An Assessment of Biofilm Disruption and Bacteriostatic Capabilities of an Autolytic Debridement Dressing

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Introduction

Microorganisms contained within biofilms often have altered phenotypes compared to their equivalents in planktonic culture and are usually more difficult to eradicate. It is thought that biofilm material is present in the majority of chronic wounds and is a factor in preventing these wounds from healing. Treatments that disrupt biofilms may aid healing in previously non-healing wounds.

In order to assess biofilm disruption highly reproducible biofilms need to be established in order to compare biofilm treatments. The CDC reactor model has been accredited by UKAS as being suitable for the growth of highly reproducible biofilms.

Aim

To assess the biofilm disruption properties of hydro-responsive wound dressings, using a CDC reactor biofilm model.

Method

- An inoculum of *S. aureus* was prepared to 1 x 10^7 $cfuml^{-1}$ and added to a CDC reactor containing polycarbonate and glass coupons.
- The reactor was incubated at 37°C and 50 rpm for 24 hours.
- After incubation, coupons were removed from the reactor and washed three times in PBS to remove planktonic cells.
- Coupons were treated by sandwiching each coupon between two sections of HydroClean® or HydroClean® plus. Controls were submerged in 2 ml PBS + 1% TSB. All samples were incubated at 37°C for 24 hours.
- Samples were taken from each dressing core for the enumeration of viable organisms present within the dressing core.
- Samples were taken from HydroClean HydroClean plus and also NA Gauze each dressing and scanning electron microscopy was used to visualise organisms within the dressing core.

Results

- Control biofilms equated to 6 log of viable biofilm material. Following treatment, an average of 4.69 ± 0.28 log and 3.75 ± 0.69 log bacteria were recovered from the inner core of HydroClean® and HydroClean® plus respectively (Figure 1), demonstrating the ability of the dressing to sequester biofilm encased bacteria.
- The neat (pre dilution of the inner core sample) resulted in significantly reduced bacterial recovery compared to the diluted samples, suggesting a bacteriostatic effect of the dressing gel.
- Scanning electron micrographs of NA gauze show a significant bacterial burden on the gauze fibres. The inner core of HydroClean® and HydroClean® plus presented with bacteria within the core of the dressings. Bacteria were visible on the dressing fibres but no organisms were visible on the gel structures. Again this suggests that the majority of the bacterial load was held within the gelling fibres (Figure 2).

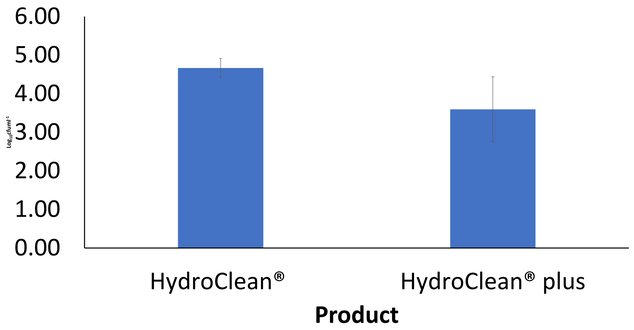

Figure 1. Quantity of viable organisms recovered from the inner core of dressings following treatment.

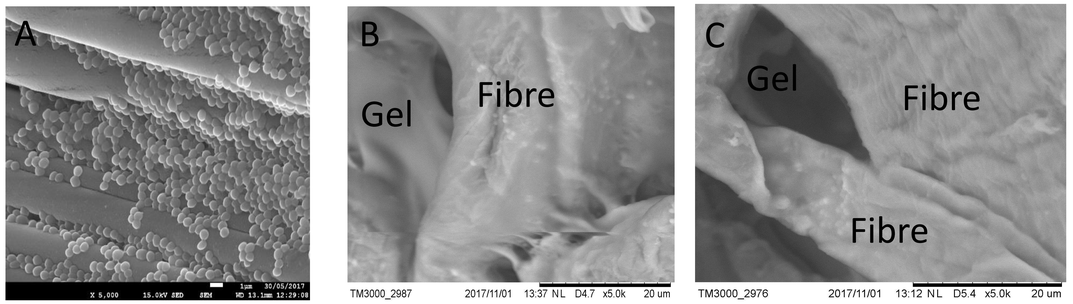

Figure 2. Scanning electron micrographs of NA Gauze (A), HydroClean (B) and HydroClean plus (C) exposed to a *Staphylococcus aureus* inoculum for 24 hours.

Discussion

Biofilm material within chronic wounds can result in difficult to treat infections and non-healing wounds.

Viable material was recovered from the inner core of the dressing but minimal organisms were visible using SEM microscopy. This suggests that the bulk of the sequestered bacteria were contained within the gelling agents of the dressing.

Treatments that sequester bacteria within the dressing present a reduced risk of wound bed recontamination resulting from the dressing core. Treatments capable of disrupting biofilms may improve healing by reducing triggers for persistent inflammation and thus supporting the wound to continue on the healing trajectory.

Conclusions

HydroClean® and HydroClean® plus disrupted pre-formed *S. aureus* biofilms and sequestered bacteria within the dressing core.

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