The diabetic foot: managing infection using Cutimed® Sorbact® dressings

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Abstract

Management of the diabetic foot is often problematic, particularly as the diabetic patient is prone to sub-clinical infections. This article reviews diabetic foot ulceration and its treatment and describes some of the commonly associated complications of these chronic wounds. It is proposed that highly hydrophobic dressings are of value in reducing the bacterial colonization of ulcers, and an excellent alternative to more commonly-prescribed, topical antimicrobial dressings, particularly those containing silver.

Key words: Dressing ■ Healing ■ Wound ■ Diabetes ■ Ulceration

Following an injury to the skin, a set of complex biochemical events take place in a closely orchestrated cascade in order to repair the damage. The natural healing process can be divided into four stages: inflammation, granulation, epithelialization and maturation (Russell, 2000). However, when a wound becomes delayed in healing, these four stages are interrupted and a large number of changes occur that result in the wound becoming chronic, lasting sometimes for years without healing. Unstable diabetes and colonization of bacteria are two of the primary causes of this chronicity (Hampton and Collins, 2005).

Diabetic foot ulcers pose challenges to even the most experienced health professionals (Hampton, 2006). The decisions of when to use antimicrobials, offloading and antibiotics are not always straightforward and inexperienced assessors can choose inappropriate and unnecessarily expensive dressings.

This article reviews diabetic foot ulceration and its management, and demonstrates the value of using a DACC coated, highly hydrophobic dressing, Cutimed Sorbact (BSN medical Ltd), in the management of infection in diabetic foot ulcers. Four case studies evaluate Cutimed Sorbact in terms of tolerability, pain, inflammation, exudate levels and wound healing.

The diabetic foot ulcer

Diabetic foot ulcers are divided into two subtypes – neuropathic and neuroischaemic.

■ The neuropathic foot is warm and well-perfused with palpable pulses; sweating is diminished and the skin may be dry and prone to fissuring.

■ The neuroischaemic foot is cool and pulseless; skin is thin, shiny, without hair (Figure 1) and there is atrophy of the subcutaneous tissue. Intermittent claudication and rest pain can be absent due to neuropathy (Grey, 2006).

Neuropathy may prevent patients from being alerted to tissue injuries. A patient might step on a sharp object and not feel it or, more commonly, be unaware of the excessive pressure over a bony prominence from a tightly fitting shoe.
Tyrell (1995) writes: ‘During the stance phase (the time during walking when the body passes over the top of the foot) the increase in foot length and width leads to impaction of the forefoot in that part of the shoe.’ Patients with diabetic neuropathy may not be aware of the damage that is occurring (Figure 2). All too often, these patients do not present until an ulcer is already well-established and colonized with bacteria or fungi (Figure 3).

Wound formation and healing are dependent on a number of factors. Blood glucose level is especially important in diabetic patients, as glucose can react with fats and proteins in the blood and destroy the ability of proteins to function (Majno and Joris, 1996). The continued interference of protein function will eventually lead to cellular destruction and the well-recognized tissue injuries that are associated with diabetes (Majno and Joris, 1996). Insulin deficiency further complicates this process by depressing collagen formation, which leads to non-enzymatic glycosylation of collagen with associated thickening of the dermis and a loss of elastic fibres, reducing flexibility (Chakrabarty et al, 2002).

In both neuropathic and neuroischaemic ulcers, once a wound is established, the patient is susceptible to infection. Peripheral vascular disease can further inhibit healing, leading to potential gangrene and amputation (Figure 4). Gordois et al (2003) estimated there are approximately 64,000 diabetic patients with open wounds in the UK at any one time. Of these, 2,600 require amputations each year at an annual cost of £300m.

However, the International Diabetes Federation (2005) claim that between 49% and 85% of all amputations can be prevented (Prompers et al, 2008). Reducing the potential for clinical infection and osteomyelitis through the use of antimicrobial dressings that do not have contraindications or side effects such as Cutimed Sorbact, must therefore be seen as good practice and is probably the most effective way in which to reduce the critically colonized wound’s bioburden to a level that promotes healing (Sibbald et al, 2004; Fumal et al, 2002). Therefore, appropriate treatment of the diabetic foot should begin with selection of the most appropriate dressing (Vowden and Cooper, 2006).

A product that protects these patients against infection will lead to better patient outcomes and reduced NHS spending, due to significant reduction in the duration of treatment and personnel costs (Berendt and Lipsky, 2003).

**Advances in wound care products**

Over the past two decades, wound management has undergone a revolution, particularly in the treatment of chronic wounds. This has led to the development of many new products, which promote the concept of moist wound healing (Gray and Cooper, 2001). Today, there is a variety of wound dressings that target specific situations such as infection management, excessive wound exudate, debridement and stimulation of granulation tissue.

Until recently, local wound infection has been a challenge with few management options. However, the advent of advanced wound dressings containing topical antimicrobial agents such as silver has provided a new approach to the control of wound pathogens (Parsons et al, 2005). There has also been an increasing interest in the use of topical antimicrobial dressings as an alternative to systemic antibiotics (Capaldi, 2006). These topical antimicrobial dressings contain chemicals that either kill or control the growth of bacteria in wounds (White, 2002).

However, silver dressings have varied responses in clinical use due to technological differences in the nature of their silver levels and of the dressing properties themselves. Some silver dressings can stain the skin, and bacteria have been found to have some resistance to silver (Parsons et al, 2005).

In order to select the most appropriate dressing, the clinician should be able to establish whether a wound is colonized or clinically infected and, more importantly, should be aware of...
wounds that have a high potential to become infected, such as diabetic foot ulcers and diabetic gangrene.

**Infection**

As previously described, the diabetic patient is at increased risk of infection. Hyperglycaemia impairs leukocyte function by prejudicing the transport of ascorbic acid into cells and reducing the ability of polymorphonuclear leukocytes to ingest bacteria (Laing, 1998; Steed, 1998). Healing is also delayed, which further opens the diabetic patient to infection (Hampton and Collins, 2005). Any deficiency in the blood supply to a diabetic foot (common in diabetic patients) will cause deterioration of newly formed tissue. This tissue injury, combined with poor perfusion, lowers patients’ resistance, increasing the risk of clinical infection.

Despite sensory impairment with diabetic neuropathy, many patients with diabetes develop foot pain when infection is present (Steed, 1998), which might be the only warning sign. Once an infection has been established it can spread rapidly, leading to the involvement of the whole foot or even septicaemia (Laing, 1998). For this reason, systemic antibiotics are often regarded as part of the standard treatment for clinical infections (Effective Health Care, 1999).

However, since antibiotic therapy encourages resistant organisms, Levy (2002) has expressed concerns over their use. There is a risk that osteomyelitis of the foot joints might develop with any such infection and if MRSA was to infect the bone, the whole limb may be threatened. Hampton and Collins (2005) recommend antibiotics should be given as necessary, and not when ulcers are clinically clean and uninfected. Edmonds (1999) argues the early use of antibiotics should not be ruled out, and recommends that diabetic patients be examined at every visit for clinical signs of infection. Swabs should be taken if indicated and antibiotics prescribed for a positive swab. Therefore, dressings that have a positive effect at reducing bacterial burden in wounds without the need for systemic antibiotics are an important part of wound treatment.

**Cutimed Sorbact**

Each year, the NHS spends approximately £2.3bn – £3.1bn (at 2005–2006 cost) on dressings and associated products, equating to 3% of the total estimated health expenditure (Posnett and Franks, 2008). Silver dressings represent one seventh of wound dressing prescriptions (Iheanado, 2010), resulting in a high cost implication for the NHS. Alternative dressings are currently being sought to help reduce this cost.

Cutimed Sorbact is one such alternative, which has proven efficacy in the treatment of colonized and infected wounds. Its effect of lowering the bacterial load promotes healing, leading to a reduced cost to the NHS, and without the risks of patient sensitisation, bacterial resistance or skin staining sometimes associated with other types of antimicrobial agents (Hampton, 2007). The dressings are available as a wound contact layer (swab), absorbent pad, ribbon and round swab (Figure 6). A tip to note is that the most popular swab product is sold by its folded dressing size but once unfolded is actually three times larger, making it an extremely cost effective offering to the clinician. (See Figure 7). In addition, for drier wounds, a hydrogel coated swab is available.

Cutimed Sorbact is the first wound dressing to utilize the hydrophobic properties of both aerobic and anaerobic wound pathogens (Ljungh et al, 2006), such as *Staphylococcus aureus*, *Pseudomonas aeruginosa* and *Klebsiella spec.*, which can be seen in Figure 5 adhering to the hydrophobic dressing fibres. Cutimed Sorbact dressings are also effective against MRSA, VRE, *E. coli C. Difficile* and *Candida Albicans*.
Using the physical principle of hydrophobic interaction and without a chemically active agent, in a moist wound environment, bacteria and fungi become physically and irreversibly bound to the dressings fibres due to a coating of a fatty acid derivative, DACC (dialky carbonyl chloride), giving the dressings highly hydrophobic properties (see Figure 11). This gives the dressings highly hydrophobic properties.

Once irreversibly bound to the dressings, microbes are inactivated and their metabolism slowed down. As a result cell replication and the formation of bacterial toxins that also impair wound healing is minimized (Ljungh et al, 2006). As pathogens are effectively trapped but not killed, endotoxins are not released into the wound bed resulting in improved conditions for wound healing.

The ability of some micro-organisms to become resistant to antibiotics does not change their hydrophobic properties. Therefore, there is no risk of resistance following the use of Cutimed Sorbact. As there is also no donation of chemicals into the wound, the dressings are the ideal choice for the prophylactic treatment of wounds that are susceptible to the development of infection or to halt the progression of a colonized wound to an infected one.

An additional benefit of the Cutimed Sorbact range is the dressings efficacy on wounds with biofilms. Clinical studies have demonstrated the ability of Cutimed Sorbact to bind biofilms to the dressing fibres (Cooper, 2009). This is a safe and natural way of cleansing contaminated, colonized and infected wounds and means that Cutimed Sorbact is effective in the treatment and management of diabetic wounds that are critically in need of quick and effective action. When the dressing is removed, the inert bacteria is simply taken with it.

Clinical application of Cutimed Sorbact in the diabetic foot
Cutimed Sorbact is simple to apply and comes in various size options. The dressings were evaluated on four patients as follows. In all cases, Cutimed Sorbact was tolerated and offered noticeable relief to the patient in terms of pain and inflammation.

Case Study 1
Mr AB is a 58-year-old gentleman with type 2 diabetes. He presented with an infection in the 2nd toe (Figure 9) that had occurred when he used a nail file on his toe nails. The wound was painful and had been non-healing for 4 weeks prior to admission to the Wound Healing Centre. The infection was localized, so antibiotics were not prescribed, but Mr AB was seen daily to ensure the infection did not spread. Dressing toe wounds can be difficult, but the Cutimed Sorbact swab is simple to apply to digits (Figure 8) and can easily be covered with an appropriate absorbent dressing and suitable fixation as necessary. Mr AB’s toe responded rapidly with signs of healing after 7 days (Figure 10) and a clean wound that was one third the

Figure 9. Pressure damage over the second toe, which has developed clinical infection.
Figure 10. The same toe free from infection, and healing after 7 days of using Cutimed Sorbact dressings.
Figure 11. The wound is colonized with high levels of exudate. A Cutimed Sorbact pad was applied to absorb the exudate and reduce colonization.
Figure 12. The antibacterial effect reduces the colonization and reduces the potential for clinical infection.
Figure 13. The wound is colonized with high levels of exudate. A Cutimed Sorbact pad was applied to absorb the exudate and reduce colonization.
original size within 10 days of admission to the centre. The wound was no longer painful and was cleared of infection without the use of antibiotics.

**Case Study 2**
Mr JB, seen in Figures 12 and 13 is a diabetic patient with sugar levels rarely below 10 and suffering with arterial disease common to diabetics. Due to the pathology of the wounds and his underlying conditions, it was not expected his wounds would heal. The wounds at presentation were colonized, causing an increase in exudate levels. Little pain was experienced, but Mr JB was embarrassed by the amount of exudate, and so the aim was to reduce colonization in order to prevent clinical infection, thus reducing exudate levels with an associate positive impact on his quality of life.

Treatment commenced with Cutimed Sorbact pads to absorb exudate as well as provide antimicrobial control. The results can be seen in Figure 13 where the wound is clean and healthy. There is a slight area of maceration at the wound margins, but this was not a problem for this patient and the wound remained free from colonization.

**Case Study 3**
Mr CS is a young diabetic patient with blood sugars controlled at around 10 mmol/L. He undertook a marathon and damaged his toe and nail during the race (Figure 14). The wound did not heal, with redness and maceration becoming an increasing problem. Cutimed Sorbact swabs were applied on 13 May 2010 (Figure 15) and the positive effect was immediate (Figure 16). Redness and pain reduced within 24 hours, and the wound was almost healed after 11 days (Figure 17).

**Case Study 4**
Mrs GB is a 77-year old lady with type 2 diabetes, controlled by diet for the past 10 years. There is some diabetic neuropathy, which meant Mrs GB did not notice her shoes had rubbed her foot, resulting in wounds on her 3rd and 4th toes (Figure 18). The 5th toe had previously been amputated 2 years for a similar problem.

The wounds were necrotic and hard, as well as deep. The podiatrist softened the area using a hydrogel sheet for 3
days (Figure 19) followed by debridement and application of Cutimed Sorbact ribbon as a prophylactic, with the aim of preventing clinical infection in vulnerable tissues (Figure 20).

The dressings wrapped easily around the toes, separating them and remaining in situ. The wound remained free of clinical infection and had no symptoms of colonization and successfully went on to heal (Figure 21).

**Conclusion**

The diabetic foot ulcer is a significant and costly health-care problem and inadequate or improper therapy could lead to life threatening outcomes. Careful monitoring, patient education and education of the professionals caring for these ulcers are all imperative. Education must include the appropriate selection and use of dressings. Due to the unique principle of hydrophobic interaction with aerobic and anaerobic bacteria and fungi, Cutimed Sorbact dressings have been described as an appropriate choice as, unlike other antimicrobial dressings, they are able to safely keep colonization to a low level without any side effects or contraindications, thereby reducing the potential for clinical infection and the spread of antibiotic resistant organisms. 


