PHMB:

The role of Kendall™ AMD Antimicrobial Foam Dressing (0.5% PHMB) in the treatment of wounds

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Wounds UK

PHMB: A new way to tackle an old problem

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When asked what is the most troublesome part of wound healing, most wound care practitioners at any level in any country will give you the same answer. Whether the wound is chronic or acute, wound infections will always present problems.

The presence of excess bacteria in the wound can lead to delayed healing through breakdown of the extracellular matrix, destruction of healthy tissue and a prolonged inflammatory response. This will lead to a reduced quality of life for the patient due to increased pain, higher exudate levels and potential malodour (Cutting and Harding, 1994). In extreme cases, wound infection can lead to sepsis and increased mortality as a result (Chow et al, 1977).

The Chow et al (1977) study included 24 patients with sepsis that was solely attributed to pressure ulcers. Isolated bacteria included *Bacteroides*, *Proteus* and *Staphylococcus*, with 10 patients having polymicrobial infections. Sixty-seven percent of the patients died, with the mortality risk being reduced by the patient having surgery and the correct antibiotics.

Chronic wounds such as pressure ulcers and leg ulcers provide a biological portal into the body. A prolonged low-level infection could evolve to become a systemic infection due to the quorum-sensing ability of bacteria (Elbright, 2005). These wounds remain open for longer periods of time than standard surgical or acute wounds and therefore are more likely to experience periods of colonisation due to exposure to skin flora and other contaminants such as urine and faeces (Moore and Gray, 2007).

As bacteria have evolved, the range of products with which to treat them has, in comparison, been relatively limited. It can also be said that as technology has evolved, bacteria has also evolved to adapt to new threats. The increase in bacterial resistance to antibiotics has led to a change in treatment options which has aimed to avoid over-prescription of antibiotics.

It is therefore essential that we try and keep ahead of the game. The main topical antimicrobials that are used today are silver, honey and iodine. Most bacteriologists would agree that the key to preventing and treating wound infection is the effective control of bacterial numbers. This can be achieved by eradication of the bacteria themselves by using products which can kill on contact, or by:

- Preventing the bacteria from multiplying which involves the use of inhibiting compounds which prevent colonisation
- Removing necrotic material from the wound bed to change the environment from one which favours bacterial growth to one which does not
- Minimising cross-infection by controlling environmental factors which can influence bacterial transfer
- To use dressings which can control the wound environment, both as antimicrobial agents and by providing optimum moisture control which prevents maceration, desiccation and promotes healing.

Antiseptic agents have been used to eradicate bacteria and prevent infection in many healthcare institutions, and have become a major force in the prevention of nosocomial infection (Gilbert, 2006). Polyhexamethylene biguanide (PHMB) is an antiseptic agent which, as with other antiseptics, has multiple targets of action which render bacteria less likely to generate bacterial resistance mechanisms (Gilbert, 2006). Some antiseptics can be removed from bacterial cells using efflux pumping mechanisms in the cell wall, however, PHMB binds to the bacterial cell membrane helping to disengage cell pumping activity. This allows the other targets of the PHMB to be reached and the cell killed (Gilbert, 2006).

PHMB is active against a number of pathogenic organisms, including *Staphylococcus aureus*, *Escherichia coli, Pseudomonas* and the fungus *Candida albicans* (even against the resistant strains such as methicillin-resistant *S. Aureus*, Vancomycin-resistant enterococci and *Acinetobacter baumannii*). Some of the biguanide antiseptic molecules such as simple chlorhexidine have shown to be ineffective against *P Aeruginosa*, thus demonstrating an improved spectrum of activity for the PHMB molecule (Moore and Gray, 2007).

Wright Lam Olsen and Burrel (2003) compared the antimicrobial activity of PHMB gauze with nanocrystalline silver (a silver-coated dressing [SCD]) both in vitro and in porcine studies. The results demonstrated that both PHMB and SCD dressings convey powerful

antimicrobial activities when tested against a number of isolates, including clinical wound isolates in vitro. In short exposure tests the PHMB dressing demonstrated a trend towards being more effective against Gram-negative organisms (although this was not universally true), but the results against the Gram-positive organisms were also generally favourable. However, the authors do state that the activity of the PHMB dressing appeared dependent on the microbes being in close proximity to the dressings.

Clinical studies which have been carried out reflect the use of PHMB-impregnated gauze used in a variety of wounds and in association with topical negative pressure (TNP). One study by Penn et al (2006) examined the role of antimicrobial gauze (Kerlix™ AMD by Covidien, Mansfield, MA) in reducing surgical site infection. Carried out in a vascular unit in the USA where the patients' risk of infection was generally high, the team switched from using normal gauze dressings on vascular wounds to using 0.2% PHMB gauze (Kerlix AMD). Nurses also used the PHMB gauze when changing dressings postoperatively. The study found that the incidence of nosocomial infection reduced from 4.6% to 0.4% as a result. The drop in infection rates was substantial and was likely to be the result of this change in practice. There was also a cost saving calculated over a five-year period of $US 876,176 due to the reduction in numbers of patients suffering from wound infection

While these studies have predominantly been based on the use of PHMB in gauze-based dressings and acute post-surgical wounds, the overall benefits of PHMB as an antiseptic are clearly visible.

Kendall™ AMD Foam

The Kendall™ AMD Antimicrobial Foam Dressing (0.5% PHMB) from Covidien (Mansfield, MA) is a polyurethane-based foam dressing which has added PHMB. The dressing offers improved absorbency and reduced adherence over gauze-based dressings. The dressing has a broad range of antimicrobial activity due to its PHMB component. These pathogens include both Gram-negative and Gram-positive bacteria which are commonly implicated in wound infection.

These include:

- *Staphylococcus aureus*
- *Staphylococcus epidermidis*
- *Pseudomonas aeruginosa*
- *Escherichia coli*
- *Candida albicans*
- *Staphylococcus coagulase*
- *Proteus mirabilis*
- *Serratia marcescens*
- *Enterbacter cloacae*
- *Klebsiella pneumoniae*
- *Enterococcus faecalis*
- *Methicillin-resistant S. aureus*
- *Vancomycin-resistant enterococci*
- *Acinetobacter baumannii*
- *Clostridium difficile.*

This dressing is recommended for use on acute and chronic wounds which are critically colonised which are moderately to heavily exuding. The dressings have been designed to promote a wound environment which controls moisture and kills bacteria, within and through the dressing.

Chronic wounds that are at high-risk of infection, such as pressure ulcers, leg ulcers, skin tears, diabetic foot ulcers and burns would benefit from the use of this dressing.

The following patient case reports have been collated over the past six months in a specialist wound care clinic in Doncaster and Bassetlaw Hospital by Kathy Leak and her colleagues. These cases illustrate the range of wound types that have been successfully treated with this new dressing.

References

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The patient, a 63-year-old woman, was reviewed following abdominal surgery for wound dehiscence. The wound measured 12cm x 2cm with a depth of 2cm and contained both slough and granulation tissue (*Figure 1*). The exudate from the wound was moderate and highly viscous, indicating the likelihood of critical colonisation or possible infection. The first phase of treatment involved negative pressure wound therapy and when the wound was granulating Allevyn (Smith & Nephew, Hull) was used.

However, after one week the skin was macerated. As the wound was deteriorating it was felt that a product with an antimicrobial agent would help to reduce the bioburden in the wound. It was decided to use the Kendall™ AMD Antimicrobial Foam Dressing (0.5% PHMB) (*Figure 2*). About three weeks later, the wound had improved substantially. The wound size was now almost flush with the skin. The tissue was clean with healthy granulation. At the final review a week later, the wound was completely healed aside from one small area of granulation (*Figure 3*).

The wound dressing was conformable and did not cause any pain on application or removal. The wound exudate levels reduced substantially once the Kendall AMD Foam was applied, which possibly indicates that the antiseptic properties of the PHMB in the foam had reduced the wound bioburden. There was no maceration on the surrounding skin and the dressing remained in place between dressing changes. Initial dressing changes were every 3–4 days, and this frequency was decreased to every 5–6 days when the wound was near to healing.

A 63-year-old man with rheumatoid disease, presented with a four-year-old abdominal wound following surgery and a failed skin graft. The wound measured 5cm x 5cm and the wound bed had granulation and epithelial tissue, but the wound was slow to heal. There was a moderate amount of exudate from the wound. Previous treatment involved nanocrystalline silver dressings (Acticoat) with Allevyn as a secondary dressing.

After one week of treatment with Kendall AMD Antimicrobial Foam Dressing (0.5% PHMB) the wound had decreased in size and the wound had almost completely healed. The dressing was soft and conformable, and did not cause pain on removal. There was no damage to the surrounding skin while using the dressing.

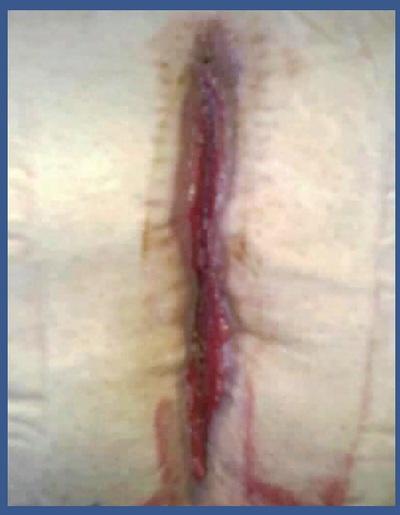

Figure 1. The wound at first review showing signs of increased bioburden such as dull granulation tissue and excess exudate. In the upper aspect of the wound there is some bridging visible.

Figure 2. The wound at second review about two weeks after commencing the Kendall AMD Foam dressing. The tissue appears healthier, there is partial closure of the wound and the exudate levels have greatly reduced.

Figure 3. At the final review the majority of the wound has epithelialised and one small area of granulation remains.

CASE REPORT 3

The patient was a 47-year-old woman with a breast wound after a post-surgical infection. The wound measured 5cm x 2cm and contained mainly sloughy tissue with some granulation present.

The wound exudate was minimal and of medium viscosity and the wound was being treated with Sorbsan (Unomedical, Redditch) and Allevyn (Smith & Nephew, Hull). The dressing was being changed daily, despite exudate levels being low because the patient was very aware of the smell. The wound was not progressing with this dressing combination, which may have been due to the presence of bacteria in the wound.

Kendall™ AMD Foam Dressing (0.5% PHMB) was applied to the wound in order to provide an antibacterial agent around the wound bed and redress the bioburden (*Figure 1*). The antimicrobial dressing was changed every 3–4 days and five days later there was a significant improvement in the wound. The sloughy area had reduced in size and the wound was decreasing in size, measuring 3.5cm long x 2cm across.

A month later the wound had decreased in size further and there was no longer any sloughy tissue in the wound bed (*Figure 2*). The wound measured 3cm x 1cm across. Again the patient found the dressing comfortable and had not experienced any pain during removal.

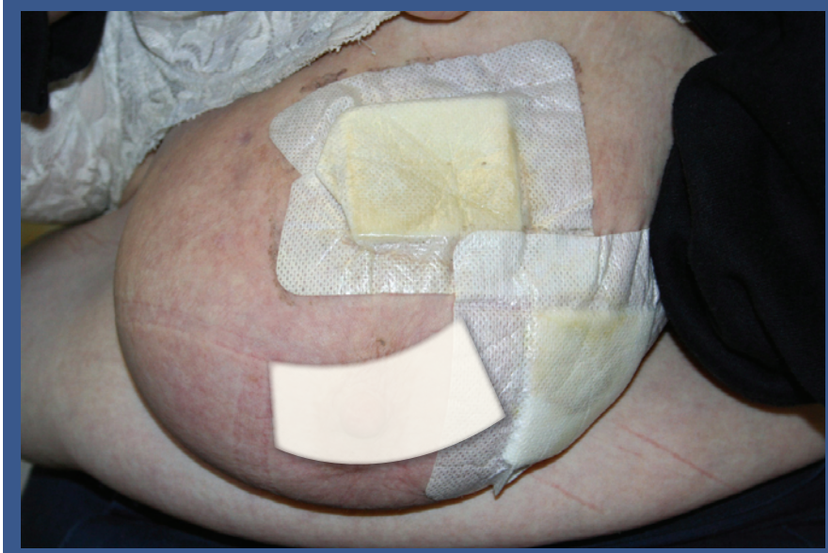

Figure 1. This image shows the dressings in situ.

Figure 2. There is a reduction in wound size and the wounds show no signs of infection

A 24-year-old woman was reviewed after a road traffic accident during which she sustained a traumatic injury to her elbow. The patient was awaiting plastic surgery treatment for the wound. The wound measured 7cm x 7cm and although the main tissue type was granulating, the wound exudate levels were high and of medium viscosity.

Topical negative pressure was used to cover the exposed ligament and bone first. Upon the first review, the exudate levels were indicative of excessive bioburden in the wound and it was decided to apply Kendall™ AMD Foam Dressing (0.5% PHMB) to the wound (*Figure 1*). Previously the wound had been treated with Allevyn Adhesive (Smith and Nephew, Hull).

Five days after the first review, wound exudate levels had reduced significantly and the exudate had become clear (*Figure 2*). The patient then had her skin graft performed and Kendall AMD Foam Dressing (0.5% PHMB) was used on the skin graft which healed successfully. One week after grafting, the wound had completely healed (*Figure 3*).

Figure 1. The wound at first review showing exuberant granulation tissue and excessive moisture, possibly indicative of increased bioburden.

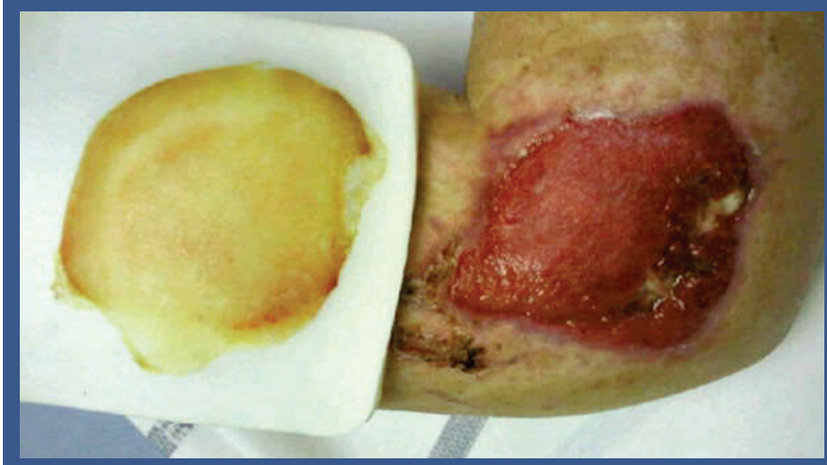

Figure 2. Five days after the initial review the granulation tissue was of a normal colour and appearance. The exudate levels were reduced and the wound no longer showed signs of increased bioburden.

Figure 3. One week after skin grafting, the graft was successful and the patient was discharged.

CASE REPORT 5

A 47-year-old woman with spina bifida presented with a wound on her foot after a toe amputation. The wound at first review was 3cm x 2cm, with predominantly sloughy tissue present with a small amount of granulation tissue (*Figure 1*). The wound exudate levels were moderate but of low viscosity. The previous dressing used was an alginate.

Due to the sloughy tissue present and the volume of exudate, it was felt that the wound was becoming critically colonised. Kendall™ AMD Foam Dressing (0.5% PHMB) was applied and changed every 3–4 days (*Figures 2 and 3*).

After three weeks of treatment the wound was almost healed. The wound bed was predominantly granulation and epithelial tissue. The wound exudate had reduced to low volume.

The patient was happy with the outcome and found the dressing easy to use. It did not cause any pain or trauma upon removal. The surgeons had considered plastic surgery to close this wound before Kendall AMD Foam was used and the patient in this case had no further surgery.

Figure 1. The wound at first review showing some irregular granulation tissue and potential overgranulation. There is some staining present on the surrounding skin.

Figure 2. The wound one week later. Epithelial tissue can be seen at the margins and in the centre of the wound. There is no longer staining on the surrounding skin.

Figure 3. Taken at a different angle, this figure shows the extent of the epithelial tissue.

CASE REPORT 6

A 60-year-old woman who had been admitted for breast reconstruction was referred following breakdown of her surgical wound. Following negative pressure wound therapy the patient was treated with Allevyn Adhesive (Smith & Nephew, Hull). The wound measured 7cm x 2cm and contained granulation tissue. There were no obvious signs of infection and the exudate levels were low.

The wound was static and there was no spreading of epithelial tissue which was likely to indicate a pH imbalance caused by bacteria (*Figure 1*). Due to this and the presence of a prosthetic implant, it was felt that Kendall™ AMD Foam Dressing (0.5% PHMB) would be appropriate for this patient.

Four weeks from the first review date, the wound had reduced in size to 3cm x 2cm. A small amount of sloughy tissue was noted, however, the wound was progressing. After seven weeks of therapy the wound had completely healed and the patient was discharged (*Figure 2*).

Figure 1. On first review the wound was irregular in shape and there was some overgranulation apparent in the wound bed.

Figure 2. At final review the wound is healed, and there are no signs of infection.

CASE REPORT 7

An elderly woman presented with a leg ulcer. She was able to walk a little when using a stick and did not like to wear compression bandages. She had an ABPI of 0.8 and her ulcer measured 3cm x 2cm. The main tissue type on the wound bed was slough and there were low volumes of moderately viscous exudate. The ulcer was being treated with Actisorb 220 (Johnson & Johnson Wound Management, Ascot) and Viscopaste bandage (Smith and Nephew, Hull). The wound was assessed and deemed to be colonised and healing was slow.

Kendall™ AMD Foam Dressing (0.5% PHMB) was applied and a modified compression bandage was used on the limb to aid tolerance of the dressing and maintain compliance. The patient was reviewed after one week of treatment and the wound was less sloughy and the wound was moving towards healing (*Figure 1*). The patient found the dressing comfortable and it did not cause pain on removal. The dressing was changed every three days and was reviewed after seven days. The wound took about one month to heal.

Figure 1. The wound is granulating and there are no signs of infection. The dressing has helped to reduce and manage the exudate levels.

The patient was a 38-year-old woman who had spina bifida. She presented with a pressure ulcer on her leg. The wound was about 4cm x 5cm and was 1cm deep. The tissue was a mixture of slough and granulation tissue and the wound was colonised. There was a moderate amount of low-viscosity exudate from the wound and it was also malodorous.

The wound was being treated with Actisorb Silver 220 (Johnson & Johnson Wound Management, Ascot) with Biatain (Coloplast, Peterborough) as a secondary dressing. However, the wound exudate was not being well managed and remained sloughy. It was felt that a new treatment regimen would be beneficial.

Kendall™ AMD Foam Dressing (0.5% PHMB) was chosen because of the need to control exudate and bacteria levels. After one week the wound was reviewed and the wound size had reduced to 2cm x 2cm with no measurable depth (*Figure 1*). The tissue within the wound was granulating and the wound was beginning to epithelialise. The wound exudate had decreased to low volume and was of low viscosity. The dressing appeared to perform well, reducing the bioburden and absorbing exudate. It was easy to apply and remove and the patient did not complain of pain when the dressing was changed. There were no signs of skin stripping and the dressing conformed well to the wound. The wound was clean and healthy and the patient was discharged to the community team after one week.

Figure 1. The wound after treatment with AMD Foam Adhesive.

A 63-year-old man with type II diabetes presented with a malodorous leg ulcer on his maleolus. The wound was 2cm x 2cm and was covered in sloughy tissue (*Figure 1*). Before the wound was reviewed it was being treated with Aquacel Ag (ConvaTec, Ickenhan). It was decided to change regimen as the wound was not improving. After one application of Kendall™ AMD Foam Dressing (0.5% PHMB) the odour was no longer apparent. The dressing had been in place for three days. The reduction in odour would suggest that the PHMB was reducing the bacterial presence in the wound. The patient felt that this dressing had been particularly beneficial as other products had not managed to tackle the malodour from his wound. After one week the slough was no longer present and there was a layer of epithelial tissue (*Figure 2*).

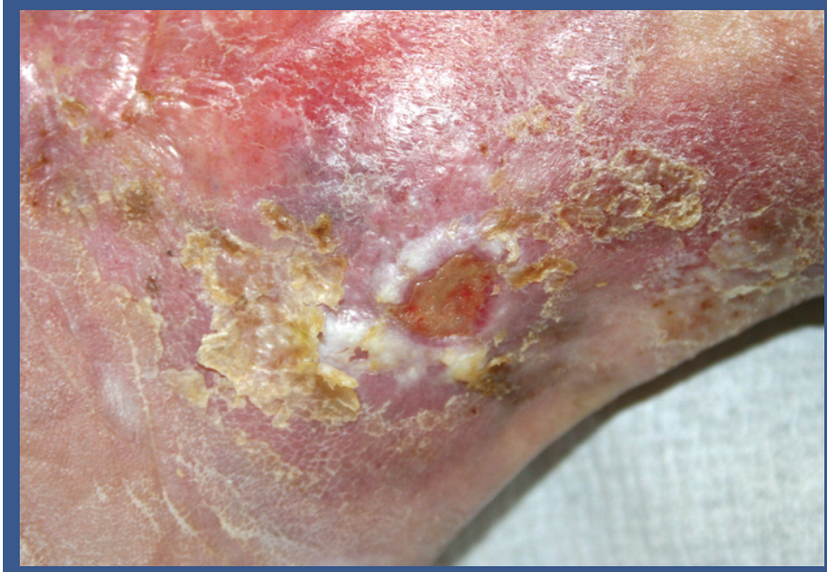

Figure 1. The wound at initial assessment showing sloughy tissue on the surface.

Figure 2. After one week of Kendall AMD Foam treatment, the slough is no longer present and there is a layer of epithelial tissue on the wound bed.

Conclusion

Kendall™ AMD Foam Dressing (0.5% PHMB) was used for 31 patients in total during this evaluation at Bassetlaw and Doncaster by Kathy Leak and her colleagues. The outcomes for this group were found to be overwhelmingly positive. The key outcome measures included:

- Effective absorption
- Atraumatic removal
- Apparent control of bioburden
- Promoting a good wound healing environment
- Dressing retention
- Conformability.

The overwhelming conclusion from these cases was that Kendall™ AMD Foam Dressing functions well as an antimicrobial and a modern wound dressing product. This resulted in consistent lowering of the wound bioburden, absorption of exudate and maintenance of an optimal wound healing environment.

Of equal importance was the ability of the dressing to remain in situ while not causing pain or trauma on removal. This was reflected in the patients' overall satisfaction with the product. Pain-free dressing removal is one of the most important features of any dressing and in recent years this aspect of wound care has become a major concern.

When used on wounds which were critically colonised or where healing had slowed, the dressing appeared to improve outcomes and in some cases facilitated debridement and epithelialisation. Although this was not tested for statistical significance the impact of the dressing was visible.

In one case, the exudate levels from the wound were such that the dressing needed to be replaced more frequently than planned. However, overall the wear time on patients with moderately exuding wounds was 3–4 days. It was also noted that the exudate levels reduced once the dressing was commenced, possibly as a result of the reduction in bioburden. The dressing was also highly conformable, which is a useful feature when treating wounds in awkward areas.

The product was trialled on patients with both chronic and acute wounds, which had become problematic as a result of increased bioburden. Kendall AMD Foam Dressing (0.5% PHMB) was shown to improve the outcomes. Above all, the wound dressing supported the healing process by reducing the bioburden and providing a moist wound environment. The dressing facilitated healing, and in some cases wound closure. Overall, the dressing proved to be a useful addition to currently available treatments, and it offers a viable alternative to silver, iodine and honey-based products.

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