

Management of foot burns in a patient with diabetes

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Burns in diabetic foot patients can be a significant problem due to loss of sensation. Fast and effective intervention is required as relatively small injuries can progress to ulceration and, in severe cases, lead to amputation. This article describes the management of a foot burn in a diabetic patient who had previously undergone a left hallux amputation following a thermal injury.

Background

In the UK approximately 250,000 people are affected by burns each year (Hettiaratchy and Dziewulski, 2004) and treatment is highly dependent on the type of burn that has been sustained. For example, a superficial partial-thickness burn, once clean, can be dressed with a non-adherent primary dressing such as a tulle dressing or Mepitel® (Mölnlycke Health Care) and an absorbent secondary dressing such as a gauze or Gamgee Tissue (Robinson Healthcare) (Papini, 2004). Antimicrobial agents can be added when infection is likely, when heavy colonisation is evident or invasive infection is suspected (Papini, 2004).

Accidental foot injuries can occur in diabetic patients with distal sensorimotor polyneuropathy due to sensory loss in the lower extremities (Putz et al, 2008). Historically, this type of burn injury has been caused by foot spas, therapeutic foot baths, hot water bottles, pillows warmed by heated stones and walking on hot sand (Putz et al, 2008). The treatment of foot burns in diabetic patients often requires antibiotics, debridement or minor amputation (Putz et al, 2008).

Neuropathy, together with poor vascular supply and oedema, leads to impaired wound healing in diabetic foot patients (Dijkstra et al, 1997). This is because

a loss of sensation in the area causes abnormal, excessive pressures to be loaded through the wound, which is not recognised by the patient who does not feel pain. This results in trauma to the wound bed and delayed healing. In addition, the presence of motor neuropathy can cause atrophy of the small foot muscles leading to deformity, such as 'clawing' of the toes. This causes excess pressure on the digits and metatarsal heads, which are the most frequent sites of neuropathy. Finally, autonomic neuropathy causes arteriovenous shunting leading to compromise of the vascular supply to the wound. Given the long healing time involved, costs can be expensive and the complication rate and morbidity is likely to be higher in patients with foot burns associated with diabetic neuropathy (Dijkstra et al, 1997; Putz et al, 2008).

There is clearly an urgent need to facilitate healing in patients with diabetes who suffer foot burns. In the UK, diabetic foot clinics ensure that services are well coordinated and promptly available to any patient with a foot problem. The multidisciplinary teams in these clinics are able to draw on a wealth of experience to ensure that each patient receives the best care possible.

Case report

Mr M, a 44-year-old male with type I diabetes, presented to the accident and emergency department with burns he had sustained five days previously by placing his right foot on a hot radiator. The patient was a smoker with poor long-term glycaemic control as well as a number of diabetes-associated complications, including retinopathy and peripheral neuropathy. He also experienced neuropathic pain which was managed with amitriptyline.

Mr M had peripheral sensory neuropathy, which meant that he was unable to experience trauma, but did experience positive neurological sensations including



Figure 1. Some of the wounds on the patient's right foot contained slough.



Figure 2. Within two weeks of applying an antimicrobial dressing, all of the wounds exhibited 100% granulation tissue.

nociceptive pain (burning, shooting pain). His left hallux had previously been amputated following a radiator burn to the foot in 2007.

The accident and emergency staff were able to detect palpable pedal pulses, indicating that the arterial blood supply

of the foot was not significantly impaired. Disruption to the vascular supply would have had a negative impact on wound healing.

The staff immediately referred Mr M to the multidisciplinary diabetic foot clinic at the local hospital. On examination at the hospital, burns to the toes on Mr M's right foot were noted. There was also a necrotic ulcer on the area of the right fifth metatarsal-phalangeal joint (MTPJ). The foot was also clinically infected with tracking cellulitis (a bacterial infection of the dermis and subcutaneous tissues, which spreads through lymphatic ducts towards the nearest lymph nodes).

Mr M's C-reactive protein (an inflammatory marker) was tested and found to be elevated at 63 (the author's hospital uses a normal reference range of 0–10mg/L). Hospital admission was recommended but the patient declined (he did not give a specific reason for this). Oral antibiotics (flucloxacillin) were started and it was eventually agreed that the patient would return to the hospital for admission as an inpatient the following day.

Mr M was admitted for intravenous (IV) antibiotic therapy and remained as an inpatient for 11 days, during which time the multidisciplinary foot team reviewed him on the ward. At this stage the podiatrist debrided and dressed the wounds. Pressure relief was provided by the orthotist who issued the patient with a Darco MedSurg™ Shoe (Darco). Mr M was discharged from the ward on day 11 with no ongoing antibiotic therapy as his infection had resolved with IV antibiotic therapy.

Mr M attended the outpatient clinic one week later (day 18) (*Figure 1*). At this stage he had ulcers on all the toes of his right foot and his right fifth MTPJ. The wounds on the third, fourth and fifth toes and fifth MTPJ were sloughy. The wound on the second toe was clean and

granulating and the wound on the first toe was covered in a dry eschar. There was maceration at the bases of the third, fourth and fifth toes due to high exudate levels from the wounds.

The wounds were debrided and the first toe and fifth MTPJ were dressed with Intrasite Gel® (Smith and Nephew) and Release® non-adherent dressing (Systagenix). Intrasite was used to hydrate the wound bed while Release was used as a secondary dressing as it would not absorb the Intrasite, allowing the gel to hydrate the wound effectively. The remaining wounds were dressed with Aquacel® (ConvaTec) to manage high exudate levels. By day 20 the second and third toe ulcers were clean, granulating and reducing in size. However, all the other wounds were sloughy and dehydrated with no significant reduction in wound size.

By day 28 the wound on the second toe had healed but all the others remained sloughy and static in terms of their dimensions. The maceration on the foot had resolved and there were no clinical signs of infection. All wounds were debrided and Flaminal® Hydro (Ark Therapeutics) was applied with Lyofoam™ (Mölnlycke Health Care) as a secondary dressing. Flaminal Hydro was used for its antimicrobial properties and Lyofoam was chosen as a secondary dressing because it had the appropriate absorbency level. The practice nurse was also given a supply of Flaminal Hydro for continued applications between hospital appointments.

Within two weeks of starting treatment with Flaminal Hydro (*Figure 2*), all of Mr M's wounds had 100% granulation tissue. The second toe had healed, while the third toe was epithelialising. There were no clinical signs of infection, therefore, Flaminal Hydro was discontinued and Lyofoam was started as a primary dressing. All of the wounds went on to progress to full healing without further incident.

Discussion

Patients with diabetic neuropathy are at greater risk of suffering injury to the feet due to loss of sensation. Furthermore, poor blood flow to the feet impairs healing and small sores or breaks in the skin can develop into deeper skin ulcers. Patients with poor glucose control are more susceptible to infection. Amputation of the affected limb may be needed when these skin ulcers either do not improve or become larger or deeper. Not surprisingly, diabetic neuropathy is implicated in a majority of all non-traumatic foot amputations (Boulton et al, 2005).

Adult diabetic patients have an increased frequency of foot burns compared with adult non-diabetic patients (Mommel et al, 2004). Furthermore, they have a significantly increased incidence of sepsis and community-acquired burn wound cellulitis compared with non-diabetic adults, as well as longer hospitalisations (Mommel et al, 2004). In one study of six diabetic patients with severe foot burns, five required amputation (Dijkstra et al, 1997).

The aim of Mr M's treatment was to facilitate healing and prevent the need for amputation. Exudate is a normal feature of a healthy acute wound. However, exudate from chronic, non-healing wounds may inhibit healing as it has been shown to delay the proliferation of dermal fibroblasts, endothelial cells and keratinocytes (Bucalo et al, 1993). Bucalo et al (1993) also found that chronic wound fluid is cytotoxic, which may contribute to its effect on cell proliferation. However, dressing choice is controversial in patients with diabetic foot ulcers due to the lack of published evidence and treatment failure is often blamed on the dressing choice (White, 2001).

Ultimately, the choice of dressing must be made on an individual basis. In Mr M's case, the author initially opted to

use a hydrogel and a low-absorbency dressing, largely based on the small amount of exudate produced by the wounds. However, these dressings failed to achieve significant progress in maintaining moisture levels, reducing the amount of slough or reducing the size of the wounds. Therefore, after 10 days, the regimen was reviewed and it was decided that an antimicrobial dressing which could simultaneously hydrate and deslough the wounds was required. To remove necrotic tissue the wounds had to be hydrated so that they could progress through the normal wound healing process (necrosis progresses to slough, which will then develop into granulation and epithelialisation).

Flaminal Hydro is an antimicrobial alginate dressing that promotes moist wound healing and autolytic debridement (White, 2006). It has a unique mode of action (de la Brassinne et al, 2006), containing an enzyme complex which incorporates glucose oxidase and lactoperoxidase. This provides a sustained broad-spectrum antimicrobial action, similar to that provided by the body's own natural white cell defences. This protects against microbial colonisation and combats infection (White, 2006). Flaminal Hydro combines strong antimicrobial activity with non-cytotoxicity, thereby destroying antibiotic-resistant bacterial strains and promoting wound healing (De Smet et al, 2009). The dressing has been shown to be active against a range of Gram-negative bacilli, Gram-positive cocci and fungi (Vandenbulcke et al, 2006).

The author chose Flaminal Hydro for its ability to hydrate and deslough the wound, while its antimicrobial properties were important in reducing the risk of infection. Lyofoam was used in conjunction with the Flaminal Hydro because it incorporates a low absorbency foam that allows the gel to penetrate into the wound, rather than being absorbed into the dressing. This makes

it highly suitable as a secondary dressing. Together, Flaminal Hydro with Lyofoam prevented the development of infection and facilitated healing, thus preventing the need for amputation.

Once the wound had healed, the main priority of the multidisciplinary team was to educate Mr M about appropriate foot care to prevent further trauma to his feet.

Conclusion

The patient in this case was at high risk of foot complications. The priority of the multidisciplinary team was to prevent wound deterioration and facilitate healing. However, there is a wealth of wound care dressings available and it is the job of the multidisciplinary team to draw on their knowledge and experience to choose the most appropriate regimen.

In this case, the original chosen treatment was not working and the patient's wounds were not progressing toward healing. Although one of the patient's ulcers healed following the application of Aquacel, the remaining wounds only improved when the treatment regimen was changed to Flaminal Hydro with Lyofoam as a secondary dressing. **WUK**

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Key points

- ▶▶ Burns in diabetic foot patients can be a significant problem due to loss of sensation. Relatively small injuries can progress to ulceration and, in severe cases, lead to amputation.
- ▶▶ The patient in this case was at high risk of foot complications.
- ▶▶ The priority of the multidisciplinary team was to prevent wound deterioration and facilitate healing.
- ▶▶ Although one of the patient's ulcers healed following the application of Aquacel®, the remaining wounds only improved when the treatment regimen was changed to Flaminal® Hydro with Lyofoam™ as a secondary dressing.