Overview – what is Dopplex Ability?

• An automatic system that measures ABI

• It is a 4 channel system to measure all limbs simultaneously

• Uses uniquely designed cuffs to measure systolic pressures

• Has integrated printer and USB port for documentation
Overview – what does Dopplex Ability do?

- Measures ABI automatically in 3mins for detection of PAD
- The measurements are simultaneous so no need to rest the patient
- However, patient must be supine
- Records the highest ankle pressure in all 3 arteries
- Produces PVR waveforms from both ankle cuffs – concur with ABI
- Can print out results on thermal paper
- Can connect to DR4 for transferring, archiving and printing
- Deskills the test
- Clinically proven against Duplex and can detect ABI from 0.29 - 1.57 (Lewis et al, 2016)
Overview – Pulse Volume Recordings

Grade A: Normal
• Sharp systolic peak with prominent dicrotic notch

Grade B: Mildly Abnormal
• Sharp peak, absent dicrotic notch; downslope is bowed away from baseline
Overview – Pulse Volume Recordings

Grade C: Moderately Abnormal

• Flattened systolic peak, upslope and downslope time decreased and nearly equal, absent dicrotic notch.

Grade D: Severely Abnormal

• Low amplitude or absent pulse wave with equal upslope and downslope time
Clinically proven against Doppler
- can detect ABI from 0.4 - 1.4 (EWMA 2010; SAWC and WOW 2012)

Clinically proven against Ultrasound Duplex Imaging
- can detect ABI from 0.29 - 1.57 with overall accuracy of 85% (Lewis et al, 2016)

Volume Plethysmography technology
- superior to other automatic systems especially in detecting low ankle pressures and ABIs
  (ABI range: 0.29 – 1.57; Lewis et al, 2016).
Most oscillometric systems cannot measures ABIs < 0.8 i.e. BoSo, MicroLife, MESI etc.

Reduced inappropriate referrals
- The introduction of Ability into a new clinical pathway can reduce inappropriate referrals and lead to the prioritisation of clinical services (Tadej, 2013)

Improved diagnosis
– using Pulse Volume waveforms to detect underlying arterial disease when calcification is present
  (Davies et al, 2014) (ABI combined with PVR - sensitivity = 100%, specificity = 76%; Lewis et al, 2016)
Advantages of Dopplex Ability

Up to 85% reduction in labour time
– when compared with Doppler ABI measurements. Resting time is eliminated

Proven reliability
- when compared to conventional methods in almost all patient groups, providing clear results with waveforms (Lewis, 2010)

Measurements comply with guidelines
- Ability measurements comply with International Guidelines which specify that all four limb pressures must be used to calculate the ABI.
Dopplex Ability - Case Study 1

Patient symptoms:
Hypertensive
Normal circulation (No PAD)
RESULT: Moderate-severe PAD. Referred to vascular surgeon. Subsequently underwent successful angioplasty. Can now walk miles with improved life style (Davies et al, 2014)
Advantages of Automatic ABI

- Extremely easy to use: fully automated
- Rapid bi-lateral ABI measurement in < 5mins (Doppler based ABI typically takes 30mins)
- No need to rest patient for 10-15mins
- ABI can now be undertaken by less skilled staff
- Only have to apply 4 cuffs
- Physiologically more accurate
- No need to remove socks and tights
- Integral printer for documentation of results and PVR waveforms
- Records the highest ankle pressure in all 3 arteries
- Automatic interpretation
- Clinically validated
VASCULAR ASSESSMENT

MASTERCLASS

SESSION 2
Aims & Objectives of Teaching Session

- Doppler Waveforms/Sounds
- Toe Pressures/Toe Brachial Index
- Doppler Venous Assessment
- Neuropathic Assessment

HUNTELEIGH

Rationale
Supporting Evidence
Equipment / Methods
Doppler Waveforms/Sounds: Rationale

The ABI can be unreliable in certain patient groups including those with diabetes, chronic kidney disease and the elderly (Davies et al. 2014).

A secondary or alternative mode of assessment is needed in such cases:

- Doppler waveforms & sounds
Medial Arterial Calcification

- Accumulation of calcium and phosphate in the medial layer of the vessel wall
- Common in diabetics or those with Chronic Renal Failure
- Causes artefactually raised occlusion pressures resulting in non-diagnostic ABIs
Evidence:

- The International Working Group on the Diabetic Foot states that “a patient with diabetes and a foot ulcer should undergo assessment which includes examination of ankle or pedal Doppler Waveforms” (IWGDF, 2015)

- **Doppler waveforms were better predictors of healing** than the ABI in a study of 50 patients with Type 2 diabetes who had undergone foot amputation (Caruana et al., 2015)

- Formosa et al. (2013) also found inconsistencies between ABI and waveform analysis in a diabetic population – they concluded that “Both ABI and Doppler waveform analysis should be used in the assessment of people with diabetes”

- Doppler waveform analysis has “**excellent inter-rater reliability**” amongst experienced clinicians (Formosa et al., 2016)
Doppler Waveforms/Sounds: Selection of Equipment

- Dopplex® DMX
- Correct probe transducer; 8MHz and 5MHz \((SVT, 2012)\)
- Appropriate ultrasound gel \((Kenney 1997)\)
- Dopplex® DR5 for documentation if required
Tri-phasic Waveform - Normal
Doppler Waveforms/Sounds: Examples

Bi-phasic Waveform – Normal
(depending upon ABI)
Doppler Waveforms/Sounds: Examples

Monophasic Waveform – Abnormal
Doppler Waveforms/Sounds: Examples

What does it sound like?
1) Tri-phasic
2) Bi-Phasic
3) Monophasic

Listen to this sound
Doppler Waveforms/Sounds: Examples

Monophasic Waveform 2
– Abnormal
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Toe Pressures
Toe Brachial Index (TBI)
Toe Pressures/TBI: Rationale

The ABI can be unreliable in certain patient groups including those with diabetes, chronic kidney disease and the elderly (Davies et al. 2014).

A secondary or alternative mode of assessment is needed in such cases:

• Toe Pressures/Toe Brachial Index

**WHY?**

Toe vessels are less susceptible to calcification and incompressibility than ankle arteries (Aboyans et al., 2006; Ramonos et al., 2010; Hoyer et al., 2013)
• Toe pressures have been used to assess arterial disease since the 1980s. (Romanos et al., 2010)

• “A quick and effective way of establishing or refuting a lower extremity PAD diagnosis” (American Heart Association/American College of Cardiology Foundation, 2013)

• Undertake toe pressures and TBI in the case of incompressible arteries or when ABI > 1.4 (TASC 2007; European Society of Cardiology, 2011)

• Lower toe pressures/TBI are associated with poor or reduced healing rates (Sonter et al., 2014)

• “In patients with Diabetes Mellitus additional care should be taken and further arterial investigations undertaken such as toe pressures” (ETRS guideline 2003)
Toe Pressures - video
Toe Pressures/TBI: Selection of Equipment

- **DMX** Doppler with PPG sensor or **ATP kit**
- **Toe Cuffs**
- **Sphyg**
- **Arm cuffs**
- **TBI Calculator**
- **Dopplex® DR5** for documentation if required
PPG vs. Doppler

- PPG: Toe pressures performed with PPG are more reliable than measuring with a Doppler (Bonham et al., 2010).
- Measuring toe pressures with a Doppler can be difficult if toes are cold (vasoconstriction).
- Portable PPG toe pressures have been found to have a high level of agreement with vascular laboratory PPG to detect PAD (Bonham et al., 2010).
Toe Pressures: Method
How to Calculate the TBI

TBI calculations

\[
\text{Toe systolic pressure} \div \text{Highest brachial systolic pressure}
\]

Right TBI

\[
\frac{75}{140} = 0.54
\]

Left TBI

\[
\frac{115}{140} = 0.82
\]
Toe Pressures

Toe systolic pressure = 75
Highest brachial systolic pressure = 140
### Foot Lesion Healing Prognosis

<table>
<thead>
<tr>
<th>TOE PRESSURE (mmHg)</th>
<th>DIABETIC</th>
<th>NON DIABETIC PATIENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-30</td>
<td>40%</td>
<td>73%</td>
</tr>
<tr>
<td>30-55</td>
<td>85%</td>
<td>100%</td>
</tr>
<tr>
<td>&gt;55</td>
<td>97%</td>
<td>100%</td>
</tr>
</tbody>
</table>

If the TBI < 0.64 then PAD is present and compression is not recommended.

Recent meta-analysis found that a cut-off value of 30mmHg was associated with 3.25 greater risk of non healing and amputation (Sonter et al., 2014)
Foot Lesion Healing Prognosis

A schematic estimate of the probability of healing of foot ulcers and minor amputations in relation to ankle blood pressure, toe blood pressure and transcutaneous oxygen pressure (TcP02) based on selected reports.

*International Working Group on the Diabetic Foot (International Consensus) 1999*
Doppler Venous Assessment
Doppler Venous Assessment: Rationale

- Use of hand-held Doppler to assess for venous reflux should be part of the routine assessment of patients with venous disease (Thompson et al., 2001)

- Varicose Vein Assessment: The most commonly used maneuver in the office/bed-side setting is hand held Doppler examination of the saphenous vein (Kim et al., 2000)

- Sensitivity (97%) and specificity (73%) for the diagnosis of SFJ incompetence compared to Duplex ultrasonography as the gold standard (Kim et al., 2000)
Doppler Venous Assessment: Selection of Equipment

- DMX Doppler
- 5MHz probe
- 8MHz probe
- DR5 software
Doppler Venous Assessment: Method

Venous reflux test using Doppler

- Patient should be standing, the leg to be examined should be relaxed and slightly flexed with weight on the other leg (Vowden & Vowden, 2004).
- Place probe over the common femoral or popliteal vein.
- Manually compress & then release calf muscle.
- Listen to Doppler sounds on release; if present (reflux).
- Document reflux (using DR5 software package).
- Clinically significant if reflux > 0.5 seconds.
Doppler Venous Assessment: Method

Normal Waveform
– no flow on release
Doppler Venous Assessment: Method

Abnormal Waveform – flow on release
Neuropathic Assessment
Peripheral neuropathy is the most common component cause in the pathway to diabetic foot ulceration (*Boulton et al.*, 2007).

Clinical exam to identify loss of protective sensation is vital (*American Diabetic Association*, 2015).

Loss of pressure sensation using the 10g monofilament is highly predictive of subsequent ulceration (*Singh et al.*, 2015).
Adults with diabetes should have an annual diabetic foot assessment including neuropathic assessment with 10g monofilament (NICE guidelines, 2015*)

Use of 10g monofilament recommended by:
- American Diabetic Association, 2015
- NICE, 2015*

*NICE (NG19) Diabetic Foot problems: prevention and management
Neuropathic Assessment: Method
Neuropathic Assessment: Method

- Nylon monofilaments are constructed to buckle when a 10g force is applied.
- Loss of ability to detect this pressure is associated at one or more anatomic sites on the plantar surface of the foot has been associated with loss of large fibre nerve function.
- Sites for testing: 1\textsuperscript{st}, 3\textsuperscript{rd} and 5\textsuperscript{th} metatarsal heads and plantar surface of distal hallux
To perform the 10g monofilament test, the device is placed perpendicular to the skin, with pressure applied until the monofilament buckles.

The monofilament test should be performed at the highlighted sites while the patient's eyes are closed.
Summary

- High risk patients (such as those with diabetes and a foot ulcer) should undergo assessment which includes examination of ankle or pedal Doppler Waveforms (*IWGDF, 2015*)
- Measure toe pressures in patients with ABI>1.4 or when Doppler waveforms and ABI do not concur to exclude calcification (*ESC, 2011; TASC II guidelines: 2007*)
- Use Doppler to determine the presence of venous incompetence in specific veins (*Thompson et al., 2001*)
- Test foot sensation using 10g Monofilament (*NICE NG19, 2015; ADA, 2015*)
Question

When should toe pressures be measured?
Answer

- when ABI > 1.4
- on all diabetics
- when arterial calcification is suspected or known to be present
- when Doppler waveforms and ABI do not concur
What do the Guidelines recommend to use for detection of neuropathy?
A 10g Monofilament
In which direction should the Doppler probe be held when detecting reflux
Towards the heart.
This ensures that the waveforms are recorded correctly.
Clinical Advisors

• Dr Jane Davies, Research Associate, Cardiff University

Reviewed and Endorsed by

• Dr Cynthia Formosa and Dr Alfred Gatt – Senior Lecturers at the University of Malta and Founder Members of the Diabetes Foot Research Group, Malta.
• Trudie Young – Director of Education, Welsh Wound Innovation Centre and Trustee of the Lindsay Leg Club Foundation