This practical guide offers tips on how to use a hand-held Doppler ultrasound for assessing peripheral arterial disease. Leg ulcers can have an extremely deleterious effect on a patient’s well being and quality of life.

One part of a comprehensive assessment of a patient with a leg ulcer is to perform a Doppler ultrasound and examine the signals transmitted from the Doppler probe. However, this is a skilled procedure and forms only one part of the overall assessment.

WHY DOPPLER ABPI IS USEFUL

When employed by clinicians as part of a vascular assessment, the Doppler assessment system uses the direction and velocity of blood flow to ascertain whether the patient’s arterial blood vessels are healthy or whether they have become diseased.

The brachial and ankle systolic pressures are measured by the clinician using a hand-held Doppler probe at the patient’s brachial pulse, and the dorsalis pedis pulse on the dorsum of the foot. The ankle pressure is then divided by the brachial pressure to obtain the patient’s ankle brachial pressure index (ABPI).

HOW TO USE DOPPLER ULTRASOUND TO MEASURE ABPI

It must be stressed that a Doppler assessment alone does not constitute the entire assessment of a patient with a leg ulcer.

1. **Preparation:** The procedure should be performed by two nurses, if possible, one of whom should be a registered nurse trained in Doppler assessment.

2. **Explaining the procedure:** Before undertaking a Doppler assessment, the patient should receive a full explanation of the procedure so they are aware of what is involved.

3. **Informing the patient:** Patients should be told that they will need to lie as flat as possible, with one pillow under their head, for 10–20 minutes, because this removes the effect of gravity on blood flow [Fig 1]. Patients with breathing difficulties may not be able to lie entirely flat, in which case they should be asked to lie as low as is tolerable for them. Patients should be informed that they may experience some discomfort from the blood pressure cuff on the ankle and that they may stop the procedure at anytime if it is too painful.
Ultrasound gel should be used as a contact medium between the patient and the Doppler probe.

The procedure: The blood pressure cuff should be applied to the arm above the patient’s elbow [Fig 2]. The brachial artery is located (with the fingers), and then ultrasound gel applied. The Doppler probe is held between 45–70 degrees on the skin and moved around until the clearest signal is heard.

Figure 3. Cling film is applied to the wound.

Figure 4. The pedal pulses are located and marked.

4 Equipment needed: Clinicians must have access to the following:
- A Doppler ultrasound with an 8Mhz probe
- A sphygmomanometer (blood pressure meter) and the appropriate size blood pressure cuff for the shape and size of the patient’s arms and ankles
- Cling film to cover the ulcer bed (this prevents the blood pressure cuff from rubbing against the ulcer bed directly, and prevents discomfort and contamination of the cuff)

Page Points
1. Cling film needs to cover the wound bed as this prevents the ulcer cuff rubbing against the wound bed directly
2. The blood pressure cuff should be applied to the patient’s arm above the elbow
3. The brachial artery is located with the fingers and then ultrasound gel applied
The blood pressure cuff should be inflated until the signal disappears, then the cuff slowly released while the nurse listens carefully for the signal to reappear. This is recorded as the brachial systolic pressure. This is then repeated on the other arm. The highest systolic pressure is used to compare against the ankle pressures.

**Blood pressure:** The patient’s ulcer is then exposed and covered in cling film Fig 3. The nurse should then locate the patient’s pedal (foot) pulse to assess the arteries Fig 4. Two of these four pedal pulses can be used:

- Anterior tibial artery
- Posterior tibial artery
- Peroneal artery
- Dorsalis pedis artery.

The two most common arteries used in the procedure are the dorsalis pedis and posterior tibial arteries, mainly because they are accessible when the blood pressure cuff is applied to the leg. The blood pressure cuff is then applied just above the patient’s malleoli (ankle).

While the registered nurse applies the Doppler probe over the artery and listens for the signal, the other nurse slowly inflates the blood pressure cuff. The registered nurse listens for the Doppler signal to disappear due to the artery’s occlusion by the blood pressure cuff.

The cuff is then slowly deflated and both nurses observe the pressure at which the Doppler signal reappears — this pressure is recorded for that artery. The registered nurse finds another pedal artery and the process is repeated. If the artery cannot be compressed by the blood pressure cuff, this indicates severe disease.

**Blood pressure result:** In theory, a patient’s brachial blood pressure should be the same as the ankle.

**Doppler ultrasound signals:** In addition to recording the ABPI, the nurse should also be listening to the signals of the Doppler probe as these can impart useful information and are equally as valuable as the ABPI measurement.

- **Triphasic signal**
  This is represented by three sounds heard very quickly together (duh...duh...dum), as the blood runs through a healthy non-diseased artery.

- **Biphasic signal**
  This can be recognised as two sounds heard together (duh, dum ... duh, dum), this may be because the Doppler probe is not at the optimum angle. Again, it indicates a healthy artery.

- **Monophasic signal**
  A single, almost ‘banging’ sound (...dum! ...) indicates that the Doppler signal is unable to penetrate a diseased artery.

**Expert Commentary**

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As a senior consultant at a very busy tertiary referral wound clinic in a major Australian hospital, I believe accurate vascular assessment is essential. Our clinic has five rooms and a multidisciplinary staff including medics, nurses, podiatrists, pharmacists, a dermatologist, plastic surgeon, dietician and an on-call orthotist.

We often treat 35–40 patients each day when we are open.

We have recently introduced an automatic ankle brachial pressure index (ABPI) system and the major advantage of this is the reduction in the time needed to obtain an ABPI measurement on each new patient attending the clinic, or those needing to be retested.

Patients do not need to rest prior to the procedure and the actual test time takes only a few minutes.

The simplicity of applying the cuffs to the patient and the operation of the test allows the procedure to be performed by any member of staff, even unqualified staff (after training). The test provides bilateral results often not done if only one leg is implicated. The result provided includes bilateral ABPIs and a wave form.

This device will be of great value in a busy clinic where time is at a premium.
Leg ulcer assessment: The nurse performs a Doppler ultrasound as well as taking a comprehensive social and medical history.

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There are a number of tips that can be very helpful when teaching registered clinicians about the accurate and safe measurement of Doppler ultrasound and the calculation of ankle brachial pressure index (ABPI). It is essential to ascertain the patient’s past medical history prior to the assessment in order to make an informed opinion about the likelihood of arterial or venous disease before measuring the ABPI. This can alert clinicians to the presence of operator errors and false readings. Clinicians should consider if the ABPI confirms what they already believed to be true. Caution should be taken when the past medical history, holistic assessment and the Doppler ultrasound results do not match.

Pain can create difficulties. If it is too painful for the patient to lie still for the time needed to undertake the Doppler assessment or if it is difficult to tolerate cuff inflation, it will not be possible to measure the ABPI. Careful consideration and planning of the Doppler ultrasound is necessary, as well as the appropriate use of analgesia. We often encounter practical difficulties with the Doppler technique, especially in patients with chronic oedema and/or lymphoedema, where the normal signs of arterial disease may not be apparent. The volume of oedema in some patients may prevent the Doppler ultrasound from detecting any signal. In extremely swollen limbs, it might not even be possible to apply a cuff. On these occasions it is important to consider the following resources:

- Duplex scan
- Larger cuff sizes
- Use of a lower frequency probe
- Measurement of toe/brachial pressure index instead

The use of headphones (usually supplied with the Doppler ultrasound) can assist when it is hard to hear the pulses. It is important to use them throughout the procedure so that the ankle and brachial results are recorded consistently. A neck cord may also be worn, so that both hands are free for the procedure. The ABPI should be calculated using an electronic calculator rather than a chart, and the registered clinician should be sure to use the correct equation.

In my experience, the main causes of false readings are:

- Insufficient rest time
- Staff taking recordings too quickly because of time constraints
- Incorrect cuff size
- The cuff being repeatedly inflated for long periods
- The cuff being poorly secured around the ankle
- The cuff deflating too rapidly
- The vessels being calcified.

Automatic systems
The advantage of an automatic system (ie, Dopplex® ABIlity; ArjoHuntleigh) is that they allow the recording of an ABPI within three minutes of the cuffs being applied. In addition no rest is needed before the test. The results are automatically calculated and are available as print-out labels.

In summary, with both manual and automatic techniques, caution should be exercised:

- Where the holistic assessment does not match the ABPI measurement
- In the presence of skin necrosis and amputation
- With the hand-held Doppler if signals are dampened or monophasic

My final tip is to look after the Doppler ultrasound equipment by keeping it in good condition, having it serviced annually, always carrying a spare battery and always storing it in its appropriate carry case.