Abstract

Data collection for the Centers for Disease Control guidelines for the prevention of catheter related bloodstream infection concluded in 2008. At approximately the same time, 3M™ Tegaderm™ Chlorhexidine Gluconate (CHG) Securement Dressing was released for clinical use.

During the 6 year period of use,

• In vitro experimentation demonstrates the ability to kill pathogens known to cause catheter related bloodstream infections.
• Ex vivo experiments illustrate the ability of the dressing to reduce *S. aureus* biofilm formation.
• Clinical studies demonstrate reductions in catheter colonization and catheter related bloodstream infections (CRBSI).

Objectives

• Provide chlorhexidine gluconate sufficient to kill known pathogens causing CRBSI.
• Prevent, remove or reduce bacterial biofilm.
• Investigate utility in reducing catheter related bloodstream infections in randomized clinical trials.

Methods

• Zone of inhibition method used to assess in vitro bactericidal activity.
• De-identified, fresh, full-thickness, ex vivo human skin used for biofilm analysis.
• Randomized clinical trials in different countries used to assess effect on catheter colonization and CRBSI rates.

Results

• Antibiotic sensitive and antibiotic resistant organisms demonstrate bactericidal effect typical of CHG effect in zone of inhibition testing.
• Biofilm production by methicillin resistant *Staphylococcus aureus* (MRSA) is reduced with significant quantitative reduction in recovered organisms.
• In clinical use, catheter colonization and CRBSI are reduced when a CHG dressing is used compared to a non-CHG dressing.

Conclusions

• CHG release from the gel pad kills known pathogens in vitro, including antibiotic resistant organisms.
• Unique tissue models demonstrate the ability of the gel pad to reduce biofilm formation by *S. aureus*.
• Catheter colonization rates are reduced significantly in clinical trials in patients receiving CHG dressings.
• CRBSI rates are reduced significantly in clinical trials in patients receiving CHG dressings.

References

*vide infra*
Biofilm reduction and Clinical effect of Chlorhexidine Gluconate (CHG) gel pad dressing

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Methods

ZONES OF INHIBITION (mm)

Suspensions of microorganisms (~10^8 colony forming units per milliliter) were prepared in sterile Butterfield's phosphate buffered water from overnight growth plates. Mueller-Hinton agar plates were uniformly inoculated with the test microorganism. Die-cut 24 mm gel disks from 3M™ Tegaderm™ CHG dressings were placed onto the agar surface. Duplicate samples were prepared for each microorganism. After overnight incubation at 35 +/- 2 °C, the diameter of the zone of inhibition (left image, below) was measured in millimeters.

Results

Gram positive bacteria (blue, middle image), Gram negative bacteria (red, middle image) and Candida species (green, middle image) killed by CHG gel pad. Kill rate sustained for at least 10 days (right image).

Reference

Hensler JP, Schwab DL, Olson LK, and Palka-Santini M. Growth inhibition of microorganisms involved in catheter related infections by an antimicrobial transparent IV dressing containing chlorhexidine gluconate (CHG) , ECCMID Helsinki (2009)
Biofilm reduction and Clinical effect of Chlorhexidine Gluconate (CHG) gel pad dressing
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Results
Fresh, full-thickness, ex vivo skin was used to develop a unique living tissue biofilm model. Biofilm reduction was noted with the CHG gel pad but not with the gel pad lacking CHG or with aqueous CHG (center image upper frames). Fewer organisms were recovered after vortexing using the gel pad compared to placebo or aqueous CHG (middle image lower frame).

The epidermal tissue remained free of organisms with the CHG gel pad (haematoxylin and eosin stain, 100x magnification, right image).

Methods:
Explants of normal human skin (~ 5 mm², full-thickness stratified, keratinized, squamous epithelium; obtained from University of Minnesota Biological Materials Procurement Network; Institutional Review Board exempt status), were infected with biofilm-producing MRSA (Xen30) at ~2x10⁶ cfu or left untreated and incubated at 37° C for 24-96 h. Following infection and microcolony development (72 h), explants were treated with the active dressing (3M™ Tegaderm™ CHG), placebo dressing (without CHG) or aqueous CHG (2%) for 24 h or left untreated. Formation of MRSA biofilm was evaluated by confocal microscopy and LIVE/DEAD staining (Molecular Probes / Invitrogen™). CFU were enumerated from infected explants following neutralization by vortex mixing, then serial dilution and plating.

A recently published paper (2014) performed a meta-analysis of published articles to assess the efficacy of a CHG-impregnated dressing for prevention of central venous catheter–related colonization and CRBSI. The authors concluded that a CHG-impregnated dressing is beneficial in preventing catheter colonization and, more importantly, CRBSI, and warrants routine use in patients at high risk of CRBSI and central venous catheter or arterial catheter colonization.

Prevalence of catheter colonization:
361 of 5,281 catheters (6.8%) were colonized in the CHG group compared with 743 of 5,200 (14.3%) in the comparator group. The CHG-impregnated dressing was associated with an RR of 0.52 (95% CI, 0.43–0.64; p < 0.001) as illustrated in the forest plot below (left).

Prevalence of CRBSI:
64 of 5,639 patients (1.1%) developed CRBSI in the CHG group compared with 120 of 5,608 (2.1%) in the comparator group. The CHG-impregnated dressing was associated with an RR of 0.52 (95% CI, 0.43–0.64; p < 0.001) as illustrated in the forest plot below (right).