

# The Role of Peripheral Arterial Disease in the Pathogenesis of Diabetic Foot Disease: When to Refer for Vascular Surgery

*Robert J. Hinchliffe, MD, MRCS, Clinical Lecturer in Vascular Surgery, St George's Regional Vascular Institute, St George's Hospital and St George's University of London, London, UK.*

*William Jeffcoate, FRCP, Professor, Foot Ulcer Trials Unit, Department of Diabetes and Endocrinology, Nottingham University Hospitals, City Hospital Campus, Nottingham, UK.*

*Individuals with ulceration of the foot should be identified and referred urgently to a specialist. Unfortunately there is little formal health care education in diabetic foot ulceration and often no specialist referral pathway. We discuss the common modes of presentation of patients with diabetes and foot ulcer. The clinical implications of a range of symptoms and signs will be explained, including the most common diagnostic pitfalls in everyday primary care practice.*

**Key words:** diabetes, peripheral vascular disease, ulcer, vascular surgery, peripheral arterial disease, diabetic foot

## Introduction

Ulceration of the foot in diabetes is a source of both considerable suffering to the patient and enormous costs to health care services. There is little formal teaching of health care providers and often no clear pathway for specialist referral.<sup>1</sup> However, it is imperative that newly occurring ulcers be assessed as soon as possible by an expert, with the prime aims of determining the relative contributions made by infection, neuropathy, and peripheral arterial disease (PAD) and instituting appropriate treatment. The

need for such early referral is emphasized in the United Kingdom by the National Institute for Health and Clinical Excellence (NICE) guidelines.<sup>2</sup>

Both peripheral neuropathy and PAD predispose to the development of ulcers and to their slow healing. Neuropathy inhibits healing partly by increasing forces on certain parts of the foot while walking (as a result of motor neuropathy and wasting of the small muscles of the foot) and by a loss of protective behaviour (as a result of reduced sensation). Peripheral arterial disease

inhibits healing through its impact on local blood flow and a disruption of the processes needed for re-epithelialization. When an ischemic foot becomes infected, gangrene can follow: the local inflammatory reaction leads to thrombosis of arteries that are already narrowed by disease. It follows that the early expert assessment focuses on the assessment of the presence and extent of any PAD that might be present, and on whether the patient should undergo investigations to determine if revascularization (by angioplasty or bypass surgery) should be considered and, if so, how soon. It is vital that the generalist be able to recognize symptoms and signs of critical limb ischemia and use these to expedite referral to a specialist unit.

## Assessment

### The Need for Early Assessment

If a patient has critical PAD, the condition of the foot can deteriorate rapidly. It is therefore essential that facilities be available in general practice whereby a new lesion can be assessed urgently. It is not acceptable for assessment to be delayed for more than 1 day.

## Look at the Foot

In our experience, many, possibly most, doctors never look at the foot of a patient who presents with an ulcer, whether in primary or secondary care. The notes for patients referred to hospital with a foot lesion often contain a phrase such as, "Foot bandaged, not examined." Doctors in both primary and secondary care must look at the foot because it is only by examining the foot that the severity and urgency of the situation can be assessed.

## Pain

Pain is uncommon in the foot ulcers of persons with diabetes because of the frequent coincidence of sensory neuropathy.<sup>3</sup> Pain does occur, however, with cracks and small punched-out ulcers over the heel—it is not known why these are so painful. Pain of the forefoot is otherwise usually the result of peripheral neuropathy, especially when it has been present for some time and is bilateral.

There are, however, three circumstances (described below) when the complaint of pain suggests the possibility of disease or deep infection that requires a specific intervention. The key feature of all three is that the pain is new or has recently worsened.

### Secondary Infection Complicating an Ulcer in an Ischemic Foot

When an ischemic ulcer becomes infected, it may not exhibit the classic signs of inflammation because there may be insufficient blood flow to permit warmth, redness, and swelling. In such cases, the signs may be much more subtle and include an increase in exudate from the wound surface and the onset of local pain.

### Pain from Critical Ischemia

When the blood supply to all or part of the foot is reduced to the extent that tissue may become nonviable, this can be extremely painful. The critically ischemic foot is usually red at first, and nonspecialists frequently make a mistaken diagnosis of cellulitis; however, cellulitis rarely causes severe pain. It is only later that the ischemic part becomes mottled purple and then turns black. In cases of acute larger artery obstruction (such as from an embolus), the painful ischemic foot may be white or purple at presentation.

### Pain in an Inflamed Foot

If a foot is inflamed, it is less likely to have critical PAD. Unrelated disease, such as gout (which is abrupt in onset, exquisitely tender, and lasts only a few days), may occur. Less extreme pain should raise the possibility of acute Charcot's foot (especially among individuals with dense neuropathy), and the patient should be referred for early expert assessment.<sup>4,5</sup>

Most cases of acute Charcot's foot (which may lead to gross deformity and loss of the limb) are misdiagnosed as a sprain or cellulitis, or even deep vein thrombosis, when they first present.

### Signs of Peripheral Arterial Disease

Signs of PAD fall into two categories: those present in the symptomless foot at

routine screening and those that accompany active foot disease, such as an ulcer.

### Signs of Ischemia on Routine Screening

The occurrence of ischemia is suggested by the presence of rather thin, red, shiny skin and reduced subcutaneous fat. The ischemic foot may also have nails that are slow growing and rather dystrophic. It may also have a number of scabs at points of normal day-to-day pressure, such as over the dorsum of the toes or the lateral aspect of the fifth metatarsophalangeal joint. These occur because the ischemic skin has a reduced capacity to withstand the direct and sheer forces to which the foot is exposed from ill-fitting shoes, slippers, or lying in bed. The presence of ischemia can be confirmed by the inability to detect either the dorsalis pedis or the posterior tibial pulse. Whether the patient with such signs should be referred for specialist assessment depends on the particular clinical circumstances. It is interesting that intermittent claudication is not a common symptom in diabetes, mainly because the predominant site of PAD is in the distal vasculature.

Every effort should be made to reduce cardiovascular risk, with attention being paid to smoking cessation, the use of acetylsalicylic acid, lipid-lowering therapy, control of blood pressure, and improved glycemic control.<sup>6,7</sup>

### Signs of Ischemia Accompanying Established Lesions

With established lesions, the signs listed above may obviously also be present, along with thin, shiny skin, a loss of subcutaneous tissue, scabs on bony prominences, and dystrophic nails, all suggesting associated ischemia. The task for the professional is to determine the extent to which ischemia is contributing to the persistence of a lesion and whether the patient should be referred for imaging of the arteries of the leg prior to possible revascularization.

Other suggestive signs are reduced skin temperature or pallor when compared with the opposite foot, tenderness, and reduced capillary filling after apply-

ing pressure to the skin to blanch it.

### Bedside Tests

The use of the ankle-brachial pressure index (ABPI) has little place in the exclusion of PAD in diabetes because the frequent occurrence of arterial calcification in diabetes means that ankle pressures are often artificially high. Failure to feel the pulse should be sufficient. If, however, the ABPI is done and is shown to be low (<0.8), this is strongly suggestive of major vessel narrowing. The ABPI can be especially useful when it reveals that one leg (especially if there is recent-onset pain) has a lower ankle pressure than the other has. In such cases, the affected side may be obviously colder and paler; the diagnosis of large artery embolus or thrombus is very likely, and urgent intervention may be needed to save the leg.

A pole test has been described in which a Doppler apparatus and calibrated pole are used to measure ankle systolic pressures.<sup>8</sup> The patient lies flat, and the affected limb is elevated until the systolic Doppler signal is lost. This gives a measure of true systolic pressure: loss of signal when the probe is 70 cm above the level of the heart is equivalent to systolic pressure of 50 mm Hg; 110 cm is equivalent to 80 mm Hg.

Measurement of toe systolic pressures requires the availability of special Doppler probes, which are not usually available outside specialist units; it is also time consuming and rarely undertaken in routine practice. The same applies to the measurement of transcutaneous oxygen saturation, which involves warming the skin on the dorsum of the foot prior to measurement of oxygen saturation. This measure may be flawed if there is associated neuropathy (which can limit the capacity of the skin to vasodilate in response to warming).

### Referral

Any newly occurring ulcer should be referred for assessment by a vascular surgeon within 1 working day (see United Kingdom NICE guidelines<sup>2</sup>). If there is no facility for urgent specialist assessment and a patient has symptoms or

## Key Points

Ischemic diabetic feet are an emergency.

Always examine the feet of patients with diabetes, including removing dressings or bandages.

Pain is an unusual symptom in diabetic foot ulcer and may mask limb threatening complications (such as infection, abscess, critical ischemia).

When an ischemic ulcer becomes infected, it may not exhibit the classic signs of inflammation.

Address cardiovascular risk factors in patients with foot ulcer.

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## Prognosis

Peripheral arterial disease is associated with worse outcome (nonhealing) in patients with diabetes and foot ulcer.<sup>9</sup> Limb salvage using reconstructive surgery is painstaking work and may require multiple operations and reinterventions before it can be considered a success. At 1 year, the amputation-free survival with completely healed wounds is only 50%.<sup>10</sup> Similar observations have been made by others. Despite what would be considered a good outcome—limb salvage and survival—some 25% of ulcers are not healed at 1 year.<sup>11</sup> Nineteen percent of patients are not able to walk, and 5% lose their independence.

## Conclusion

Ulceration and ischemia of the foot in diabetes is an emergency and should be referred immediately for specialist assessment. Early identification of patients improves outcome. The symptoms and signs of ischemia of the foot in diabetes may be masked because of neuropathy. Pain is an unusual symptom and is often an indicator of limb threatening complication (such as infection, abscess, or critical ischemia). It is imperative that family physicians regularly examine the feet of patients with diabetes. Despite specialist assessment and revascularisation, the healing of foot ulcers among individuals with PAD and diabetes is poor. Mortality is also high and requires treatment of associated cardiovascular risk factors.

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