RECOGNITION OF INFECTION IN THE DIABETIC FOOT

Caroline McIntosh is Senior Lecturer in Podiatry, University of Huddersfield, Yorkshire

Infection in the diabetic foot can spread with alarming rapidity leading to considerable death of tissue (necrosis) and impaired wound healing. Infection left undetected or untreated can increase the likelihood of lower limb amputation (Sheppard, 2005). Early recognition of infection and prompt management is imperative, yet the identification of infection in the diabetic foot is challenging.

Diabetic foot infection is commonly encountered in clinical practice usually as a consequence of diabetic foot ulcers (DFU) (Edmonds, 2005); all open wounds are colonised with bacteria normally found on the skin surface (skin commensals). Usually skin commensals colonise a wound without impacting negatively on wound healing as the level of bacteria present is low. However diabetes is known to impair the normal immune response rendering individuals with diabetic foot ulceration susceptible to infection (Falanga, 2005).

Classic signs of infection are not always present; in fact, only half of infection episodes show signs of infection (Edmonds and Foster, 2006). This is attributed to neuropathy (nerve dysfunction) and ischaemia (poor arterial blood supply) both of which can impair the normal inflammatory response resulting in diminished signs of infection and a delayed diagnosis of infection (Edmonds, 2005).

Recognition of infection in the diabetic foot

Recognising infection in the diabetic foot is problematic. The aim of this article is to introduce a systematic, four-step approach to assist practitioners in identifying infection in the diabetic foot.

Classic signs of infection are not always present; in fact, only half of infection episodes show signs of infection (Edmonds and Foster, 2006).

Step 1: Assess local clinical signs of infection

The classic signs of infection are reported by Collier (2004) to be:

- Heat
- Erythema (redness)
- Inflammation (swelling)
- Pain.

Classic signs, however, may be absent in people with diabetes due to peripheral neuropathy and/ or ischaemia. *Figure 1* illustrates infected DFUs that do not show classic signs of infection, but on examination of the soiled dressing a significant volume of blue/green exudate (*Figure 2*) was observed. Subsequent swab results confirmed the presence of a heavy growth of the bacteria *Pseudomonas aeruginosa*.

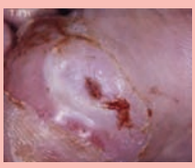
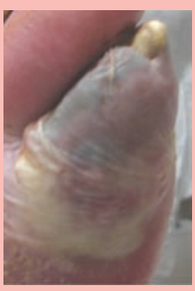
A recent consensus document listed criteria for identifying infection in DFU (Cutting et al, 2005). Some of the suggested criteria are listed in *Table 1*; those listed in the dark pink section are considered highly indicative of infection, those in light pink are suggested to be additional signs of infection. The full list of suggested criteria can be obtained from www.ewma.org.

Step 2: Systemic signs of infection

Systemic symptoms should be explored with the patient. Specifically explore whether the patient is experiencing nausea, fatigue, vomiting, fever or chills as this can be indicative of severe infection (Frykberg et al, 2006). However, it should be noted that these

Table 1

Local signs of infection in diabetic foot ulcers

Cellulitis	An acute bacterial infection of the skin and subcutaneous layers mainly caused by the bacterial species *Staphylococcus aureus* and group A Streptococcus (Collier, 2004). *Figure 3. Localised Cellulitis in the foot.* 
Phlegmon	Inflammation of soft or connective tissues due to infection.
Purulent exudate	It is generally accepted that purulent exudate, pus or abscess formation indicates infection (Melling et al, 2005). Purulent exudate is a thick wound fluid indicative of infection, which is usually yellow, grey or green in colour (White and Cutting, 2006). *Figure 4. A DFU with evidence of purulent exudate oozing from under the necrotic eschar.* 
Pus/Abscess	A collection of pus under the skin- can affect superficial tissues as in *Figure 5*, or deeper structures. *Figure 5. A DFU with visible pus under the skin.* 
Localised pain	Pain in the normally painless foot (due to neuropathy) is often a sign of deep infection, including infection of the bone (osteomyelitis) (Frykberg et al, 2006).
Increase in the volume of exudate	A sudden increase in wound exudate can be a sign of infection (Collier, 2004). It is useful to assess the volume and colour of exudate absorbed into the wound dressing, as seen in *Figure 2*, as this can assist in the recognition of infection.
Malodour	An abnormal or unpleasant smell can indicate infection.

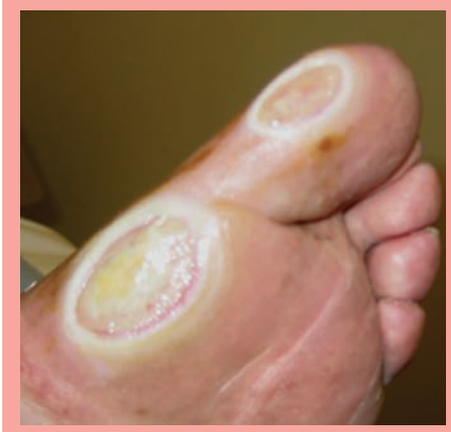


Figure 1. Infected DFUs that do not show obvious signs of infection.

Figure 2. Green/blue exudate is visible on the soiled dressing typical of pseudomonas infection.

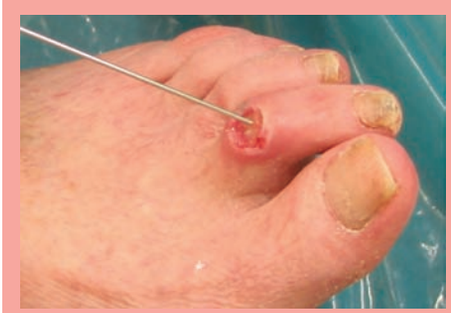


Figure 6. Probing to bone in DFU.

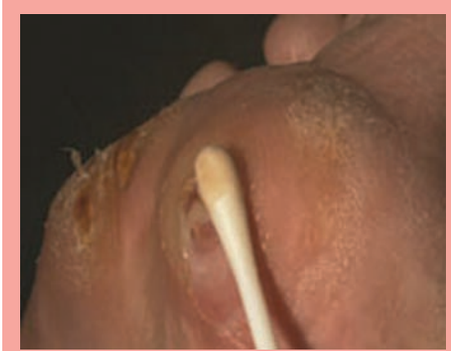


Figure 7. Taking a wound swab.

signs are also absent in 50% of diabetic patients. Often the only systemic sign observed is unmanageably high blood glucose levels (Edmonds, 2005; Frykberg et al, 2006).

Step 3: Probe to bone test

It is always important to establish the depth of a DFU. This can be achieved by probing the wound with a blunt sterile probe, as seen in *Figure 6*. If bone is visible, or bone can be palpated this is highly indicative of osteomyelitis (Frykberg et al, 2006). If osteomyelitis is suspected a referral should be made for X-ray to detect bony changes due to infection. In the case of severe infection, urgent hospital admission is required for intravenous antibiotic therapy and an assessment of the need for surgical drainage (Edmonds, 2005).

Step 4: Wound culture

If infection is suspected or the wound is not responding to treatment, wound culture should be taken to allow microbiological analysis. Most DFU in clinical practice are cultured by wound swabs (Sheppard, 2005), as seen in *Figure 7*. Microbiological analysis will assist in identifying infecting bacteria and ensure appropriate antibiotic therapy is initiated (Kelly, 2003).

Conclusion

Identifying infection in the diabetic foot is problematic. This article has highlighted some of the reasons why the classic signs of infection are not present in people with diabetes and suggests four key steps to assist practitioners in recognising infection in the diabetic foot. It is crucial infection is promptly recognised so timely management strategies can be implemented and adverse outcomes such as delayed healing and amputation can be avoided. **WE**

Collier M (2004) *Recognition and Management of Wound Infection.* World Wide Wounds (online) Available at: http://www.worldwidewounds.com/2004/january/Collier/Management-of-Wound-infections.html (last Accessed 24/01/07)

Cutting KF, White RJ, Mahoney P et al (2005) Understanding wound infection. In: European Wound Management Association (EWMA) Position Document: *Identifying Criteria for Wound Infection*. MEP Ltd; London: 2–5

Edmonds M, Foster AVM (2006) ABC of wound healing. Diabetic foot ulcers. *Br Med J* **332:** 407–10

Edmonds M (2005) Infection in the neuroischaemic foot. *Lower Extremity Wounds* **4(3):** 145–153

Falanga V (2005) Wound healing and its impairment in the diabetic foot *Lancet* **366:** 1736–43

Frykberg RG, Zgonis T, Armstrong DG et al (2006) Diabetic foot disorders: a clinical practice guideline. *J Foot Ankle Surg* **45(5) (Supp):** 1–65

Kelly F (2003) Infection control: validity and reliability in wound swabbing. *Br J Nurs* **12(16):** 959–64

Melling A, Hollander DA, Gottrup F (2005) Identifying surgical site infection in wounds healing by primary intention. In: European Wound Management Association (EWMA) Position Document: *Identifying Criteria for Wound Infection*. London: MEP Ltd; 14–17

Sheppard SJ (2005) Antibiotic treatment of infected diabetic foot ulcers. *J Wound Care* **14(6):** 260–3

White R, Cutting K (2006) *Modern Exudate Management: A Review of Wound Treatment.* World Wide Wounds (online). Available at: http://www.worldwidewounds.com/2006/september/White/Modern-Exudate-Mgt.html (last accessed 24/01/07)