SUPRASORB® X +PHMB:
A NEW WOUND DRESSING

When a reduction in microbial load of a wound is required, antiseptic dressings can be used. The ideal product has the ability to promote an optimal environment for healing, reduce the selection of resistant bacterial strains and is not cytotoxic. Suprasorb X +PHMB is a new antiseptic dressing that has these properties.

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The indiscriminate use of antibiotics is widely considered to be a crucial factor contributing to the rise of resistant microorganisms such as Methicillin-resistant *Staphylococcus aureus* (MRSA) (Kingsley et al, 2006; Moffatt, 2006). This has led to a renewed interest in the use of antiseptics in wound care. Antiseptics offer many benefits as they can be relatively easy to use, are widely available, frequently cost less than antibiotics, and can be administered without prescription (Principles of Best Practice, 2008). However, they too should not be used indiscriminately or indefinitely, as there is also evidence for bacterial resistance to some antiseptics, such as silver (Maillard and Denyer, 2006). There is also a lack of clinical evidence surrounding the cytotoxicity of some antiseptic products (Principles of Best Practice, 2008).

When should antiseptics be used?

It is almost inevitable that the majority of wounds will become contaminated with bacteria to some extent. However, contamination, which describes the presence of organisms in a wound, with no active growth and no host response, is of no relevance to clinical practice (Kingsley et al, 2006). However, when wound bioburden increases, clinical effects may be noted and may require intervention. The increasing bacterial numbers in wound tissue can be described using conceptual names:

- Colonisation
- Critical colonisation
- Local infection
- Spreading infection

(Kingsley, 2006).

Colonised wounds contain multiplying bacteria, however, the host does not have an overt clinical response or clinical symptoms, meaning that the need for topical antimicrobial intervention is unnecessary, unless there are concerns regarding the patient's immune response or overall medical condition.

Critically colonised wounds require a reduction in the level of bacteria present, if the wound is to progress towards healing. In chronic wounds, critical colonisation may cause delayed healing in the absence of any indicators of infection, thus the clinician should be alert to this and microbial involvement must be suspected when other causes of indolence have been eliminated. The topical application of an antimicrobial is probably the most effective way in which to reduce the critically colonised wound's bioburden to levels that allow the wound to heal (Sibbald et al, 2001; Fumal et al, 2002).

Localised infection is often characterised by the classic signs and symptoms of inflammation, including redness, heat and pain (Cutting and Harding, 1994). If local infection is identified, in most instances it can be managed with topical antimicrobials, providing the practitioner is satisfied that the patient's overall condition does not suggest that there is a risk of the infection spreading. However, the clinician should remain alert to the possibility of spreading infection, and be prepared to alter treatment as required (Kingsley et al, 2006). If, however, infection has invaded soft tissues or is spreading, then treatment with both local and systemic measures is indicated. Wound dressing choice will have little impact on the spreading infection, but can help to reduce the level of bacteria at the wound surface.

Once the need for topical antiseptic intervention has been identified, it is important to select a product that will provide optimum conditions to support rapid healing. The

ability of the agent to reduce or eradicate microorganisms must also be considered, along with its specificity, cytotoxicity to human cells, its potential to select resistant strains and its allergenicity (Vowden and Cooper, 2006).

The ability of the carrier dressing to handle exudate and remove necrotic tissue from the wound is beneficial, since purulent exudate, necrotic tissue and slough are all growth mediums for bacteria (Cutting, 2008). The dressing's ability to reduce malodour, conform to the site and shape of the wound, perform wound bed preparation functions, satisfy patients' expectations and to meet treatment goals also need careful consideration (Vowden and Cooper, 2006).

Antiseptic agents

Antiseptics have been in use for much longer than antibiotics yet resistance to antiseptics presents much less of a problem. This may be because antiseptics differ from antibiotics in that they are generally active against a broader-spectrum of organisms including common pathogenic anerobic and aerobic bacteria, and fungi. Unlike antibiotics, antiseptics also tend to have multiple target sites, including the bacterial cell wall or membranes, in the organisms on which they exert their effects. This means that the microorganisms are less likely to mount an effective defence and survive as resistant strains (Gilbert, 2006).

The range of topical antiseptic agents currently in common use in wound dressings in the UK include silver, iodine, and honey. Polyhexamethylene biguanide (PHMB) is a relatively new entrant to the UK wound care market, although it is in common use in Europe and US.

Polyhexamethylene biguanide

PHMB is a synthetic compound which is structurally similar to naturally occurring antimicrobial peptides (AMPs). AMPs are produced by the majority of living organisms and have a broad spectrum of activity against bacteria, viruses and fungi (Moore and Gray, 2007). AMPs are positively-charged molecules that bind to bacterial cell membranes and induce cell lysis by destroying membrane integrity, in a similar way to penicillin and cephalosporin antibiotics. AMPs are produced by many cells within the wound, such as keratinocytes and inflammatory neutrophils, where they are thought to play a role in protection against infection (Sorensen et al, 2003).

The structural similarities between AMPs and PHMB mean that the latter can insert into bacterial cell membranes and kill bacteria in a similar way to AMPs (Moore and Gray, 2007). This mechanism of action is quick and means that bacteria are unlikely to develop resistance to PHMB (Seipp and Korber, 2008).

PHMB in wound management

PHMB is a commonly used antiseptic which appears in a variety of products including contact lens cleaning solutions, perioperative cleansing solutions and swimming pool cleaners. Its safety and effectiveness as an antiseptic both *in vitro* and *in vivo* in these different applications is well documented (Motta et al, 2004; Motta and Trigilia, 2005; Larkin et al, 1992). It exerts little toxicity and has been in general use for approximately 60 years with no evidence of the development of resistance (Moore and Gray, 2007). In wound care, specifically, PHMB has previously been demonstrated to block *Pseudomonas aeruginosa*-induced infection (Cazzaniga et al, 2000) and prevent its degradation of wound fluid and skin proteins *in vitro* (Werthen et al, 2004). It can also kill a diverse range of bacteria and fungi (Lee et al, 2004).

Furthermore, to date PHMB has been used successfully in wound dressings, including non-adherent products, gauze, drains and intravenous sponges (Motta and Trigilia, 2005; Moore and Gray, 2007). The long-term use of PHMB in other indications without cytotoxicity or the development of resistance suggests this is unlikely to happen when the antiseptic is used in wound management (Gilbert, 2006).

PHMB has been incorporated into a new wound management product, Suprasorb® X +PHMB (Activa Healthcare), giving anti-microbial activity to the Hydro-Balance dressing, Suprasorb X.

The Suprasorb X dressing range

Suprasorb X dressings have a unique structure made up of biosynthetic HydroBalance fibres, that enhance both its moisture handling capabilities and its tensile strength.Thus, Suprasorb X is able to regulate the absorption and donation of moisture at the wound-dressing interface (*Figure 1*). Depending on the status of the wound, surplus exudate can be absorbed by the dressing, or donated in the case of lightly exuding wounds. This moisture

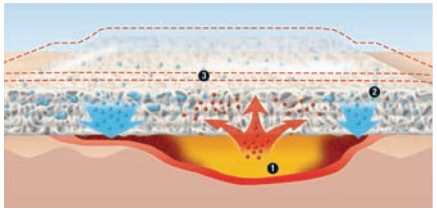

Figure 1. The unique HydroBalance of Suprasorb X. 1. Surplus exudate from the wound is absorbed, and 2. Moisture is released from the dressing to lightly exuding wound areas. 3. Safely removes debris and traps it within the dressing.

absorbing and donating capacity can also be exerted within the same wound, removing exudate and donating moisture to drier areas.

It also protects the wound against abrasion, desiccation and external contamination. These unique fluid-handling capabilities of the dressing mean that Suprasorb X can be used on moderately exuding, non-exuding and dry wounds. The moist environment also has a cooling effect that has demonstrated a significant reduction in pain (Alvarez et al, 2004; Davis, 2006).

In a 24-patient, multicentre randomised controlled study carried out by Alvarez et al (2004) to determine the effectiveness of Suprasorb X compared with care already being received in patients' venous leg ulcers, Suprasorb X was found to significantly promote autolytic debridement and reduce wound pain at weeks three, six and eight of the 12-week study. An improved rate of wound closure, in terms of increased epithelialisation and granulation tissue was also noted (Alvarez, 2004). Results of decreased pain, increased granulation and epithelialisation and an improved rate of wound closure were also observed by Vijverberg et al (2007) and Eberlein et al (2007).

The new dressing, Suprasorb X +PHMB, combines the proven efficacy of Suprasorb X with the antimicrobial action of PHMB (0.3%), and is indicated for use on lightly to moderately exuding, superficial and deep, infected wounds in all phases of wound healing. The PHMB component exerts its antimicrobial effects both within the dressing, but also at the wound-dressing interface (*Figure 2*). As the PHMB is not bound to the HydroBalance fibres of the dressing, it is released into the surrounding fluid along a concentration gradient.

The presence of fluid in the dressing means that antimicrobial activity is possible even on dry wounds, unlike silver-containing dressings which require the mechanical action of wound fluid to initiate antimicrobial activity.

Suprasorb X +PHMB in clinical practice

A clinical case series performed by Mulder et al (2007) to determine the antimicrobial effects of Suprasorb X +PHMB showed that PHMB effectively reduced wound bioburden and had a positive effect on wound healing. Twelve patients with a total of 26 wounds were evaluated, 11 of whom had previously been unresponsive to silver- or iodine-containing dressings.

Wound swabs were taken before and after treatment with Suprasorb X +PHMB. Before treatment, organisms were identified in the wounds of eight patients, most commonly *Pseudomonas aeruginosa* and *Staphylococcus* (including MRSA). At the end of the evaluation, levels of bacteria were decreased

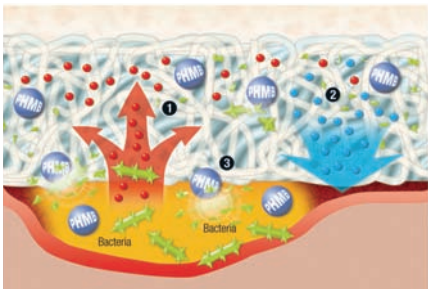

Figure 2. Mechanism of action of Suprasorb X +PHMB. Surplus exudate from the wound is absorbed by the dressing, and 2. Moisture is released from the dressing to lightly exuding wound areas. 3. Killing of micro-organisms by the PHMB that is released.

in five of the eight patients (two patients were lost to follow up, and one patient experienced no change in bioburden). For the eight patients, there was a mean reduction in wound size from 6.79cm^2 to 4.57cm^2 in a mean of 25 days. Two wounds healed during the study and 13 showed improvement.

An evaluation of Suprasorb X +PHMB in the treatment of four patients with wounds which had previously been treated unsuccessfully with various silver-containing dressings was undertaken by Davis (2006). Although two wounds were locally infected, application of Suprasorb X +PHMB healed three of the four wounds, protected periwound tissue and resulted in a decrease in wound pain (Davis, 2006).

Similarly, an evaluation of Suprasorb X +PHMB in the treatment of 79 wounds of varying aetiology by Cavorsi (2006) revealed that healing or clinical improvement was achieved in >80% of the cases receiving treatment with Suprasorb X +PHMB. In a subset of wounds that had not been responsive to prior treatment with

silver dressings, a decrease in wound size of 33% was observed after three weeks.

Conclusion

Suprasorb X +PHMB is able to effectively reduce the number of pathogens in the wound. Currently, PHMB does not have a history of resistance or cytotoxicity, making it a good alternative to antiseptics for which the development of bacterial resistance and toxicity is an issue. Suprasorb X's unique ability to absorb and/or donate moisture depending on the needs of the individual wound provides a moist environment that will allow the wound to progress towards healing and leads to a reduction in pain. These unique properties of Suprasorb X +PHMB make it an attractive alternative to the antiseptic dressings that are currently available. WE

Alvarez OM, Patel M, Booker J, Markowitz L (2004) Effectiveness of a biocellulose wound dressing for the treatment of chronic venous leg ulcers: results of a single center randomized study involving 24 patients. *Wounds* **16(7):** 224–33

Cavorsi JP (2006) Experience in US with Suprasorb X + PHMB — an antimicrobial wound dressing. Poster presentation, EWMA, Prague

Cazzaniga A, Serralta V, Davis S, Orr R, Eaglestein W, Mertz P (2000) The effect of an antimicrobial gauze dressing impregnated with 0.2% polyhexamethylene biguanide (PHMB) as a barrier to prevent *Pseudomonas aeruginosa* wound invasion. *Wounds* **14:** 169–76

Cutting K (2008) Wound infection of the lower limb. In: Lindsay E, White R (2008) *Leg Ulcers and Problems of the Lower Limb: An Holistic Approach*. Wounds UK, Aberdeen: 207–17

Cutting KF, Harding KG (1994) Criteria for identifying wound infection. *J Wound Care* **3:** 198–201

Davis C (2006) Evaluation of pain control and healing rates using an advanced cellulose dressing with 0.3% PHMB. Poster presentation, SAWC Annual Congress, Tampa

Eberlein TH, Fendler H, Mustafi N, Sauer B, Schmitz M, Heib A (2007) Exudate management, HydroBalance, pain reduction: special aspects in the treatment of chronic wounds in Germany. Presentation at EWMA, Glasgow 2007

Fumal I, Braham C, Paquet P, et al (2002) The beneficial toxicity paradox of natimicrobials in leg ulcer healing impaired by a polymicrobial flora: a proof-of-concept study. *Dermatology* **204(suppl 1):** 70–4

Gilbert P (2006) Avoiding the resistance pitfall in infection control. *Ostomy Wound Manage* **52(10A Suppl):** 1S–3S

Kingsley A, White R, Gray D, Cooper P (2006) Using the wound infection continuum to assess wound bioburden. In: Applied Wound Management Supplement: Part 2 Implementation. Wounds UK, Aberdeen

Larkin DF, Kilvington S, Dart JK (1992) Treatment of Acanthamoeba keratitis with polyhexamethylene biguanide. *Ophthalmol* **99(2):** 185–91

Lee WR, Tobias KM, Bemis DA, Rohrbach BW (2004) *In vitro* efficacy of a polyhexamethylene biguanide-impregnated gauze dressing against bacteria found in veterinary patients. *Vet Surg* **33(4):** 404–11

Maillard JY, Denyer SP (2006) Demystifying silver. In: European Wound Management Association (2006) Position Document: *Management of Wound Infection*. MEP Ltd, London

Moffatt CJ (2006) Management of wound infection. In: European Wound Management Association. Position Document: *Management of Wound Infection*. MEP Ltd, London

Moore K, Gray D (2007) Using PHMB antimicrobial to prevent wound infection. *Wounds UK* **3(2):** 96–102

Motta GJ, Milne CT, Corbett LG (2004) Impact of antimicrobial gauze on bacterial colonies in wounds that require packing. *Ostomy Wound Management* **50:** 48–62

Motta GJ, Trigilia D (2005) The effect of an antimicrobial drain sponge dressing on specific bacterial isolates at tracheostomy sites. *Ostomy Wound Management* **51:** 60–6

Mulder GD, Cavorsi JP, Lee D (2007) Polyhexamethylene biguanide (PHMB): An addendum to current topical antimicrobials. *Wounds* **19(7):** 173–82

Principles of Best Practice (2008) Wound Infection in Clinical Practice: An International Consensus. MEP Ltd, London

Seipp HM, Korber A (2008) Biofilm, fibrin, resistance: antibacterial measures with focus upon polihexanide. In: *Polihexanide — an antimicrobial substance with various properties — for critical colonised or local infected wounds*. Lohmann & Rauscher, Neuwield, Germany

Sibbald RG, Browne AC, Coutts P, et al (2001) Screening evaluation of an ionised nanocrystalline silver dressing in chronic wound care. *Ostomy Wound Management* **47:** 38–43

Sorensen OE, Cowland JB, Theilgaard-Monch K, Liu L, Ganz T, Borregaard N (2003) Wound healing and expression of antimicrobial peptides/polypeptides in human keratinocytes, a consequence of common growth factors. *J Immunol* **170(11):** 5583–9

Werthen M, Davoudi M, Sonesson A Nitsche DP, Morgelin M, Blom K, Schmidtchen A (2004) *Pseudomonas aeruginosa*-induced infection and degradation of human wound fluid and skin proteins ex vivo are eradicated by a synthetic cationic polymer. *J Antimicrob Chemother* **54(4):** 772–9

Vowden P, Cooper RA (2006) An integrated approach to managing wound infection. In: European Wound Management Association (2006) Position document: *Management of Wound Infection*. MEP, London: 2–6

Vijverberg-Houdjik AM, Sivro S, Kiottenbelt A (2007) Presentation at EWMA, Glasgow 2007