ASSESSING THE VASCULAR STATUS OF THE FEET FOR PATIENTS WITH DIABETES

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A reduced blood supply to the lower limb, due to arterial disease, is a common cause of foot ulceration in patients with diabetes. Early identification of arterial disease allows the implementation of prompt management strategies to prevent adverse outcomes, such as ulceration. Regular vascular assessment is therefore essential to establish the patient's risk of ulcer development. This article will now examine the important aspects of lower-limb vascular assessment.

Diabetes mellitus is a significant risk factor for the development of peripheral arterial disease (PAD) (Baker et al, 2005). Figures suggest that PAD occurs 20 times more often in people with diabetes compared with the non-diabetic population (Shaw and Boulton, 2001) and is known to be a major risk factor for diabetic foot ulceration. Of all lower extremity amputations, 40–70% are related to diabetes, with the majority occurring as a result of PAD (Apelqvist et al, 1992; International Working Group on the Diabetic Foot, 2005).

There is a general consensus that diabetic patients should receive regular vascular assessment to allow early identification of vascular changes and prompt intervention to prevent deterioration (International Working Group on the Diabetic Foot, 1999; Scottish Intercollegiate Guidelines Network [SIGN], 2001; National Institute for Health and Clinical Excellence [NICE], 2004). This article provides advice based on current clinical guidelines to assist practitioners when undertaking vascular assessment of the diabetic foot.

An accurate vascular assessment can prove invaluable in clinical practice as a screening tool to predict ulcer risk, identify patients in whom vascular conditions require further investigation and inform a prognosis for wound healing in patients with active ulceration. However, vascular assessment of the diabetic foot can be complicated by a number of factors: calcification of the arterial walls is common in diabetes, with approximately one third of diabetic patients developing calcified arteries (medial arterial calcification) (Vowden, 1999). This causes the vessels to lose elasticity and become rigid. The presence of medial arterial calcification and/or neuropathy can also render some assessment techniques unreliable (Falanga, 2005). It is imperative that practitioners have an awareness of the potential limitations of commonly utilised assessments to ensure accuracy when assessing a patient's vascular status.

Vascular assessment

In terms of vascular assessment, the NICE guidelines stipulate that basic foot examination should include palpation of pulses (NICE, 2004) (*Figures 1 and 2*).

In reality, palpation of foot pulses may not provide sufficient information to allow the clinician to make an informed judgement about a patient's vascular status. It is a common misconception that a palpable pulse equates to a good blood supply (Baker et al, 2005). In the diabetic foot, strong, rapid (bounding) foot pulses may be palpated due to the presence of autonomic neuropathy (the nerve supply to the blood vessels can be affected causing dilation of the arteries), however, blood flow to the toes could still be compromised (Baker et al, 2005). Further tests are often indicated.

Doppler ultrasound is probably the most widely used method for diagnosing vascular disease in the diabetic foot (Vowden, 1999). *Figure 3* shows the use of Doppler to assess foot circulation. Doppler is particularly effective in locating non-palpable pulses and quantifying disease progression (Baker et al, 2005).

The ankle brachial pressure index (ABPI) is a useful clinical aid to the practitioner involved in assessing the vascular status of the diabetic foot. The ABPI provides an objective method to assess the severity of vascular disease in the lower limb and is frequently used to inform management decisions, e.g. whether compression therapy is appropriate, or as a prognosis for wound healing (Marshall, 2004).

Obtaining an ABPI involves measuring systolic pressure at the arm and ankle, usually with a hand-held Doppler and a sphygmomanometer. Marshall (2004) outlines a recommended protocol to assist practitioners when undertaking an ABPI.

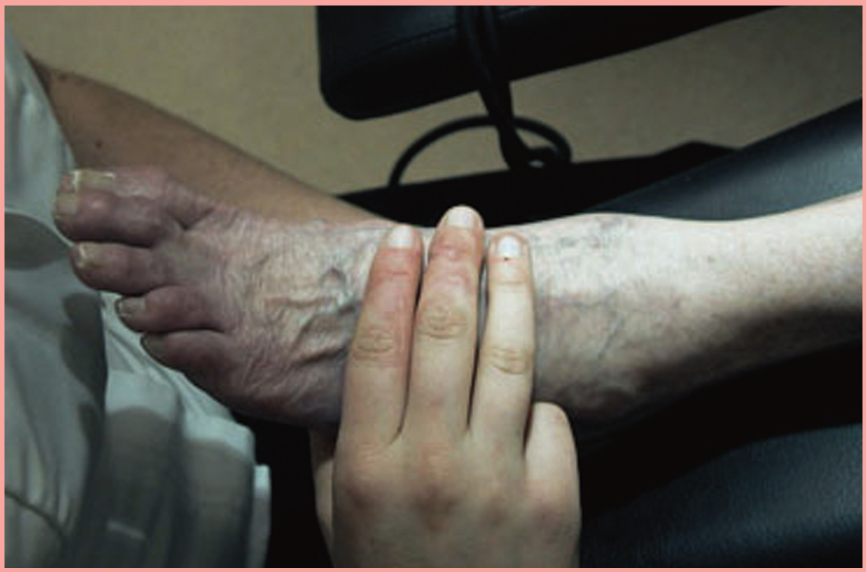

Figure 1. Palpating the dorsalis pedis pulse.

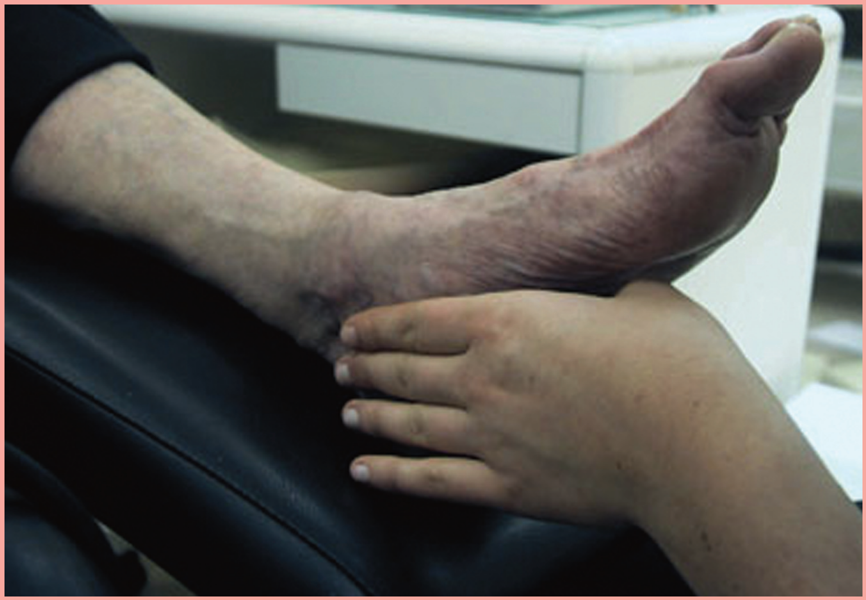

Figure 2. Palpating the posterior tibial pulse.

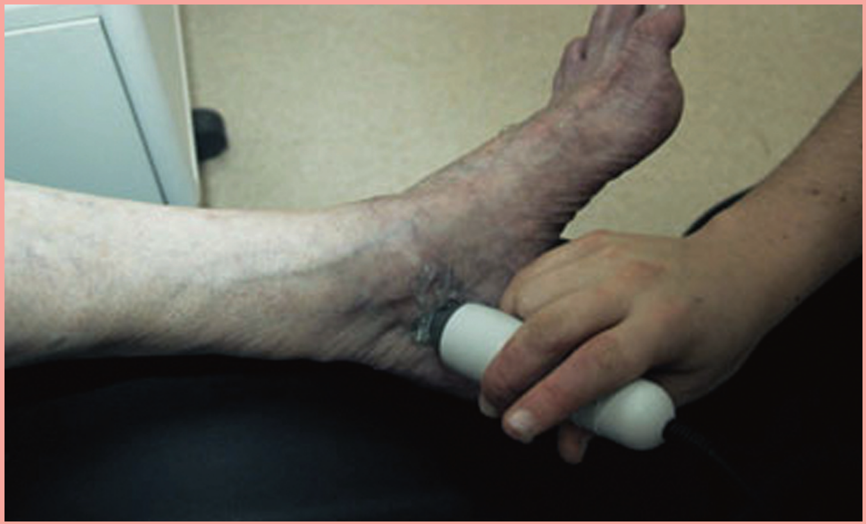

Figure 3. Doppler ultrasound to assess circulation in the foot.

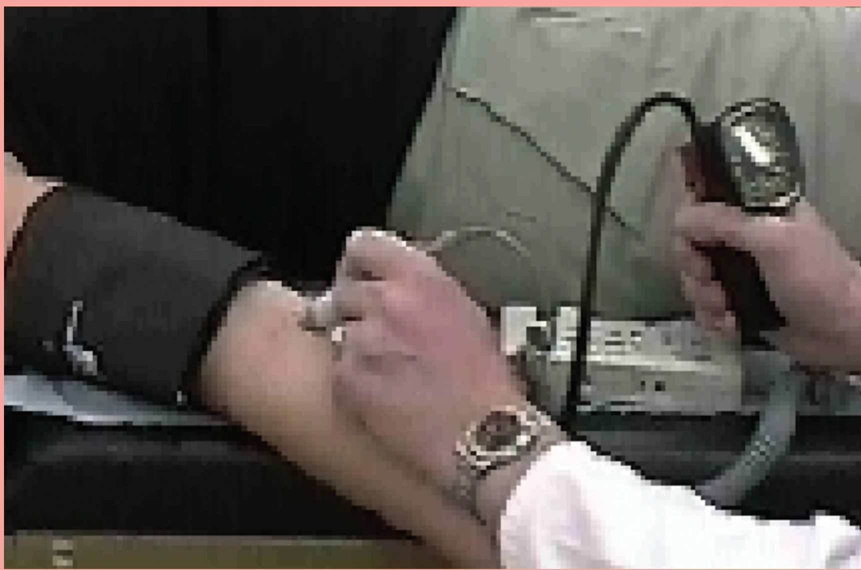

Figure 4. Using the Doppler probe to locate the brachial pulse.

Figure 5. Using the Doppler probe to locate posterior tibial pulse.

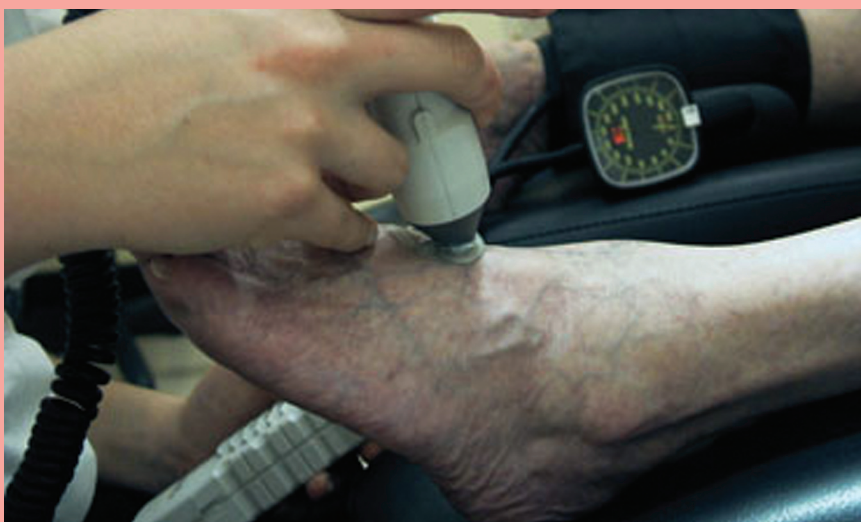

Figure 6. Using the Doppler probe to locate the dorsalis pedis artery pulse.

1. The patient should be laid supine for at least 10 minutes in a relaxed environment before any measurement is taken
2. Wrap the sphygmomanometer cuff around the right arm ensuring the cuff is the correct size for the limb
3. Locate the brachial pulse by palpation. Apply ultrasound gel to the pulse site and locate the pulse with the Doppler probe, ensuring you obtain a clear signal (*Figure 4*)
4. Maintaining the Doppler probe position, gradually inflate the cuff until the signal disappears
5. Monitoring the pressure gauge, slowly deflate the cuff and record the pressure at which the first Doppler signal returns: this is the systolic pressure
6. Repeat the procedure on the left arm and record the systolic pressure
7. Locate the right posterior tibial pulse (*Figure 2*) by palpation; apply ultrasound gel to the pulse site. Locate the posterior tibial pulse with the Doppler probe and repeat the above procedure (*Figure 5*)
8. Record the systolic pressure at the right posterior tibial pulse site
9. Locate the right dorsalis pedis pulse (*Figure 1*) by palpation. Apply ultrasound gel to the pulse site. With the Doppler probe locate the dorsalis pedis pulse and repeat steps 4 and 5 (*Figure 6*)
10. Finally, repeat the whole technique on the left leg
11. A ratio should be calculated for each leg separately by dividing the highest ankle

systolic pressure by the highest brachial pressure (Marshall, 2004). This is the formula used to calculate ABPI.

Interpretation of the ABPI

Systolic pressures should be similar in lower and upper limbs in the absence of arterial disease; therefore, when ankle pressure is divided by brachial pressure a ratio of 1.0 should be obtained. Allowing for some variation, healthy values have been found to range from 0.98–1.3 (Grasty, 1999).

In the presence of arterial disease in the lower limb, systolic pressure at the ankle is reduced, resulting in a lower ABPI ratio. With increasing severity of ischaemia, the ABPI ratio decreases (*Table 1*). A traffic light system allows a visual prompt to highlight those categories where urgent referral to the vascular team is required (red), where the patient requires referral to the diabetes foot care team for close monitoring (amber), and where values are normal (green).

Although ankle pressures are useful to quantify the extent of any existing ischaemia, they should be used in conjunction with a thorough clinical examination. This is particularly the case if being used to inform management, as there are a number of limitations to the ABPI, such as:

- Inexperienced practitioner/ poor technique
- Incorrect patient positioning
- Calcification of vessel walls can cause falsely elevated ratios.

Table 1

Interpreting ankle brachial pressure index values

Value	Clinical indication	Action
>1.3	Suspect	Refer to calcification vascular team
0.98–1.3	Normal ratio	No action needed. Advise annual vascular assessment to monitor any deterioration
0.97–0.8	Mild vascular disease	Refer to the diabetes foot care multidisciplinary team for regular assessment
0.8–0.5	Significant vascular disease	Refer to the diabetes foot care multidisciplinary team for regular assessment
<0.5	Severe arterial disease	The limb is in a critical state and so refer to the vascular team urgently

(Grasty 1999; Vowden 1999; Marshall 2004)

Any disease state that results in calcification of the arterial wall causes the vessel to become resistant to compression. Therefore, the ABPI ratio obtained is often abnormally high (>1.3), as it is the stiffness of the vessel wall that has been measured, not blood pressure (Vowden, 1999; Marshall, 2004).

It has been suggested that as many as 30% of patients with diabetes will develop medial arterial calcification (Vowden, 1999). ABPI values can therefore be falsely elevated in diabetic patients.

It is important to be aware that arterial calcification may still be present even when a normal ratio has been calculated. This is because false highs are possible. ABPI results should therefore always be viewed with caution in people with diabetes (SIGN, 2001). If calcification is suspected, the toe brachial pressure index (TBPI) offers an alternative method for assessing lower limb perfusion. Calcification rarely affects digital arteries so the TBPI may be more reliable in diabetic patients. The method for measuring the TBPI is the same as that for the ABPI, but pressure is measured at the great toe using the digital artery.

Conclusion

People with diabetes are more prone to PAD than non-diabetics. Routine vascular assessment allows early identification of a reduced arterial blood flow to the lower limbs which, in turn, allows the implementation of management strategies to reduce ulceration risk. Regular assessment is advocated to identify changes to vascular status so any deterioration can be managed promptly. If significant arterial disease is suspected, or there is any doubt about the significance of the ABPI calculated, the patient should be referred to the diabetes foot care team or the vascular team for further investigation dependent on the assessment findings. **WE**

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