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Major article

Hospital-acquired infections and thermally injured patients: Chlorhexidine gluconate baths work

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Background: Thermally injured patients are at high risk for infections, including hospital acquired infections (HAIs). We modeled a twice-daily chlorhexidine gluconate (CHG) bath protocol aimed at decreasing HAIs.

Methods: Bathing with a 0.9% CHG solution in sterile water was provided twice daily as part of routine care. Institutional HAI prevention bundles were in place and did not change during the study. Baseline HAI rates were collected for 12 months before the quality study implementation. Centers for Disease Control and Prevention definitions for HAIs were used; our blinded Infection Control physician made each determination. This was an Institutional Review Board–exempt protocol.

Results: The study cohort included 203 patients before the quality trial and 277 patients after the quality trial. The median burn area was 25% of total body surface area. Baseline HAI rates were as follows: ventilator-associated pneumonia, 2.2 cases/1,000 ventilator-days; cathether-associated urinary tract infection, 2.7 cases/1,000 catheter-days; central line–associated bloodstream infection, 1.4 cases/1,000 device-days. With implementation of this protocol, the rates dropped to zero and have stayed at that level with the exception of 1 cathether-associated urinary tract infection. There were no untoward effects or observed delays in wound healing with this protocol. All of these changes were clinically significant, although not statistically significant; the study was not powered for statistical significance.

Conclusions: Using this nurse-driven protocol, we decreased, in a sustainable manner, the HAI rate in our intensive care unit to zero. No integumentary difficulties or wound healing delays were related to this protocol.

Thermal injury (TI), one of the most severe traumatic injuries that a human can survive, results in approximately 40,000 hospital admissions yearly, 25,000 of which are to specialized burn centers. In 38% of cases, the burns exceed 10% of total body surface area (TBSA), and in 10% of cases, the burns exceed 30% of TBSA. Some 70% of affected patients are male. Causes of TI include fire (46%), scalding (32%), contact with a hot object (8%), electrical injuries (4%), and chemical burns (3%). TI has systemic effects, with each organ system responding in a predictable manner proportional to the TBSA involvement.[1]

Immunologic function, both cellular and humoral, is degraded in patients with TI as TBSA involvement increases.[2-4] These patients are at risk for hospital-acquired infections (HAIs),[5-7] including central line–associated bloodstream infection (CLABSI), ventilator-associated pneumonia (VAP), and catheter-associated urinary tract infection (CAUTI), in addition to burn wound infection. Macrophages, T cells, other lymphocyte subpopulations, and humoral factors, such as opsonins, immunoglobulins, protease inhibitors, and chemotactic factors, are implicated in the process.

The use of standard prevention bundles for CLABSI, VAP, and CAUTI in our burn center has led to improvements in, but not elimination of, HAIs. In the present study, we evaluated the use of a nurse- and physician-developed chlorhexidine gluconate (CHG) bathing protocol in conjunction with the standard prevention

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At the time that this project was carried out, A.J.L. was Division Chief, Critical Care Medicine and Associate Director of the Burn Center, Shands Hospital.

Conflict of interest: None to report.

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Table 1
Bundles implemented before and maintained during the quality trial

Bundle	Description
VAP bundle	Every 4-hour mouth care including CHG alternating with nystatin swish and swallow, deep vein thrombosis prophylaxis, appropriate stress ulcer prophylaxis, head of bed elevation, subglottic aspiration, sedation, and ventilator weaning protocols
Central line bundle	Use of full surgical drape and gowning/gloving, CHG skin preparation, use of subclavian or internal jugular venous sites instead of the femoral vein whenever possible, line removal as soon as possible, strict glucose control with insulin protocol, covering of insertion sites with antimicrobial dressing, and use of antibiotic-coated catheters
CAUTI bundle	Standard nursing quality protocol directed the care of the device before and during this trial, including using of silver-coated catheters, maintaining a sealed urinary drainage system, keeping the bag dependent, using a leg-fixation device to minimize urethral trauma, questioning the need for an indwelling bladder catheter each day, and removing the device as soon as possible

bundles in an attempt to decrease HAIs in our burn population. Previous work in nonthermal injuries suggests that daily bathing with CHG decreases bloodstream infections and vancomycin-resistant enterococci[8-10]; to the best of our knowledge, there are no published data on this protocol in burns.

MATERIALS AND METHODS

The Burn Center of Shands Hospital at University of Florida Health is an 8-bed unit that admits approximately 500 burn patients annually, one-half to the burn ICU. The average TBSA of the burns is approximated 8%, similar to national figures. The unit is staffed by full-time burn surgeons, a stable nursing staff, and intensivists providing care in collaboration with the center's staff.

A multidisciplinary team composed of infection control professionals, burn center nurses, and the physicians caring for the patients with TI reviewed the literature and were intrigued by the limited data suggesting that the use of CHG baths decreased the rate of bloodstream infections.[1,2,8-10] We initially had some concerns that the application of CHG, which is not recommended for use on mucous membranes, might further injure already compromised skin[11]; however, we determined that the benefits would be significant if this quality project was successful and thus proceeded with this intervention.

Protocol

The aim of this project was to evaluate the use of dilute CHG solution baths in preventing HAIs. Our standard protocols and bundles* were not changed, and no other interventions were implemented during the study period. After collecting baseline HAI data for 13 months (January 2010 through January 2011) as part of our routine quality monitoring program, we instituted a new bathing protocol for our patients with TI beginning in February 2011.

The bathing protocol for our adults with TI was changed from twice daily with soap and water to twice daily with an ~0.9% CHG solution.† The entire body, with the exception of the face and eyes but including the perineum and genital area, was bathed and rinsed. The CHG solution was not allowed to dry before rinsing; the sole protocol change was the addition of CHG. Because this was a bedside "mini-debridement," appropriate analgesia was used.

The median TBSA involved was 25% deep partial-thickness/full-thickness burns. All HAIs were identified by the physician practitioner who directs our institution's Infection Control office; definitions used were those of the Centers for Disease Control and Prevention.[12]

This quality protocol was exempted by our Institutional Review Board, which limits the information that we collected and present herein. We evaluated a clinically significant outcome and did not power the study to detect statistical significance.

Table 2
Statistical analysis of the pre- and post-quality trial infections

Infection	Pre-quality trial cases (n = 203)*	Post-quality trial cases (n = 277)	*P* value
CAUTI, n (%)	4 (2.0)	1 (0.4)	.17
CLABSI, n (%)	2 (1.0)	0 (0)	.18
VAP, n (%)	3 (1.5)	0 (0)	.08

*n / N (%).

Statistical analysis

CAUTI, CLABSI, and VAP cases were compared between the pre-trial and post-trial periods using Fisher's exact test. We hypothesized that the use of the twice-daily CHG baths would decrease HAIs while producing no untoward skin/wound effects.

RESULTS

There were 203 patients in the pre-quality trial group and 277 patients in the post-trial group, cared for over the 17-month period of the quality trial. These were unwell individuals, with a 2%-85% TBSA deep-partial and full-thickness TI; 40% received mechanical ventilation, 68% had an indwelling bladder catheter, and all had a central venous catheters. There were no noted differences in Burn Center demographics, protocol use, antimicrobial use, nor wound healing in the prestudy, intrastudy, and poststudy periods.

Baseline HAI rates were as follows: VAP, 2.2 cases/1,000 ventilator-days; CAUTI, 2.7 cases/1,000 catheter-days; CLABSI, 1.4 cases/1,000 central catheter-days. Standard bundles for the prevention of HAIs were used both before and during the quality trial (Table 1). Table 2 presents the number and frequency of each type of case stratified by observation period, along with the corresponding *P* value before and after implementation of the bathing protocol.

Our nursing staff used this dilute CHG solution on the patient's entire body including the perineum, except the face. There were no integumentary complications, as has been reported previously in patients without TI.[3] Over the initial 17 months since the start of the trial, no VAPs, CAUTIs, or CLABSIs were reported (Fig 1). From the end of the study through June 2013, these results have been sustained, with the exception of 1 case of CAUTI.

DISCUSSION

Control of HAIs is the most basic component of hospital quality. Although quality improvement has not spread across the health care landscape as rapidly as desired, the use of care bundles has led to improved outcomes and care practices.[13] Burn patients are at particularly high risk for infectious complications.[5-7] Previous studies have strongly suggested that daily bathing with CHG can decrease bloodstream infections and vancomycin-resistant enterococci.[8-10,14]

* CAUTI bundle: http://app.ihi.org/imap/tool/imap.html. CLABSI bundle: http://www.ihi.org/knowledge/Pages/Changes/ImplementtheCentralLineBundle.aspx. VAP bundle: http://www.ihi.org/knowledge/Pages/Changes/ImplementtheVentilatorBundle.aspx.

† 236 mL of 4% CHG solution (Hibiclens) in 1,000 mL of sterile water.