

The bacterial endotoxin binding activity of a silver impregnated activated charcoal dressing

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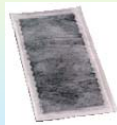
OBJECTIVE

To evaluate the bacterial endotoxin binding capability of a proprietary silver-impregnated activated charcoal dressing (SIAC). The study assessed the time dependant endotoxin binding behaviour and also the antimicrobial activity and simultaneous endotoxin binding ability upon bacterial cell lysis.

TEST DRESSING

The proprietary silver impregnated activated charcoal dressing used in this study was ACTISORB® Silver 220 Dressing, Johnson & Johnson Wound Management Worldwide, a division of ETHICON, INC.

ACTISORB Silver 220 dressing is a silver impregnated activated charcoal cloth sealed within a porous nylon protective envelope



* Trademark of Johnson & Johnson.

INTRODUCTION

Bacterial endotoxins are the lipopolysaccharide component of the cell wall membrane of Gram negative bacteria. Small quantities of endotoxin are released during cell replication but the majority of endotoxin is released into the environment upon cell lysis. Bacterial endotoxin release is one of many factors considered to cause delayed healing in infected and critically colonized wounds. Depending on mode of action antimicrobial treatment of infection may induce release of these endotoxins with subsequent detrimental effects¹.

Specific to wound healing endotoxins have been shown to cause decreased fibroblast proliferation *in vitro*², and *in vivo*, increased expression and release of proinflammatory cytokines^{3,4}, decreased production of collagen⁴ and decreased tensile strength in healing wounds⁵.

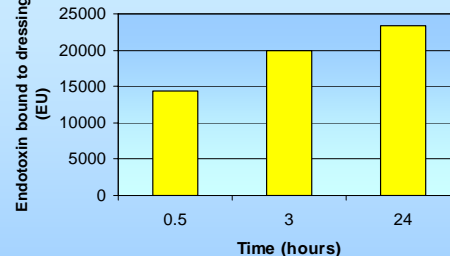
Activated charcoal has been used in the past to bind endotoxins found in plasma due to Gram-negative bacterial sepsis⁶. A wound dressing which is antimicrobial and also capable of binding toxins detrimental to wound healing may be beneficial in the treatment of infected wounds.

METHODOLOGY

To determine antimicrobial activity and simultaneous endotoxin binding of SIAC, test dressings were pre-wet and exposed to *Pseudomonas aeruginosa* solutions of differing bacterial concentrations (10^4 - 10^5 , 10^5 - 10^6 , and 10^6 - 10^7 cfu/ml). Aliquots of bacterial solutions after incubation with dressings were sampled and bacterial counts of the aliquots were determined. The endotoxin content of the aliquots was also determined by chromogenic LAL assay.

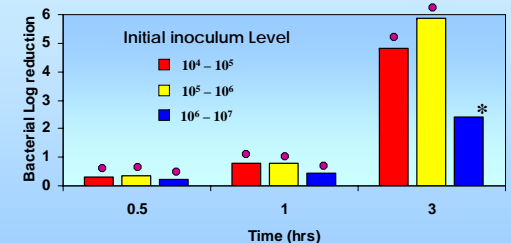
SIAC was also exposed to O55:B5 *E. coli* endotoxin standard to determine endotoxin binding capability. Pre-wet dressings were exposed to solutions of known endotoxin concentration over 24 hours (37°C). Aliquots of the endotoxin solution were taken after 0.5hrs, 3hrs, and 24hrs contact with the dressing. Aliquots were analyzed for toxin content (chromogenic LAL). Experimental controls included a nylon dressing and endotoxin solution alone.

Figure 1. Time dependant binding ability of SIAC over 24 hours?



SIAC was capable of binding 1800EU/cm² of dressing (assuming binding on both sides of the dressing)

Figure 2. Bacterial log reduction of SIAC over 3hrs?



● No endotoxin was detected in solution

* Endotoxin was detected in solution (60EU/ml)

CONCLUSIONS

ACTISORB Silver 220 dressing was found to bind increasing levels of endotoxin over a 24-hour period with significant differences compared to controls after 3 and 24 hours (Mann-Whitney U-test, $p = 0.002$). There was no significant difference between control dressing (nylon) and endotoxin solution at any time point. The binding capacity of ACTISORB Silver 220 dressing under the experimental conditions used was 1800EU/cm², assuming binding on both sides of the dressing.

ACTISORB Silver 220 dressing also showed antimicrobial efficacy against *Pseudomonas aeruginosa* over the 3 hour contact period. During this experiment any endotoxins released due to the antimicrobial effect of ACTISORB Silver 220 dressing were shown to be bound to the dressing and not released into the surrounding. The only exception to this was when very high levels of bacteria were present, although levels of endotoxin in solution were relatively low.

An antimicrobial dressing that also binds bacterial metabolites and endotoxins regarded to be detrimental to wound healing, could offer an alternative addition to the management of infected and critically colonized wounds.

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