Conclusion

The CDC recommends the use of CHG on the skin before and after placement of a central venous catheter as part of a strategy to reduce CRBSIs. In this study, the CHG polyurethane foam disk provided better transfer of CHG to the porcine skin samples than did the CHG hydrogel pad. This more efficient coverage of CHG is thought to be attributed to greater intimate contact between the skin and the CHG polyurethane foam disk. Products that transfer CHG to the skin have been shown to reduce skin bacterial counts, reduce catheter colonization, and reduce CRBSIs.

References

10. Ryder M, Bambrot J. Improving skin antiseptic: 2% No-Rinse CHG Cloths improve antiseptic persistance on patient skin over 4%. CHG Rinse-Off Solution. Poster presented at: Annual Congress of the Association for Professionals in Infection Control and Epidemiology; June 2007; San Jose, CA.
Introduction

Bloodstream infections associated with central vascular access are a common complication, occurring at a rate of up to 1.8 infections per 1000 catheter days. Catheter-related bloodstream infections (CRBSIs) are associated with a mortality rate of 51% in ICU (intensive care unit) patients compared with a rate of 28% in patients without a CRBSI. CRBSIs not only increase morbidity and mortality rates but also contribute significantly to medical care costs, which are reported to range from $11,971 to $56,000 per infection. The Centers for Disease Control and Prevention (CDC) have reported to range from $11,971 to $56,000 per infection.

The use of a foam disk with CHG was shown to reduce the microbial colonization of epidural catheters (P = 0.001) patients who used a foam disk with CHG compared with a control occlusive dressing (P = 0.0003). Mann et al13 found that bacterial colonization at an epidural site corresponded with areas where CHG transferred from the device to the surrounding skin.8 Whereas bacterial colonization of central venous catheters is common, any breach in the skin, such as that caused by catheter insertion, increases the risk of infection; the risk is related to the bacterial colonization of the devices and the surrounding skin.9 Whereas an initial cleansing of the skin with CHG or povidone iodine lowers bacterial counts, one cleansing of the skin is not adequate to maintain lower skin bacterial counts over time, because bacterial counts quickly return to normal after the antiseptic is no longer present.10 Thus, persistent residual action of an antiseptic is needed to maintain lower bacterial counts on the skin.

Methods

This study explored CHG transfer to porcine skin samples with 2 different devices. All Experiments were run at ETHICON, Inc. in Somerville, NJ.

Porcine skin samples were cut into 2-inch squares, rinsed to remove debris and surfactant present from the harvesting process, and placed in petri dishes on 2-inch pieces of towel saturated with buffered saline to maintain moisture during incubation.7

A 1.5-mm biopsy punch was used to make a hole in the porcine skin to accommodate insertion of a catheter tube (PowerPICC™ Solo Catheter; Bard Access Systems, Salt Lake City, UT). The openings were made in the center of the porcine samples for the foam disk with CHG and 1 cm from the edge for the hydrogel pad with CHG. The catheters were inserted into the porcine samples, and either a CHG polyurethane foam disk or a CHG hydrogel pad was applied. Each device was applied according to the Instructions for Use documents provided with the device. The samples were inspected to ensure a complete seal on the porcine skin, placed into zip-seal bags containing towels saturated with deionized water, and incubated at 30° C for 24 hours.

After incubation, the samples were removed from the bags, and the dressing materials and catheters were removed from the porcine samples and discarded. A 10-mL aliquot of freshly prepared staining agent (sodium hypobromite solution; 7.8651 g of bromine in 10,042 g of sodium hydroxide in 100 mL of deionized water) was then placed on the surface of the porcine skin and allowed to oxidize for 30 seconds. Chlorhexidine oxidizes in the presence of sodium hypobromite and forms a red-orange stain.

The porcine samples were photographed immediately after the 30-second oxidation period. The photographs were compared to determine skin transfer of CHG with the 2 different delivery devices.

Results

Comparison of the photographs of the skin samples before and after staining showed that CHG transferred to the skin only in areas where intimate contact between the skin and the CHG device was maintained. The porcine samples with the foam disk with CHG in place and the subsequent staining pattern are shown in Figure 1. Porcine samples with the hydrogel foam pad in place and the subsequent staining pattern are shown in Figure 2.

Discussion

Bacterial colonization of central venous catheters is common. Any breach in the skin, such as that caused by catheter insertion, increases the risk of infection; the risk is related to the bacterial colonization of the devices and the surrounding skin.9 Whereas an initial cleansing of the skin with CHG or povidone iodine lowers bacterial counts, one cleansing of the skin is not adequate to maintain lower skin bacterial counts over time, because bacterial counts quickly return to normal after the antiseptic is no longer present.10 Thus, persistent residual action of an antiseptic is needed to maintain lower bacterial counts on the skin.

Chlorhexidine gluconate (CHG; C22H30Cl2N10·2C6H12O7) is a commonly used skin antiseptic that disrupts microbial cell membranes and is effective against a broad spectrum of microbes.9 Furthermore, CHG is not affected by organic matter (e.g., blood), binds to the skin, and remains active for at least 6 hours.4

In the present study, we evaluated the properties of CHG transfer to the skin by 2 different devices: a foam disk with CHG (BIOPATCH™; ETHICON Inc., a Johnson & Johnson Company, Somerville, NJ) and a hydrogel pad with CHG (Tegaderm™ CHG; 3M™ Health Care, St Paul, MN).

Studies of CHG application suggest that residual amounts of CHG increase with increasing CHG contact. A study in 24 subjects that compared residual amounts of CHG after the use of a CHG no-rinse cloth and the use of a 4% CHG solution (which was rinsed off) showed that the amount of CHG residual directly correlated with the number of 2% CHG cloths used (P = 0.0003), but not with the amount of 4% CHG solution used.11 Similar results were found in a study by Edmiston et al11, in which 70 subjects cleansed their skin with either a 4% CHG solution or a 2% no-rinse cloth. Residual amounts of CHG were significantly higher at all anatomic sites in the subjects who used the 2% no-rinse CHG cloths than in those who used a 4% CHG solution (P = 0.003 to P = 0.0001). Edmiston et al11 note that optimal skin asepsis is affected by contact time, CHG concentration, and when a valid standardized protocol is used.

The use of CHG-containing devices appears to lower skin bacterial counts and reduce colonization of the device. Bhide and Rothenberg4 found that the foam disk with CHG had excellent antimicrobial activity and sustained efficacy over a period of seven days. Mann et al11 found that bacterial colonization at an epidural site developed in significantly fewer (P = 0.001) patients who used a foam disk with CHG (3.45%) than in patients who used a control occlusive film dressing (42%).

The use of a foam disk with CHG was shown to reduce the microbial colonization of epidural catheters (P = 0.0006). The use of a foam disk with CHG was also associated with fewer CRBSIs than was the use of a control film dressing in adult patients with a central vascular access line (relative risk: 0.38; 95% confidence interval: 0.16-0.89).12 The addition of foam disk with CHG dressings to the bundle of other guideline-driven recommendations for CRBSI prevention led to a reduction in CRBSIs from 3.1 per 1000 catheter days to 0 per 1000 catheter days.13

The observed reductions in bacterial counts and in CRBSI rates may be due to the ability of the dressing to transfer CHG onto the skin. In this study, staining patterns observed on the porcine samples corresponded with areas where CHG transferred from the device to the porcine skin sample. The difference in the patterns indicates that CHG only transfers onto the skin in areas where intimate skin contact is maintained with the device. The design of the foam disk with CHG allowed circumferential coverage and maintained skin contact throughout the 24-hour incubation period. The comparator, the hydrogel pad with CHG, provided less CHG transfer because it did not provide circumferential coverage (the pad is placed on top of the catheter) and did not have as much intimate contact with the skin at the catheter insertion site. It is not possible to make conclusive statements about the comparative clinical benefits of the 2 devices based on a qualitative ex vivo study that did not measure bacterial counts on the skin.