Adoption of antimicrobial gauze bandages for standard use in heavily exuding wounds
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Abstract
Since cotton gauze was first placed on exudating wounds, the need for a method to control the growth of bacteria in the gauze on exudating wounds. BioGuard can be used with, and does not interfere with any silver based dressings, or supplemental skin coverings.

Summary of Clinical Experiences
With plain cotton gauze, in order to maintain clean, non-contaminated dressings, burn unit staff were changing the dressings up to three times per day. Even with these frequent dressing changes, we continued to have evidence of bacterial fouling. As we have moved exclusively to the Bioguard dressing, we have been able to decrease the exposure and discomfort during dressing changes for the patients, and reduced workload on the caregivers. Patients, caregivers and family all expressed that they were uniformly pleased with the reduction in bacterial fouling and odor.

Antimicrobial Testing of BIOGUARD® Dressings
The gold standard of assessment is of course clinical performance. In order to design the product that provides patients and caregivers with effective antimicrobial activity, standard test procedures are utilized to quantitatively assess performance of dressings and devices. This testing is used prior to clinical implementation, as validation of relevance to wound care. Testing was executed on cited bacterial strains, per protocols based on ISO 20743, JIS L 1902 and AATCC method 100.

Mechanism of Antimicrobial Activity
The BIOGUARD antimicrobial barrier dressing is based on the patented NIMBUS® technology (Quick-Med Technologies, Inc.). The active antimicrobial agent is permanently bound to the dressing, and acts on the wound pathogen by physically disrupting the prokaryotic cell wall. The macromolecular agent responsible for this mode of action is poly(diallyldimethylammonium chloride), or polyDADMAC, a cationic quaternary ammonium polymer. Gilbert and Moore (2005) describe the mechanism of cell wall disruption induced by polymeric cationic biocides in detail as shown graphically in Figure 1. Cationic polymer chains coordinate to the anionic segments of the phospholipid membrane, disrupting stabilizing calcium ions. As increasing numbers of cell membrane molecules coordinate to the polymer, the integrity of the bacterial membrane is compromised, leading to gaps and holes as shown in the conceptual representation below (Figure 1) and in the TEM micrographs of Figure 2.

Figure 1: Conceptual Representation: action of polymeric cationic biocidal agent

The theoretical representation is supported by electron micrographs (Figure 2 on the right), which show Escherichia coli cells before and after contact with a polymeric quaternary microbicidal agent (as immobilized on a gauze surface). The left panel shows healthy intact cells, while the right panel shows disrupted and fused cells—defibrinated membrane sacs with their intracellular contents released (Mikhaylova et al, 2011).

Figure 2 (left). Scanning Electron microscope images of E. coli on an unimmobilized wound dressing and on BIOGUARD dressing (as labeled). E. coli resides in gaps in contact with control substrates had intact membranes and full rod shapes. E. coli exposed to BIOGUARD surfaces show clear membrane damage and altered general morphology. Some bacteria show small holes and indentations with extruding intracellular content.

Figure 2 (right). Resheding of bacteria into a wound from a conventional dressing (far left image) compared to an antimicrobial dressing. Wound fluid absorbed by a non–antimicrobial dressing serves as nutrient to grow bacteria that can in turn recolonize the wound, which can in turn resediment the wound. This scenario is interdicted by the use of an antimicrobial dressing.

Wound pathogen ATCC number of species Average log kill vs. unimmobilized control, overnight Average % kill vs. immobilized control, overnight
Staphylococcus aureus ATCC 8558 7.10 99.99992%
MSSA (methicillin-resistant S. aureus) ATCC BAA-44 7.10 99.99999%
Staphylococcus epidermidis ATCC 12228 7.52 99.99997%
Pseudomonas aeruginosa ATCC 15442 7.00 99.99999%
Enterococcus faecalis ATCC 13434 8.69 99.99999%
Escherichia coli ATCC 8097 7.52 99.99997%
Acinetobacter baumannii ATCC 19609 8.00 99.99999%
VRE (Vancomycin resistant Enterococcus faecium) ATCC 12228 7.05 99.99991%

Conclusions
Pre-clinical development testing of the BIOGUARD dressing demonstrated high microbicidal efficacy (~6-log kill) against common wound pathogens, while maintaining the highest possible level of biocompatibility per laboratory testing on the products. Clinical observations at Shands Burn Center continue to be very positive. Burn Unit nurses have noted a significant reduction in exudate odor and color in patients treated with BIOGUARD as compared to standard dressings. Further clinical trials are being discussed to show efficacy.

In summary, Bioguard has continued to prove its value as a staple in burn wound care. Our experiences with the Bioguard dressing have influenced our burn center to convert all cotton gauze to gauzes bound with an antimicrobial polymer.

References

Figures 4a and 4b show a Donor Site treated with traditional gauze dressings. There is exudate that has developed metallic green color and strong odor. These signs are symptomatic of colonization with Pseudomonas aeruginosa, which CDC cites as the most prevalent burn wound pathogens.

Figures 5 (a, b, c) show Lower Extremity Graft Sites treated with BIOGUARD gauze bandages. Although there are large amounts of exudate present, the dressings are not discolored and, based on the observational input, are odor-free. Dressings can be repeated daily, with no need to change the dressing.

Further clinical trials are being discussed to show efficacy.