

HOW TO OBTAIN THE RESTING ABPI IN LEG ULCER MANAGEMENT

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The use of Doppler ultrasound to detect arterial insufficiency is an essential part of the assessment process for chronic leg ulcer management. Here, the procedure carried out to obtain and calculate the ankle:brachial pressure index (ABPI) will be described. Competency in determining an ABPI is important if reliable results are to be produced.

Competency in carrying out an ankle brachial pressure index (ABPI) is important if reliable results are to be produced. Practitioner variables affecting the ABPI measurement are well documented and inexperience is noted as a key factor (Ray et al, 1994; Kaiser et al, 1999). This article will provide details of the correct procedure to be followed in order to obtain and calculate the ABPI. The process is specific and any deviation will produce variables, which will affect the result obtained.

The role of Doppler ultrasound in detecting arterial insufficiency is considered an essential part of the assessment process for chronic leg ulcer management (Scottish Intercollegiate Guidelines Network [SIGN], 1998; Royal College of Nursing Institute, 1998). A common misunderstanding is that the ABPI is used to diagnose the

type of ulcer, but it does not tell the clinician whether the ulcer is venous or arterial in origin. However, when used in conjunction with the medical history, physical assessment and clinical presentation of the ulcer, it helps the clinician to decide care.

Doppler assessment of the lower limb seeks to determine the resting brachial systolic pressure (as an approximation of central pressure) and the resting ankle systolic pressure, presenting it as a ratio: the ABPI. The resulting calculation, combined with competent interpretation, enables the clinician to decide upon the safety of applying compression bandaging. Understanding and following the correct procedure is important if the interpretation of the ABPI is to be meaningful and the results valid.

Preparation

The equipment required to perform an ABPI is as follows:

- ▶▶ A hand-held Doppler with accompanying probe. Ensure you have the correct probe size. Use an 8mgHz for lower limb assessment, and a 5mgHz probe if there is a lot of oedema
- ▶▶ Sphygmomanometer, ultrasound gel and tissues
- ▶▶ Cling film for covering any ulceration.

Patient preparation

If competency and inexperience are issues then, after carrying out the procedure, discuss and interpret the findings with a more experienced practitioner.

- ▶▶ Do not perform a Doppler ultrasound if suspicion of deep vein thrombosis is present as it will be painful and may dislodge the clot. The clinical signs of DVT may include pain which becomes worse



Figure 1. Hold the probe at a 45–60 degree angle to the blood vessel and direct it into the blood flow.



Figure 2. When measuring ankle systolic pressure, apply the blood pressure cuff just above the malleoli to cover the gaiter area.



Figure 3. Location of the posterior tibial pulse.

when standing or walking, and swelling. Calf pain may be experienced if the calf veins are affected. However, individual signs and symptoms are poor predictors of the presence or absence of DVT and need to be confirmed by appropriate investigations (Goodacre et al, 2005).

The procedure should be explained to the patient. Although it is non-invasive, it can be uncomfortable and, for some, painful because the blood pressure cuff may squeeze the leg over existing ulceration and/or oedema. Patients need to know what to expect and that they can stop the practitioner from continuing should the pain become unbearable.

Before carrying out the procedure the patient should rest for 10–20 minutes (Carter et al, 1969; Yao et al, 1969; Stoffers, 1996) in the required position. The emphasis is upon obtaining a resting systolic pressure so time should be allowed within the nursing schedule for the patient to be rested.

The patient must lie flat in order to minimise hydrostatic pressure variables (Vowden and Vowden, 2001). However, many patients will not be able to lie flat and for some having their legs elevated is difficult, e.g. in the case of patients with breathing problems or arthritis. In these instances lie the patient as flat as is comfortably tolerated, and/or with the legs elevated as much as possible. The patient's position should be documented. This will contribute

to consistency for future readings and put the ABPI within a context that relates to patient positioning.

Procedure to obtain the brachial systolic pressure

1. To obtain the brachial systolic pressure place the blood pressure cuff around the patient's arm. As for all blood pressure measurements, the cuff should be the correct size for the limb. A range of cuff sizes should be available. An elevated ABPI will result if the cuff is too small and the artery cannot be compressed. The arm should be supported at heart level. Position the cuff with the tubing away from the probe as this may interfere with the probe positioning (*Figure 1*).
2. Locate the brachial artery, initially palpating for the artery may be helpful. A stethoscope is not used. Apply ultrasound gel over the pulse. Ultrasound gel is used as other types of gel contain too much water and are ineffective as conductors of sound. A generous pea-sized amount of gel should be used. Too little and there will not be enough to conduct the sound, too much and it will be difficult to maintain the position of the probe (*Figure 1*).
3. Switch the doppler on. Hold the probe at a 45–60 degree angle to the blood vessel and direct it into the blood flow (*Figure 1*). Arterial sounds will be different from venous sounds, the latter being continuous and 'whooshy' reflecting the respiratory pattern of breathing in and out. Doppler measurements are not usually reliable at

- angles of less than 25 degrees or greater than 60–70 degrees (Kremkau, 1995). If at first the pulse is not heard do not move the probe to a new location straight away. Rather, try adjusting the angle of the probe: it should be at a 45–60 degree angle to the blood vessel. If no sound is heard move the probe slowly tracing the path of the artery and listen carefully. Do not press the probe down into the patient. This is uncomfortable and can compress the vessel. Once the pulse is found and the best sound is located, keep the probe still.
4. Inflate the cuff while holding the probe over the pulse until any sound disappears. Slowly deflate the cuff and when the sound reappears this indicates systolic pressure; the value must be charted. It is important that the cuff is deflated slowly. If done too quickly the initial sound may be missed, particularly in instances of irregular heartbeat. Once the sound has been identified the cuff should be quickly deflated. Prolonged inflation can be extremely uncomfortable. Re-inflation of the cuff before it has been fully deflated and successive inflations without resting the limb will cause low readings (Vowden and Vowden, 2001).
 5. Repeat the procedure for the other arm. Both arms need to be considered because of measurement variability, although only one reading will be used to calculate the ABPI (Stubbing et al, 1997).
 6. Use the higher of the two brachial arm readings to calculate the ABPI for both lower limbs.

Procedure to obtain the ankle systolic pressure

To obtain the ankle systolic pressure, a similar procedure to that already described is carried out.

1. The practitioner needs to be comfortably positioned as this procedure may take time. It is also important to have a clear view of the anatomy of the foot. Cover any ulceration with cling film.
2. Apply the blood pressure cuff just above the malleoli (ankles) to cover the gaiter area (*Figure 2*).
3. Locate one foot pulse. If possible, it is helpful to palpate the foot pulse first as this will also aid in positioning the probe. However, having prior knowledge of the anatomy of the foot and where the foot pulses are located will enable them to be found even in oedematous feet. Two foot pulses will need to be used for each leg: there are four to choose from (*Figures 3–5*). The posterior tibial pulse is located behind the medial malleolus (*Figure 3*). The peroneal pulse is alongside as well as distal to the lateral malleolus (*Figure 4*).
4. The anterior tibial and the dorsal pedis are part of the same artery, so choose either of these, but not both (*Figure 5*). Note that when the extremities are cold the pulse may be more difficult to locate.
5. Apply gel to the chosen foot pulse and position the probe in the direction of the blood flow as previously described (*Figure 6*).
6. Inflate the blood pressure cuff as for the arm until any sound disappears. Slowly deflate the cuff and when the sound reappears this



Figure 4. The peroneal pulse.



Figure 5. Anterior tibial and dorsal pedal pulses.



Figure 6. Apply gel to chosen pulse and position the probe into the direction of the blood flow.

indicates systolic pressure: the value must be charted. If the sound does not disappear it is because of arterial calcification and thus the artery cannot be compressed. Arteriosclerosis provides its own information for the clinician indicating that the artery has become rigid and less distensible. Arteriosclerosis may include atheromatous plaques which will narrow the lumen of the artery and restrict blood flow.

5. Locate a second foot pulse and repeat the procedure.
6. Take the highest of the two pedal readings to provide the calculation for that leg.
7. Repeat for the other limb. Both limbs need to be assessed regardless of whether only one is ulcerated or appears affected by symptoms such as oedema. This is to provide a thorough assessment and to offer comparison.

Calculation of the ABPI

Two calculations will be obtained:

- ▶▶ Left ABPI: Divide the highest of the two ankle readings for the left leg by the highest of the two brachial pressures
- ▶▶ Right ABPI: Divide the highest of the two ankle readings for the right leg by the highest of the two brachial pressures.

ABPI = Ankle systolic pressure (highest ankle pressure for each leg) divided by the brachial systolic pressure (highest of the two arms).

Make a record of all Doppler measurements including the blood pressure readings, not just the ABPI. The absolute values can be helpful to specialists. Recording the Doppler sounds

is helpful as this will assist in determining the status of the artery and will provide complementary information to the ABPI (Tables 1 and 2).

Interpretation of the results

The ABPI should be interpreted within the context of a full limb assessment. General interpretations are listed in Table 1.

The limitations of the ABPI results and the facts to consider when interpreting findings are outlined in Table 3.

The ABPI result should not be used solely to indicate the amount or types of compression to be applied. Medical history, presenting clinical symptoms, psycho-social factors, patient choice and lifestyle, shape of limb, past experiences and practitioner competence are just some of the issues that need to be addressed.

Management must also take account of local guidelines and protocols. This will include guidance on compression therapy and at what intervals doppler re-assessment should be performed for patients.

Conclusions

This article has described the procedure for carrying out and calculating the resting ABPI. It

should be used by practitioners as part of leg ulcer prevention and management.

The procedure should only be performed by practitioners who have received specific training. Competence should develop with practice but initially it is advisable to carry out the method with another more experienced practitioner. This will assist with operator difficulties and interpretation of results. Significantly it is important to realise that the ABPI does not stand alone and must be placed within the context of a comprehensive medical history together with an assessment of clinical features in order to guide management. **WE**

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Table 1

Ankle brachial pressure index values and clinical interpretations

≥1 is 'normal'. High compression can be used

≥ 0.8 excludes significant arterial disease

< 0.8 indicates arterial disease. Reduced compression bandaging 0.6–0.8 and vascular assessment should be considered as per local protocols

< 0.5 contraindicates compression. Urgent vascular referral is required as per local protocols

Table 2

Interpreting Doppler sounds

Doppler sound	Status of vessel	Characteristics	Comments
Tri-phasic	Healthy	Sound has three parts; is pulsatile (bouncy in nature) and is heard at a higher frequency than that of a diseased vessel	
Bi-phasic	Vessel has become less elastic. This may be part of the normal physiological process of aging or due to a stenosis	Sound has two parts, is more dampened than the tri-phasic and heard at a lower frequency	Oedema may distort a tri-phasic sound so that it is heard as bi-phasic. If the optimum position for the probe has not been found a pulse may appear to be bi-phasic because the best possible location for the artery has not been determined
Monophasic	Diseased vessel	Sound has a single component and is of lower frequency. Sound descriptors include 'whooshy', 'roaring wind' or 'soldiers marching'. In a very diseased vessel the sound can be similar to a vein which appears as an almost continuous 'whoosh'	Arterial sounds can be distinguished from venous as the latter modulate with the respiratory cycle by mirroring the breathing pattern

Table 3

Limitations of the ABPI and factors to consider

ABPI determinations	Limitation	Rationale	Management implications
The ABPI is a calculation of ankle pressure by determining the pressure within the major arterial vessels in the lower limb	It does not assess micro-vessel status. It therefore cannot assess micro-vessel disease in diabetes, vasculitis and rheumatoid arthritis	Microvascular disease occurs in diabetes, vasculitis and rheumatoid arthritis	Caution with high compression bandaging and hosiery. Refer to medical history and presenting clinical symptoms. Doppler sounds may be helpful. Further investigations may be needed
Elevated ABPI of above 1.3		The elevated ABPI may be due to incompressibility of the artery (arteriosclerosis, atherosclerosis)	In general proceed with caution as to high compression bandaging. Refer to medical history and presenting clinical symptoms. Doppler sounds may be helpful.
ABPI is inversely related to the patients blood pressure status (Hugues et al, 1988; Belcaro and Nicolaidis, 1989; Carser, 2001)	ABPI may be calculated as low where hypertension is present and high where hypotension is found		Refer to medical history and presenting clinical symptoms. Doppler sounds may be helpful.
An elevated ABPI will occur if the leg is bent during the procedure (e.g. the knee is bent in the sitting position)		Hydrostatic pressure variables	Refer to medical history and presenting clinical symptoms. Doppler sounds may be helpful
Practitioner inexperience (Ray et al, 1994)	Results will be affected by: <ul style="list-style-type: none"> ▶▶ Deviations from the procedure ▶▶ Difficulties associated with carrying out the procedure ▶▶ Difficulties in interpreting the results 		If unsure, refer to: <ul style="list-style-type: none"> ▶▶ A more experienced practitioner ▶▶ Clinical nurse specialist (leg ulcer or tissue viability)

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