

The management of a neuropathic diabetic foot ulcer using ActivHeal® PHMB foam

Donna Welch, Rebecca Forder

Diabetic foot infection may lead to serious complications so prevention and effective management of wound infection is a high priority for clinicians. Antimicrobial-impregnated wound dressings may reduce the risk of infection and even treat mild infections. Polyhexamethylene Biguanide (PHMB) has recently been added to wound care products as an alternative to silver or honey. This case study evaluates the effectiveness of the Activheal® PHMB foam dressing in the management of an infected plantar neuropathic foot ulcer.

The International Working Group on the Diabetic Foot (IWGDF, 2014) has reported that as many as 50% of people with diabetes will have significant peripheral neuropathy and ‘at-risk’ feet. Nerve dysfunction in people with diabetes can affect three different types of nerves in the lower legs and feet, namely the sensory nerves, motor nerves and autonomic nerves. Sensory neuropathy (loss of sensation) is a major risk factor for developing diabetic foot ulcers; approximately 45–60% of diabetic foot ulcers are due to sensory neuropathy (Frykberg et al, 2006). The loss of protective sensation can increase the risk of trauma or injury to the foot (Bergin et al, 2013).

Approximately 50% of all diabetic foot ulcers occur on the plantar surface (sole) of the foot (Bus et al, 2011). Diabetic foot infection may lead to serious complications, such as gangrene and amputation (Hisham, 2015). The prevention and effective management of wound infection is a high priority for clinicians as infection is a significant problem and can result in delayed healing. Appropriate antibiotic therapy is still advised for the management of diabetic foot

infections, however, antibiotic therapy is associated with adverse reactions, increased financial costs and increasing the risk of antibiotic resistance and should, therefore, only be used for infected wounds (Tentolouris et al, 1999). It has been suggested that antimicrobial-impregnated wound dressings may reduce the risk of infection or even treat mild infections (Gotttrup et al, 2013).

Polyhexamethylene Biguanide (PHMB) has been used for a number of years as an antiseptic agent, however, it has recently been added to wound care products. PHMB works by inhibiting bacterial cell metabolism and binding to the bacteria’s phospholipid (outer) membrane (Kingsley and Kiernan, 2012). The positively-charged PHMB molecules attach to the outer membrane of the negatively-charged bacterial cell, causing areas of dysfunction and allowing PHMB to penetrate the inner membrane. The cell is increasingly unable to control normal transmembrane ion exchange, leading to increased fluidity, permeability, loss of integrity and cell death (Gilbert, 2006; Hubner and Kramer, 2010). PHMB is currently used in wound dressings as an alternative to silver or honey.

Citation: Welch D, Forder R (2016) The management of a neuropathic diabetic foot ulcer using Activ-Heal® PHMB foam. *The Diabetic Foot Journal* **19**: 205–9

Article points

1. This case study evaluates the use of Polyhexamethylene Biguanide (PHMB)-impregnated dressings in the management of infected diabetic foot ulcers.
2. Diabetic foot infections may lead to serious complications, including gangrene and amputation. Prevention and effective management of wound infection is a high priority for clinicians.
3. Activheal® PHMB foam dressing produced positive outcomes, it was easy to apply and surface area of the ulcer reduced by 53% from initial assessment to week 5.

Key words

- Diabetic foot ulcer
- Polyhexamethylene Biguanide

Authors

Donna Welch is Advanced Podiatrist Diabetes, Humber NHS Foundation Trust;

Rebecca Forder is Clinical Research Manager, Advanced Medical Solutions

Page points

1. PHMB is effective against a broad spectrum of microorganisms that are frequently associated with bacterial colonisation and infection of wounds.
2. Patients who routinely wear therapeutic footwear are less likely to develop ulcers.
3. NICE clinical guideline NG19 (2015) recommends that oral antibiotics with activity against gram-positive organisms are commenced as soon as possible for mild diabetic foot infections.

ActivHeal® PHMB foam

Advanced Medical Solutions Ltd has launched an antimicrobial foam under the ActivHeal range called ActivHeal® PHMB foam. The products are available as adhesive and non-adhesive. The dressing is a three-layer construction, and each layer contributes to the overall performance of the dressing. The wound contact layer side of the dressing has a clear perforated film. The contact layer prevents adherence of the dressing to the wound bed by preventing growth of granulating tissue into the dressing, thus reducing trauma to the wound bed on dressing removal. The polyurethane foam pad contains the antimicrobial substance PHMB, which is released in the presence of wound exudate and is effective against a broad spectrum of microorganisms (gram+, gram-, fungi and yeasts) that are frequently associated with bacterial colonisation and infection of wounds. The topmost layer of the dressing is a waterproof polyurethane film, which provides an effective bacterial barrier function, while simultaneously allowing the transpiration of exudate. ActivHeal PHMB foam is indicated for use on diabetic foot ulcers, leg ulcers, pressure ulcers and postoperative wounds.

This case study will explore the management of a neuropathic diabetic plantar foot ulcer using ActivHeal PHMB foam.

Background

A 54-year-old male patient with poorly controlled type 2 diabetes — HbA1c 122mmol/mol — presented with a plantar, superficial neuropathic ulcer on his right foot. The patient had previously been supplied with footwear by an orthotist, however, had chosen to wear his own shoes. Therapeutic footwear has been shown to have a beneficial effect in the primary and secondary prevention of diabetic foot ulcers and is essential to prevent the excessive pressure, shear and friction that can cause tissue damage and foot ulceration. Patients who routinely wear therapeutic footwear are less likely to develop ulcers or recurrence; Tyrell and Carter (2008) reported in a study that people with diabetes who wore their therapeutic footwear for more than 60% of the daytime reduced ulcer recurrence by more than 50%. After walking in his own shoes for a significant amount of time, the patient developed a blister. He initially attempted to self-manage the blister and only

attended the diabetic foot clinic a week later, when it started to deteriorate.

Initial presentation

Initial assessment found the foot pulses to be palpable, and sensation absent to 10g monofilament. The ulcer measured 2.6cm x 2.6cm and Visitrak® (Smith & Nephew) confirmed the surface area to be 4.6cm². The ulcer had 10% slough and 90% granulation to base, macerated callus to margins extending to first and second toe cleft and moderate exudate levels (*Figure 1*). The foot showed signs of infection, including heat and erythema, and the patient had a raised temperature and felt feverish. No pain was reported due to neuropathy. The healing time in diabetic foot ulcers is predominantly determined by the aetiological cause of the ulcer, with the shortest healing times associated with neuropathic ulcers (Zimny et al, 2002).

The ActivHeal PHMB foam was selected to assist in reducing the wound bioburden and reduce signs and symptoms of infection, as well as manage and absorb levels of exudate, maintain a moist wound environment, and promote healing. The patient was also commenced on oral antibiotics to avoid admittance to hospital. NICE clinical guideline NG19 (2015) suggests oral antibiotics with activity against gram-positive organisms are commenced as soon as possible for mild diabetic foot infections. As the neuropathic foot ulcer was superficial with soft tissue infection, hospital admission was not considered appropriate for this patient. However, the patient was advised that if his feverish symptoms did not improve or if the redness and swelling to his foot increased, he should contact the diabetic foot clinic immediately for advice and possible admission for intravenous antibiotics.

Due to infection, the foot was swollen and the shoes the patient had attended clinic in were considered inappropriate. Therefore, a soft cast slippercast was manufactured to departmental protocol to offload the area and improve healing potential. The patient was advised to wear the slippercast when weight bearing to reduce pressure to the ulcerated area.

Results

Week 1

The patient presented in clinic wearing his



Figure 1 (above left). Initial presentation of right plantar neuropathic foot ulcer with infection. The ulcer measures 4.6 cm².

Figure 2 (above centre). Week 1 — ulcer had reduced in size 3.6 cm² with an acceptable level of maceration. Infection resolved with oral antibiotics.

Figure 3 (above right). Week 2 — ulcer continues to improve, measuring 3.2 cm².

therapeutic footwear and reported no issues with the slippercast, but was now able to get his shoe on as his foot was less swollen. Significant progress was then noted in the wound, with the wound reducing in size. The ulcer measured 2.2 cm x 2.2 cm. Visitrak confirmed the surface area to be 3.6 cm², 21.8% reduction in surface area. The patient reported feeling much better and found the dressing comfortable, and easy to apply and remove, causing no trauma to the surrounding skin. The ulceration showed signs of improvement with an acceptable level of maceration to the surrounding tissue and 10% slough and 90% granulation tissue (Figure 2). No clinical signs of infection were noted, and further antibiotics were not clinically indicated. The patient agreed to continue with the ActivHeal PHMB foam dressing.

Week 2

The patient continued to be satisfied with the comfort of the dressing. The ulcer continued to improve and now measured 2.0 cm x 1.6 cm

with a surface area of 3.2 cm² — a further 11.2% reduction in surface area. The wound bed still contained 10% slough and overlying granulation tissue (Figure 3). The ulcer margins and surrounding skin appeared less macerated and healthier. No signs of infection were present and further antibiotics had not been required. The patient was then booked to return in 2 weeks.

Week 4

The patient presented complaining that the ulcer was leaking more. On examination, the dressing had slipped slightly and was not covering all of the ulcer. The patient had applied the dressing himself. Exudate had leaked through the top of the dressing resulting in some maceration to the interdigital cleft of the first and second toes. However, the actual ulceration had still improved, reducing in size to 1.1 cm x 1.6 cm. Visitrak confirmed a further 34.4% reduction in surface area, now measuring 2.1 cm². The ulcer base showed minimal slough overlying granulation tissue (Figure 4). The ulcer margins were debrided.

Figure 4 (left). Week 4 — dressing had slipped releasing exudate to interdigital area causing maceration. Ulcer size continues to reduce to 2.1 cm².

Figure 5 (right). Week 5 — interdigital area had resolved. Ulcer measures 1.7 cm².



The patient agreed to continue with the PHMB ActivHeal foam adhesive dressing and was advised to ensure it completely covered the ulceration. A dry softpore dressing was applied to the moist interdigital area.

Week 5

The patient reported less leakage and was satisfied with the dressing. He was pleased that he could see the progression of the ulcer and that it had reduced in size to 1.0 cm x 1.5 cm. Visitrak confirmed a further 19.9% reduction in just 6 days and the ulcer now had a surface area of 1.7 cm². The interdigital area had dried out and was now intact (*Figure 5*).

Conclusion

ActivHeal foam with PHMB was found to be an appropriate dressing in the management of a mildly infected diabetic foot ulcer with moderate exudate levels. The dressing produced positive patient outcomes. The ease of applying a single dressing, rather than an antimicrobial primary dressing with a secondary foam dressing, was advantageous and enabled the patient to self care, not only reducing the cost of dressings, but reducing the amount of healthcare appointments. PHMB is a highly effective and safe antimicrobial agent that can be an efficacious alternative to other antimicrobial wound care products. The dressing was able to provide effective exudate handling, while maintaining a moist wound environment, delivering antimicrobial efficacy

and wound progression with a reduction of 53% in surface area from initial assessment to week 5. This case study illustrates the importance of taking a holistic approach when caring for a patient with a challenging wound and ensuring that the correct diagnosis is made based upon a thorough assessment, ensuring good clinical outcomes for the patient. ■

- Bergin S, Nube V, Alford J et al (2013) Australian Diabetes Foot Network: practical guideline on the provision of footwear for people with diabetes. *Journal Foot Ankle Res* **6**: 6
- Bus S, Haspels R, Busch-West-Broek T (2011) Evaluation and Optimisation of Therapeutic footwear for Neuropathic Diabetic foot patients using in shoe Plantar pressure Analysis. *Diabetes Care* **34**: 1595–600
- Frykberg R, Zgonis T, Armstrong D et al (2006) Diabetic foot disorders: a clinical practice guideline. *J Foot Ankle Surg* **45**: 51–65
- Gilbert P (2006) Avoiding the resistance pitfall in infection – does the use of antiseptic products contribute to the spread of antibiotic resistance. *Ostomy Wound Manage* **52**: 1s–3s
- Gottrup, F, Apelqvist J, Bjansholt T et al (2013) EWMA document: Antimicrobials and non healing wounds; evidence, controversies and suggestions. *J Wound Care* **22**: 81–9
- Hisham A (2015) Diabetic foot infection. *Research Journal of Pharmacy & Technology* **8**: 575–9
- Hubner N, Kramer A (2010) Review on the efficacy, safety & clinical applications of polihexanide, a modern wound antiseptic. *Skin Pharmacol Physiol* **23**: 17–27
- International Working Group on the Diabetic Foot (2014) Diabetic Neuropathy. Available at: <http://bit.ly/1FqhF0q> (accessed 24.10.2016)
- Kingsley A, Kiernan M (2012) *Suprasorb X and PHMB Made Easy*. Wounds UK, London. Available at: http://www.wounds-uk.com/pdf/content_10135.pdf (accessed 24.10.2016)
- NICE (2015) *Diabetic Foot Problems: Prevention and Management*. Available at: <http://www.nice.org.uk/guidance/ng19> (accessed 20.10.2016)
- Tentolouris N, Jude GB, Smirnof I et al (1999) Methicillin Resistant Staphylococcus aureus; An increasing problem in a diabetic foot clinic. *Diabet Med* **16**: 767–71
- Tyrell W, Carter G (2008) *Therapeutic Footwear: A Comprehensive Guide*. Churchill Livingstone, Edinburgh
- Zimny S, Schaltz H, Pfohl M (2002) Determinants and estimation of healing times in diabetic foot ulcers. *J Diabetes Complications* **16**: 327–32