The Use of 3.15% Chlorhexidine Gluconate/70% Alcohol Hub Disinfection to Prevent Central Line-Associated Bloodstream Infections in Dialysis Patients

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Highlights

- Using alcohol with CHG before accessing central line hubs helps reduce CLABSI events.
- Using alcohol with CHG before accessing vascular grafts helps reduce CLABSI events.
- A statistically significant reduction (65%) in CLABSI events occurred after use.
- Statistically significant lower CLABSI rates are sustainable with use of alcohol with CHG.

Abstract

Purpose: Preventing central line-associated bloodstream infection (CLABSI) events in the dialysis inpatient population represents significant challenges. Bacteremia associated with lines or grafts are common health-associated infections that lead to adverse patient outcomes. Dialysis patients represent a much higher infection risk due to health frequency needs, more frequent hospitalizations, multiple comorbidity issues, fistula functionality, and multiple attempts for line access leading to additional complications, costs, morbidity, and mortality.

Methods: An observational study was conducted including central line device days, CLABSI events, and possible confounding variables in admitted dialysis patients. All CLABSI data were identified according to the Centers for Disease Control and Prevention's National Healthcare Safety Network's definitions for CLABSIs. The

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intervention involved the removal of 70% alcohol swabs and alcohol hub disinfecting caps, then replacing with swabs containing 3.15% chlorhexidine gluconate/70% alcohol for central line hub disinfection and vascular graft access skin disinfection.
Results: The 5-year preintervention period (2008–2012) involved 7568 central line days, 11 CLABSI events, and a 1.45 per 1000 device day rate. The 6-month trial period involved 1559 central line days and no CLABSI events. The 5-year postimplementation period (2013–2017) involved 9787 central line days, 5 CLABSI events, and a 0.51 per 1000 device day rate. The postimplementation period represented a statistically significant (*P* value = 0.0493) reduction with 65% fewer CLABSI events compared with the preimplementation period.
Limitations: A limitation was variations in scrub time and dry time during central venous catheter hub access. While we were comparing 2 products, behavioral practices using these 2 products were possible influencers and represent a possible confounding variable.
Conclusions: This study found that using alcohol with chlorhexidine gluconate prior to accessing central line hubs and vascular grafts allows for reduction in CLABSI events and sustains statistically significant lower CLABSI rates in the inpatient dialysis population.

Keywords: alcohol chlorhexidine gluconate, swab, dialysis, CLABSI, disinfection

Introduction

Central line-associated bloodstream infections (CLABSIs) result in thousands of deaths yearly that are preventable and that lead to billions of dollars in additional health care costs in the United States.[1] Although central lines are important in treating many medical conditions, there is an innate infection risk associated with each use (environmental, mechanical, and intrinsic). Central lines are widely used in the chest, neck, groin, or arm to give fluids, blood, and various medications. These devices can remain in place for days, weeks, or months. Frequency of use varies greatly because some patients may require lines accessed infrequently, while others may have lines accessed multiple times daily.

Preventing CLABSI events in the dialysis inpatient population represents significant challenges. Bacteremia associated with lines or grafts is a common cause of health care-associated infections (HAIs) that lead to adverse patient outcomes. Dialysis patients have a much higher infection risk associated with additional complications, costs, morbidity, and mortality due to frequent contact with the medical community, multiple comorbidity issues, more frequent hospitalizations, fistula functionality, and repeated line access.

The primary objective of this study was to evaluate the effectiveness of using chlorhexidine gluconate (CHG)/alcohol device swabs, compared with using alcohol-only swabs in combination with alcohol disinfecting caps, as evidenced by the effects on CLABSIs in dialysis patients.

Methods

Study Design

Quasi-experimental. This is a retrospective lookback of CLABSI data before and after substitution of CHG/alcohol device swabs. Alcohol-only device swabs and alcohol device caps used on central line ports prior to access were removed. Alcohol device caps were utilized during the preintervention period from 2011 to 2012. All CLABSI data have been identified according to the Centers for Disease Control and Prevention's National Healthcare Safety Network definitions for central line-associated bloodstream infections.

Study Population

The study involved deidentified dialysis inpatients and publicly reported data from a large community hospital's dialysis floor. The University of North Carolina Health System Institutional Review Board served as the central institutional review board for the trial.

Statistical Analysis

The Centers for Disease Control and Prevention's National Healthcare Safety Network's statistical calculator was utilized. This program compared 2 incidence density rates by performing a statistical test that also calculated a *P* value.

Results

The 5-year preintervention period (2008–2012) involved 7568 central line days, 11 CLABSI events, and a 1.45 per 1000 device day rate. A 6-month trial period was implemented, which involved 1559 central line days and no CLABSI events. The 5-year postimplementation period (2013–2017) involved 9787 central line days, 5 CLABSI events, and a 0.51 per 1000 device day rate.

The overall yearly CLABSI rate (Table) identifies the downward trend of overall CLABSI events and longest time between infections during the study period. The postimplementation period represented a statistically significant (*P* value = 0.0493)[2] reduction with 65% fewer CLABSI events compared with the preimplementation period.

Discussion

To prevent CLABSIs, several key challenges exist. Care and maintenance of central lines involve necessary precautions and processes that take time, have associated increased costs, and can also become burdensome for both staff and patients while

Table. **Dialysis Unit CLABSI Events Using the Centers for Disease Control National Healthcare Safety Network Incidence Density Rate Statistical Calculator**

Dialysis patient population	Preintervention, 2008 to 2012	Postintervention, 2013 to 2017
Number of infections (CLABSIs) dialysis unit	11	5
Number of device days dialysis unit	7568	9787
Incidence density rate	0.015	0.005
P value	0.0493	
Longest time frame between infections	26 months, October 2013 to November 2015, postintervention period	

interfering with daily activities of life. Although this research primarily involves the hub contamination, other influencing factors can have a large role relating to infection, for example, the risks associated with access such as technique, maintenance, necessary time required to swab the hub, and dry time allotted.

The 70% alcohol-only swabs used in the preintervention period are most commonly used across the health care spectrum. Alcohol swabs are effective, are easy to use, and can quickly kill many pathogens that contribute to CLABSI. Opportunities for improvement involve appropriate use, persistency, size, and chemical composition. When accessing central line catheters, common practice for hub disinfection involves the use of alcohol-only swabs. Alcohol concentrations between 60% and 90% are extremely effective at killing microbes immediately, yet lack residual killing effect as with CHG, which provides high immediate, persistent, and residual microbial killing effect.[3,4] To provide better residual activity, concentrations of CHG can be added to alcohol-based preparations. The combination of alcohol and CHG provides powerful antibacterial activity effectively reducing bacterial counts, while providing substantial residual activity.[5]

Infection control breaches can easily occur on the hub while using a small disinfectant wipe. The typical 70% alcohol swab frequently used to clean central line hubs is very small (just over 1 inch). It can be difficult to wipe the surface of a central line hub properly without an infection control breach occurring (i.e., not wiping hub surface completely, long enough, or contaminating hub with finger before, during, and after wiping with hand manipulations).

Alcohol swab product size may inadvertently influence infections. The smaller-sized swab utilized in the preintervention period potentially increased the risk of hub contamination by finger manipulation during the disinfection stage. The larger-sized swab utilized during the postimplementation period covered more surface of the fingers allowing for less potential contamination during the disinfection process, and has greater surface drag to potentially remove more microbes. The strategy of using CHG 3.15%/70% alcohol on a larger-sized swab (approximately 3.125 by 1.125 inch) may help prevent certain central line infections due to the initial and persistent microbial killing effect it has on the hub of the central line and the reduction of inadvertent contamination associated with a larger swab size. A larger-sized swab may also help reduce the risk of finger/hub exposure and the contamination that occurs with organisms located on the fingers.

The swab solution volume of the 2 separate swabs could also play a contributing confounding role. The alcohol-only swab contained far less fluid volume (0.0006762805 fluid ounce) than the alcohol/CHG swab, which contained 1 mL (0.034 fluid ounce).

Alcohol disinfectant caps utilized on line central line hubs during part of the preintervention period posed a few challenges. Although the usage of caps was validated in greater than 95% of the population during the prephase, there were several occasions involving improper manipulation of the disinfectant caps by patients. The bright-colored caps stood out and seemed to help create a special interest for patients resulting in increased manipulation, improper handling, dropping on dirty surfaces and floors, and sucking as with a candy, resulting in drying out and unwanted replacement of the hub surface.

Hand hygiene has been well proven to play a vital role in the transmission of infectious agents. The Centers for Disease Control and Prevention acknowledges the impact hand hygiene practices can have on HAIs, calling it the number 1 influencer. Hand hygiene during the pre- and postphase periods was reviewed and showed variations of increases and decreases each month. Correlations with CLABSI events were not identified relating to fluctuations.

Limitations

1. Variations in scrub time and dry time during central venous catheter hub access. While we were comparing 2 products, behavioral practices using these 2 products were possible influencers and represent a possible confounding variable.
2. To make a true comparison, alcohol swabs with equal size and volume of solution to compare against the alcohol/CHG swab would have been ideal.
3. Internal disease processes that could influence CLABSI surveillance pose a different kind of challenge. Infections that cannot be proven, but may be suspected, could easily mask the true nature of a disease.

Conclusions and Areas for Future Research

This study found that using 70% alcohol with 3.15% CHG for central line hub disinfection, with a larger-sized swab prior to access, makes it possible to achieve the goal of reducing CLABSI events while sustaining statistically significant lower CLABSI rates. CLABSI events were not completely eliminated and continued to take place, but at decreased frequencies. Special consideration should be given to strategies that improve care by focusing on line antisepsis, personal technique habits, better education methods, and adherence to appropriate line care. Early detection of all unnecessary lines with an emphasis on timely removal is also an important element identified with this research to help reduce the number of HAIs.

In order to completely achieve and sustain zero CLABSI events, additional research is warranted. Additional studies not looked at in this research that could prove beneficial involve the influence of swab size and disinfectant volume on CLABSI when using the same chemical composition.

Disclosures

The authors have no conflict of interest to disclose.

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