Burn-care in Practice

The impact of antibiotic impregnated PICC lines on the incidence of bacteremia in a regional burn center

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ABSTRACT

Introduction: Peripherally inserted central catheters (PICCs) have been used increasingly in burn patients who often have decreased intravascular volumes and obtaining intravascular access for resuscitative efforts can be difficult. A potentially serious complication is bloodstream infection. The purpose of our study is to examine the impact of antibiotic impregnated PICC lines on the bacteremia rate in a regional burn center.

Methods: Consecutive patients admitted to the burn unit and receiving an antibiotic impregnated PICC line were included in the study. Baseline demographics and bacteremia rate was recorded. A retrospective chart review was then undertaken of the 30 consecutive patients admitted to the burn unit and receiving a PICC line prior to the study period.

Results: Nineteen patients were enrolled over the two-year period. The bacteremia rate for the study group was 0% compared to the 50% bacteremia rate of the retrospective control group (p < 0.001).

Conclusion: Antibiotic impregnated PICC lines decrease the bacteremia rate in our burn population. This has potential benefits for both patient morbidity and mortality as well as potential cost savings for the healthcare system.

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1. Introduction

Peripheral inserted central catheters (PICCs) have been used increasingly in critically ill populations. This is especially true for patients with burns who often have decreased intravascular volumes and obtaining intravascular access for resuscitation can be difficult. PICCs provide an invaluable crystalloid delivery modality during resuscitation. However, PICC lines are not without complications. A potentially serious complication is bloodstream infection. Previous studies have found the incidence of bloodstream infections in intensive care unit patients range from 5 to 8% [1,2]. Additional studies have shown bloodstream infection rates as high as 49% in burn intensive care units [3]. Despite these studies there remains a paucity of studies exploring the incidence of bloodstream infection in the burn population.

Recently, the West Michigan Regional Burn Center (WMRBC) Quality Initiative committee retrospectively examined the incidence of blood stream infections in its burn
population. The committee examined 30 consecutive patients and found an alarming 50% bacteremia rate [4]. Because of the high rate of bacteremia in our burn patients with PICC lines, the decision was made to begin using antibiotic impregnated PICCs in our burn unit. The potential health benefits to patients as well as cost benefits to the healthcare system were the impetus for the change. The purpose of this study is to prospectively evaluate the effectiveness in decreasing the incidence of bacteremia in patients affected with burns by instituting antibiotic-impregnated PICC lines.

2. Methods

An institutional review board approved prospective observational study of patients consecutively admitted to a regional burn center over a two-year period was conducted. All patients receiving an antibiotic-impregnated (minocycline/rifampin) PICC (Spectrum Turboject, Cook Medical, Bloomington, IN) were included in the study. All patients admitted to the burn unit during the study period requiring a PICC line received an antibiotic impregnated PICC line.

Baseline demographics and co-morbidities were recorded. All blood cultures, antibiotic use, chemotherapeutic use and steroid use was noted. Duration of PICC placement and presence of burn wound infection also recorded. Unfortunately, the date of PICC line removal was not well documented in the retrospective cohort and therefore the infection rate per thousand line days was unable to be calculated for that group.

All PICCs were inserted using standard sterile technique by the interventional radiologist. No changes in patient care or in PICC care occurred during the study period compared to the non-antibiotic PICC cohort. The indications for PICC placement (i.e. large volume resuscitation, difficulty in peripheral access, and need for long-term central access) did not change from pre-intervention period. Upon admission to the burn unit the patients had central venous catheters (CVC) placed. At hospital day 3 patients had the CVCs removed and PICC lines placed. This protocol was standard for both the pre-intervention and post-intervention periods. The Centers for Disease Control and Prevention criteria was used to determine if a patient had bacteremia, defined as “a primary bloodstream infection in a patient that had a central line within the 48 h period before the development of the blood stream infection and is not related to a bloodstream infection at another site [5].”

The historical control group consisted of 30 consecutive burn patients admitted to the burn unit prior to introduction of the antibiotic impregnated PICC lines. Baseline demographics of the control group were recorded in a similar fashion as the study groups’. The technique used for PICC line insertion did not change over the study period.

Statistical analysis of the data was conducted with the Statistical Package for the Social Sciences Windows version 14.0 (SPSS). Chi-squared test, independent t test, Levene’s test for equality of variances, Fisher’s exact test, logistic regression, and Pearson’s coefficient were used. Significance was assessed at p < 0.05.

3. Results

3.1. Study group

Nineteen patients were enrolled in the study over the two-year period. None of the patients experienced PICC related bacteremia. Four (21%) patients had diabetes, and four had COPD (21%). Only four (21%) patients had no prior medical problems. Mean BMI was 28.25 (16–49), and mean age was 11–82 (46.10). Three patients were on oral steroids and one patient was taking metothexate for renal transplant antirejection. Average TBSA percent burn was 18.3% (5–50%). Four patients had burn wound infections. Eight patients had prophylactic antibiotics. Two patients had pneumonia. No mortalities occurred during this study. Mean duration of PICC placement was 18.2 days. These patients had a total of 375 catheter days. The bacterial flora isolated was most commonly Pseudomonas (20%), followed by Staphylococcus epidermidis (13%), Staphylococcus aureus (13%), Klebsiella (7%), E. coli (7%), Serratia (3%), and Proteus (3%).

3.2. Control group

Prior to the start of our study we retrospectively examined the previous 30 burn patients with non-antibiotic impregnated PICCs. Average percent TBSA burn in this group was 31.1%. The overall bacteremia rate in this control group was 50% (15/30). Examining these data further a correlation was found between percent total body surface area (TBSA) of the burn and the incidence of bacteremia. For patients with <20% TBSA burns the bacteremia rate was 23.5%, whereas the bacteremia rate for patients with >20% TBSA burns the bacteremia rate increased to 84.6%. Average length of PICC placement was 14.1 days. Average number of PICCs was 3.5 (1–21). Demographics

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<th>Table 2 – Bacteremia by %TBSA: two tails fisher exact probability (sig = p &lt; 0.05).</th>
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are listed in Table 1. There were no mortalities in the control group.

3.3. Comparison

Compared to the study group the control group had a significantly higher bacteremia rate 0% versus 50% \((p < 0.001)\). Because the control group had a higher mean %TBSA burn \((31.1\% \text{ versus } 18.3\%, p = 0.048)\), the control group was further analyzed by comparing bacteremia rates for patients with >20% TBSA burns and <20% TBSA burns to the study group. Not surprisingly, the group with >20% TBSA burns had a significantly higher bacteremia rate \((0\% \text{ vs } 84.6\%, p < 0.001)\). The control group with <20% TBSA burns also had a significantly higher rate of bacteremia \((0\% \text{ vs } 23.5\%, p = 0.04)\) (Table 2 and Fig. 1). Of note, neither group experienced PICC-related thrombophlebitis.

4. Discussion

Recent studies have found that antibiotic-impregnated PICC lines are five times more effective in decreasing catheter-related bloodstream infections than maximal sterile barrier alone [6]. According to manufacturer studies, PICC lines with antibiotic impregnation can provide a 15 mm zone of inhibition for greater than 30 days [7]. Despite the routine use of antibiotic PICC lines, no evidence of bacterial resistance has emerged. Additionally, antibiotic impregnated PICC lines have been shown to decrease the need for systemic antibiotic use [8–10] in ICU patients. Most antibiotic impregnated PICCs are impregnated with minocycline and rifampin due to their synergistic action through two distinct pathways, as well as their potential to penetrate bacterial-secreted biofilms.

PICC line infections continue to be a major cause of mortality as well as significant cost. Mortality rate from an ICU catheter-related infection has been estimated at 35% [11]. The additional cost per survivor per ICU catheter-related infection has been estimated at $40,000.00 [12]. Because of the benefits to reducing catheter-related blood stream infections, antibiotic impregnated PICC lines have been developed. In vitro studies have shown the combination of rifampin and minocycline to be statistically superior to chlorhexidine gluconate and silver sulfadiazine coated PICC lines in inhibiting gram-positive bacteria, gram-negative bacteria, and Candida albicans [13]. Additional studies have shown rifampin/minocycline to be statistically superior to vancomycin-impregnated catheters against S. epidermidis, S. aureus, and Enterococcus faecalis [14].

Despite the evidence to suggest a potential benefit with the use of minocycline/rifampin coated CVCs, variability exists regarding the use of these catheters. A recent survey found that 27% of respondents used non-coated catheters, 13% used rifampin/minocycline coated catheters and 42% used chlorhexidine/silver sulfadiazine coated catheters. Additionally, 38% of catheters used were PICCs and the remainder were central venous catheters [15].

Additional factors potentially influencing the bacteremia rate during our study period including the institution of “wash-in, wash-out” campaign. However, despite this campaign, the rates of Clostridium difficile colitis and urinary tract infections did not change at our institutions. Neither did the bacteremia rates in the intensive care units. Another factor potentially affecting the bacteremia rate was the move of the burn unit to a new location within the hospital. This move occurred half-way through the study period and could have altered the flora colonizing the unit. While these two factors are important to consider the impact of the antibiotic-impregnated PICCs more than accounts for any expected influences these other factors may account for in reducing bacteremia rate. It must be noted that other authors have found success with the use of uncoated catheters and have previously reported 0% infection rate [16], unfortunately we were unable to reproduce these results in our burn unit and required additional intervention to reduce our bacteremia rate.

While there have been many studies using antibiotic-impregnated catheters in ICU patients, few studies have examined their use in the burn population. Our study is one of the largest to date exploring the use of these catheters. While our control group and study group exhibited a moderate degree of heterogeneity, the impact of the antibiotic impregnated catheters cannot be overlooked. The estimated cost savings over the study period reached $360,000.00, this savings more than accounts for the small added cost of the antibiotic impregnated PICC lines.

5. Conclusion

Antibiotic impregnated PICC lines decrease the bacteremia rate in our burn population. This has potential benefits for both patient morbidity and mortality as well as potential cost savings for the healthcare system. Because of the cost savings and more importantly the patient health benefits, and pressure on epidemiologic flora in the burn unit, we recommend the use of rifampin/minocycline impregnated catheters, and are in the process of implementing them in our intensive care units.

Conflict of interest

The authors declare no conflict of interest with regard to employment, consultancies, stock ownership, honoraria, paid
expert testimony, patent applications/registrations and grants or other funding.

REFERENCES


[4] Personal communication with director of WMRBL; October 2009.


