

Assessment of the vascular status of the diabetic foot

AL Fowler and DC Mitchell

Introduction

Patients with diabetes experience both large vessel peripheral vascular disease and microcirculatory changes (Lumley, 1993; Boulton et al, 1994). In those presenting with foot sepsis, ulceration, necrosis or bony disintegration, detailed vascular assessment is a clinical priority. Those with a normal circulation can undergo local surgical debridement or bony stabilisation. Those with a compromised circulation may require revascularisation if tissue necrosis or amputation is to be avoided.

The vascular assessment of the diabetic patient, presenting with soft or bony tissue damage requires a careful history and clinical examination, supplemented by appropriate tests. It is important not to rely on a single finding, such as the Doppler pressure, as this may be misleading.

History

The history should include detailed assessment of any pain, or inappropriate lack of pain (Boulton, 1988). Some diabetic patients with sensory neuropathy may not feel pain from severe foot ischaemia.

Pain due to neuropathy usually has a constant element and may be described as burning in character, whereas pain due to vascular disease typically affects the calf and foot and comes on after walking some distance without pain (intermittent claudication). The latter pain is relieved by rest. Ischaemic rest pain may be continuous or occur only at night when the foot is elevated. Typically the patient finds that hanging the foot down reduces the pain.

The patient should be asked about the following risk factors for vascular disease:

- Duration of diabetes and degree of diabetic control (Orchard et al, 1993)
- Smoking
- Family history of vascular disease
- Hyperlipidaemia.

It is also important to ascertain whether the patient has other symptoms of vascular disease, or a history of transient ischaemic

stroke, stroke, angina or myocardial infarction, as these will indicate the presence of established vascular disease.

Clinical examination

Inspection of the leg should be meticulous. All clothing and both socks should be removed. The heels and interdigital clefts should be particularly examined for evidence of necrosis (Figure 1), ulceration or pus (Levin and O'Neil, 1983).

The colour of the foot should be noted. Severely ischaemic feet may be white, but can sometimes be a dark brick-red colour — the so-called 'sunset foot' of severe ischaemia. The foot should be elevated to see if it blanches, and then hung down over the edge of the couch (Buerger's test). The test is positive if blanching is followed by a

ARTICLE POINTS

1 The clinical priority in diabetic patients presenting with foot disease is assessment of vascular status.

2 Vascular assessment requires a careful history and clinical examination, together with appropriate tests.

3 Reliance on a single finding, such as Doppler pressure, may be misleading.

5 Patients with vascular disease require referral to hospital-based services if they have ulceration, necrosis or sepsis.

KEY WORDS

- Diabetic foot ulceration
- Vascular status
- Doppler studies

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Figure 1. Dry gangrene of distal foot in a diabetic patient.

AL Fowler is Specialist Registrar in Surgery, South West Region, and DC Mitchell is Consultant Vascular and Transplant Surgeon at Southmead Hospital, Bristol.

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1 Normal femoral and popliteal pulses with absent foot pulses are commonly seen in patients with diabetes.

2 They indicate that vascular disease is mainly confined to the tibial vessels, and is more difficult to treat by angioplasty or bypass surgery.

slow return of a dusky-red colour before gradual return to normal. The presence of these signs indicates severe ischaemia (Clair, 1980).

Examination should include all peripheral pulses. The presence of foot pulses indicates that the patient has a good peripheral circulation. Often foot pulses are absent. Two common patterns of pulse abnormality are seen:

- A weak femoral pulse, with absent pulses below. Patients with this pattern usually have their circulation improved by angioplasty or bypass.
- Normal femoral and popliteal pulses, with absent foot pulses. This pattern of

disease is more common in patients with diabetes and is significant (Conrad, 1967). It indicates that the disease is confined mainly to the tibial vessels. This pattern of arterial disease is more difficult to treat by angioplasty or bypass surgery.

Doppler studies

The use of the hand-held Doppler probe is becoming widely accepted in general medical and nursing practice. It provides invaluable information, but is open to misinterpretation in patients with diabetes.

Assessment errors may occur because undue reliance is placed upon the ankle: brachial index (ABI). Many diabetic patients have calcified vessels, which are resistant to compression. Patients with calcified vessels and significant arterial disease may have an ABI of >1 and on some occasions it may not be possible to occlude the artery with pressures up to 300 mmHg (Gibbons et al, 1995).

An important feature of this test is to listen to the quality of the signal. Patients with a clearly triphasic or biphasic signal are more likely to have a representative ABI. Those with monophasic signals should have their ABI interpreted with caution. It is important that those carrying out the ABI have been trained to assess the quality of the pulse signal.

Where the adequacy of the peripheral circulation is in doubt, referral to a vascular surgical specialist for further assessment is indicated. Further studies can then be carried out as follows.

Duplex scanning

This technique combines ultrasound imaging (giving a picture of the vessels) with Doppler assessment of flow (Figures 2 and 3). In experienced hands it is highly accurate, but very user-dependent and less accurate for examining small vessels. Ultrasound does not travel well through calcified tissue, and this may limit its usefulness in more severe disease.

Duplex scans can be used to exclude significant disease, but are more commonly used to assess the length and severity of arterial stenosis and occlusion and thereby indicate the appropriate modality of treatment.

Bypass surgery may also be planned on the basis of such scans, although most units still require angiograms.

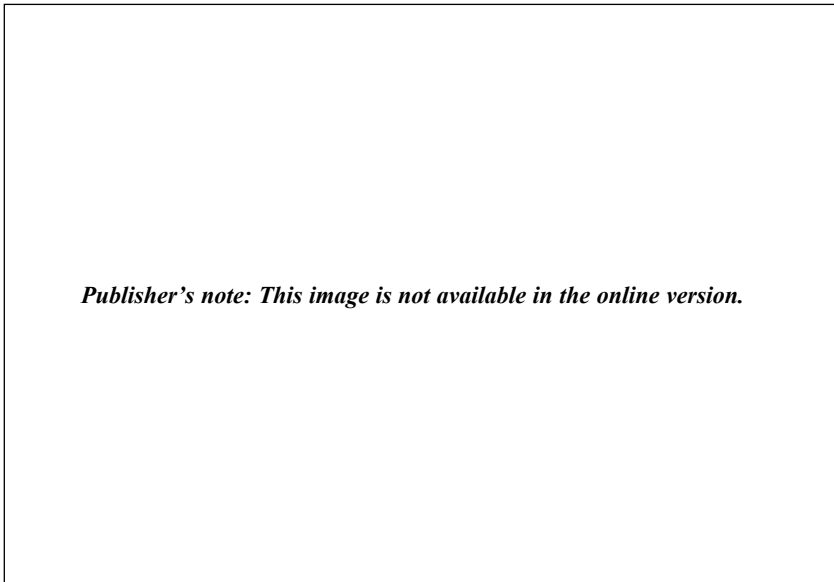


Figure 2. Normal flow pattern in superficial femoral artery on duplex imaging.

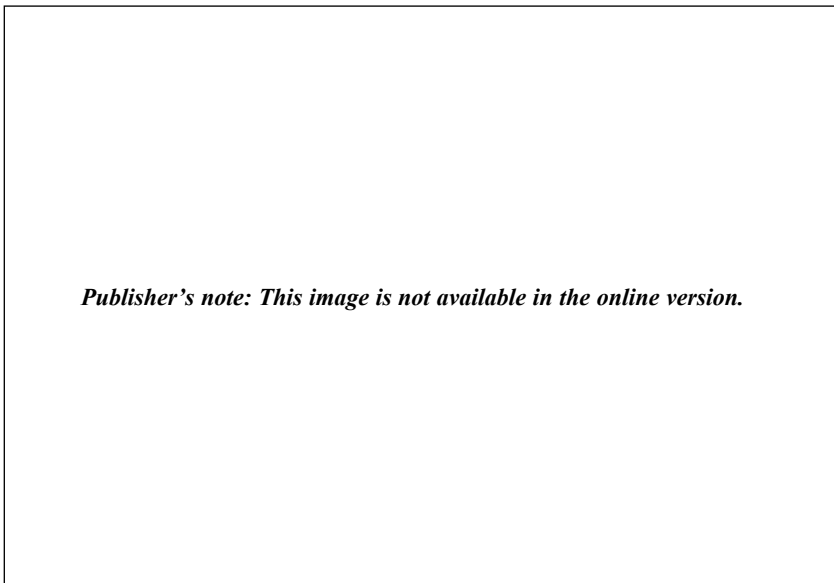


Figure 3. Monophasic flow in calcified posterior tibial artery typical of diabetic vascular disease.

Angiography

Angiograms are obtained by injecting contrast through catheters placed in major arteries under local anaesthetic. Current technology using digital subtraction of bony tissues gives a very good quality image of small vessels in the calf and foot.

In patients with normal proximal pulses but no pulses below the knee joint, angiography may show patent vessels that can be grafted onto. However, the images are two-dimensional, and this can limit the accuracy of this technique in small vessels (Figure 4).

An advantage of angiography is that it may be possible to treat the patient at the same time, using thrombolytic agents or angioplasty to open occluded vessels.

There is a small risk of damage to the vessel wall from catheters and balloons, which is not seen with less invasive assessment.

Other investigations

Oxygen tension can be measured in the skin of the dorsum of the foot using a laser Doppler probe. A supine $TcpO_2$ at rest of less than 30 mmHg signifies critical ischaemia (Jacobs et al, 1992).

A similar technique, involving the use of a toe cuff and Laser Doppler probe, is employed to measure the systolic pressure in the toe. A systolic pressure of <30mmHg is highly suggestive of critical ischaemia (European Working Group on Critical Leg Ischaemia, 1992).

Conclusion

Assessment of the vascular status of the diabetic foot relies heavily upon careful history-taking and meticulous clinical examination. When supplemented with hand-held Doppler pressure measurement, this should allow the clinician to decide whether the patient has evidence of significant vascular disease. If severe vascular disease is found to be present, referral to hospital-based vascular services may be indicated, especially in the presence of ulceration, necrosis or sepsis.

More complex evaluation may be required in these cases to clarify the extent of vessel involvement and the potential for treatment. ■

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PAGE POINTS

1 Digital subtraction arteriography gives a good quality image of the small vessels in the calf and foot.

2 An advantage of angiography is that patients may be given thrombolytic therapy, or undergo angioplasty, at the same time.

3 A disadvantage is that the vessel wall may be damaged by the catheter or balloon.

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Figure 4. Digital subtraction arteriography showing severe calf vessel disease.