International Journal of Sciences: Basic and Applied Research (IJSBAR)

ISSN 2307-4531
(Print & Online)

http://gssrr.org/index.php?journal=JournalOfBasicAndApplied

Effect of Admission Type on the Risk of Bloodstream Infections among Critically Ill Patients with Peripherally Inserted Central Catheters in a Tertiary Center in Saudi Arabia

Mohammad S. Al-Shahrani[a*], Bander F. Al-Dhafery[b], Hana M. Al-Anezi[c], Sattam S. Al-Russayes[d] , Abdulaziz M. Al-Sharydah[e]

[a,c] *Department of emergency medicine, University of Dammam, Khobar , 31952, Kingdom of Saudi Arabia*

[b] *Departemnt of Radiology, University of Dammam , Khobar , 31952 , Kingdom of Saudi Arabia*

[d,e] *College of medicine, University of Dammam, Khobar , 31952, Kingdom of Saudi Arabia*

[a]*Email: msshahrani@uod.edu.sa*

[b]*Email: baldhafery@uod.edu.sa*

[c]*Email: H.anezi@hotmail.com*

[d]*Email: alrussayes.sattam@gmail.com*

[e]*Email: abdulazizalsharydah@hotmail.com*

Abstract

The purpose of the study was to evaluate the association between type of admission (medical versus surgical) with risk of central line associated bloodstream infection (CLABSI) in a university hospital setting. A retrospective analysis was performed on critically ill patients who had peripherally inserted central catheters (PICC) during the period between January 2010 and October 2012. Demographic data, duration of catheterization and type of admission were obtained from patient's records. In 1299 catheter days, 19 CLABSI's were diagnosed among 65 patients who had a PICC during the study period. Overall infection rate was 3.7 per 1000 catheter days for PICC. In the medical ICU, there was 1 infection per 1000 catheter days.

---

* Corresponding author.

In the surgical ICU, the infection rate was 2.7(p = 0.018). All PICCs were in place for a mean period of 20±11 days. A significant association was found between the duration of the catheter and the risk of infection (p = 0.001). The use of PICCs carries a risk of infection. Our results showed that the risk was higher among surgical patients in the ICU compared with medical ones. More aggressive infection control measures may be needed for surgical patients with PICC in place.

Keywords: PICC; CLABSI, ICU

1. Introduction

Peripherally inserted central catheters (PICCs) have represented a great advancement in patient care because they provide stable access for prolonged administration of intravenous medications. Therefore, these catheters are frequently used to deliver antibiotic therapy, chemotherapy, and total parenteral nutrition in both inpatient and outpatient settings. As a portal of entry into the vascular tree, PICCs have been associated with bloodstream infection which referred to as central lines associated blood stream infections (CLABSI) with rates ranging from 1.5% to 5.6% [1-4]. CLABSI defined as a laboratory-confirmed bloodstream infection (LCBI) where central line was in place for more than 2 days on the date of event as per the CDC's National Healthcare Safety Network January 2014 [5]. Bloodstream infection (BSI) is a significant complication of indwelling central venous catheters. It has been estimated that 16,000 patients develop catheter-related sepsis each year, with an associated mortality of 12%–25% [6].

A large proportion of central venous catheters (CVCs) inserted are PICCs. Currently, PICCs have become increasingly popular in both ICU and non-ICU settings. These catheters are non-tunneled and non-cuffed, and prolonged use may predispose them to bacterial colonization and biofilm formation [7-8]. The objective of this retrospective surveillance study was to compare the CLABSI rate between critically ill patients admitted to the internal medicinal ICU versus those admitted to the surgical ICU in a university hospital setting. We hypothesized that surgical patients carry greater risks for infection due to more manipulation during wound care and longer ICU stay especially head and spinal cord injuries patients.

2. Method

A retrospective study was performed on patients hospitalized in the ICU who required the use of a PICC during the period between January 2010 and October 2012 at a university hospital in Saudi Arabia. Data for admitted patients were obtained from their electronic medical records. CLABSI events were provided by the infection control team surveillance data. Demographic data of patients including age and gender were collected. Data regarding duration of catheterization and on area where patients were admitted (medical versus surgical ICU) were collected. Patients were then divided into groups depending on their hospitalization into the medical ICU (MICU) or surgical ICU (SICU). Infected patients were divided into sub-groups depending on duration of the catheterization with PICC.

Statistical Package for Social Sciences (SPSS version 19) was used for data entry and analysis. Frequency distribution, cross tabulations, and graphs were used for descriptive statistics and Chi-square test and Kruskal–

Wallis test were used for inferential statistics.

3. Results

Between January 2010 and October 2012, 65 patients required the use of PICC intervention. Of these, 40 patients were men and 25 were women. Patients had a mean age of 38 ± 28.9 years and duration of stay of 20±11.5 days. CLABSIs were diagnosed in 19 patients for 1299 catheter days, and the mean age of infected patients was higher than the average age of patients included in the study. Most of the infected patients were men and they were admitted into the SICU (Table 1).

Table 1: Patient baseline characteristics and outcome

	All Cases	Infected	Non-infected	P value
Mean Age (SD)	38 (24.9)	48.05 (24.6)	34.2 (24.2)	0.035
Gender, n				
Male : Female	40:25	12:7	28:18	0.03
Type of Admission, n				
Surgical : Medical	33:32	14:5	19:27	0.018
PICC Duration	20 (11.5)	28 (11.8)	16.7 (9.7)	0.001

SD, standard deviation; PICC, peripherally inserted central catheter

The overall infection rate was 3.7 infections per 1000 catheter days. More infected patients were identified among those admitted to the SICU compared with those admitted to the MICU. In SICU, 2.7 infections per 1000 catheter days were observed, while in MICU, 1 infection occurred per 1000 catheter days. *Staph Species* was the culprit of 25% of PICC-related infections followed by *Klebsiella Pneumoniae*, with 20% of the infected 20 percent of the PICC-related infections (Table 2).

Table 2: Organism causing bloodstream infection

Organism	Number (%)
Staph species	5 (25)
Klebsiella Pneumoniae	4 (20)
Enterococcus Fecalis	2 (10)
Acinetobacter Baumannii	2 (10)
Pseudomona Aeruginosa	2 (10)
Serratia marcescens	1 (5)
Sten. Maltoph + Bulkholderia	1 (5)
Providencia Stuartii	2 (10)
Stenotrophomonas maltophilia	1 (5)

Patient age ranged from 2 to 92 years. Age categories were used for statistical analysis; approximately 65% of patients were found in the range of 2 to 44 years, but the percentage of infected patients was higher among those older than 45 years (Figure 1), and this difference was found to be statistically significant, with a p-value of 0.035.

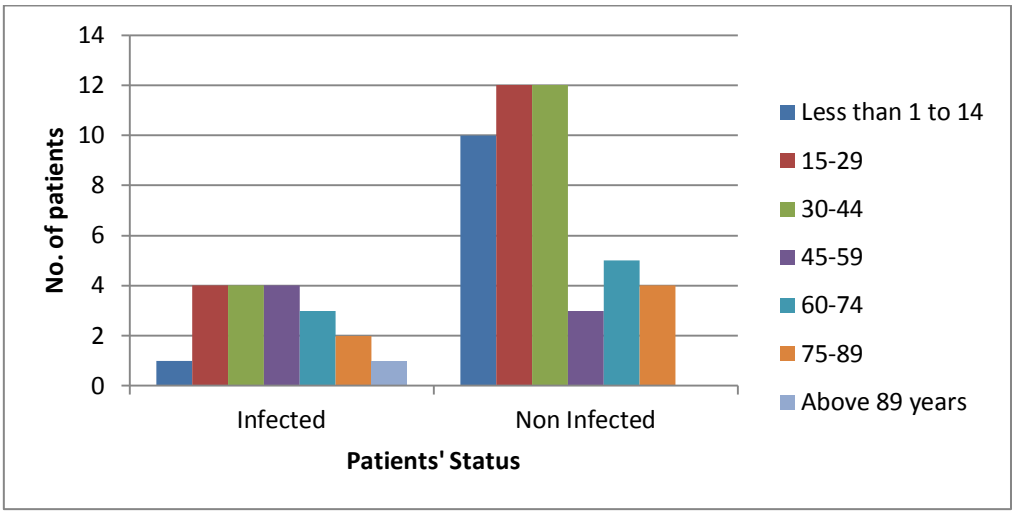

Figure 1: Risk of PICC infection in correlation to age of patients in years.

A significant correlation was also found between patient status (infected and non-infected), gender, and type of admission (surgical or medical). Significant correlations were found between both gender and type of admission and patient status (p-values were 0.03 and 0.018, respectively (Table 1).

Total period (in days) of PICC intervention was also a part of the analysis. The duration of PICC intervention ranged from 4 to 54 days and mean duration was 20±11 days (Figure 2). Mean duration of intervention was longer among patients with PICC-related infections. It was also observed that increasing duration could result in increased risk of infection (table 1), and this correlation was statistically significant (p-value <0.001).

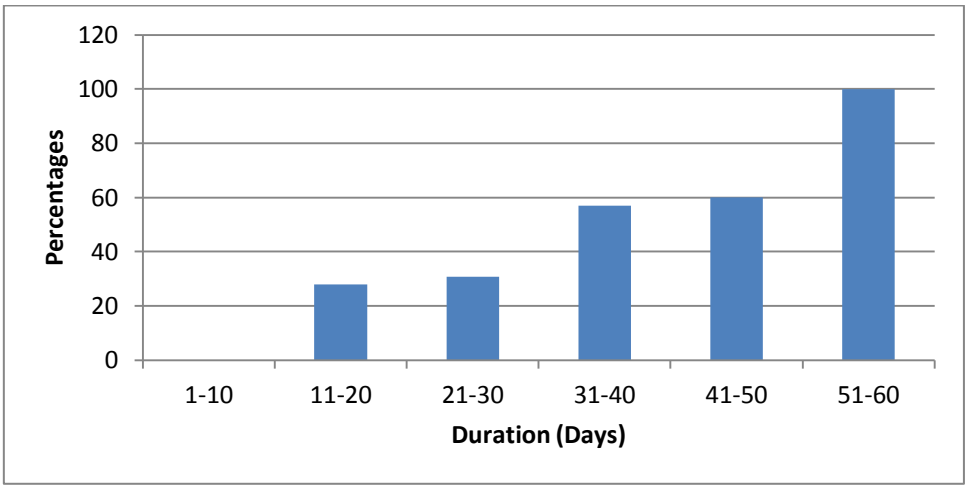

Figure 2: Risk of PICC infection in correlation to total duration of placement in days.

4. Discussion

Generally, PICCs are used in place of short-term CVCs [6]. In our institution the interventional radiologists insert those catheters. Insertion of PICC line was performed under sterile technique according to the standards of CDC practice guidelines [9]. After localizing the proper vein for insertion by ultrasound ,the basilic vein of nondependent arm was chosen for all patient unless thrombosis found then cephalic or brachial veins were chosen for insertion . The skin was cleaned using antiseptic solution (alcoholic chlorhexidine gluconate) then was covered by fenestrated drape after covering the whole patient with sterile drape . All PICC line were inserted using ultrasound guidance after covering the probe with sterile cover .The operator was wearing sterile gown , head and shoes cover and sterile gloves . Non cuffed non antimicrobial impregnated 6 F dual lumen PICC lines with passive valve technology PASV (vaxcel picc line from navilyst medical) were used .

There is controversy regarding which line, either PICC or CVC, carries a lower risk of CLABSI. Safdar et al. studied the risk associated with PICCs compared with CVCs in 2005. They reported that the risk of catheter-related BSI was lower in PICCs than with CVCs [8]. A recent systematic review and meta-analysis by Chopra and his group showed no significant difference in term of infection related risks [10]. To the best of our knowledge, no previous studies have addressed the question of association between type of admission in term of surgical versus medical and rate of PICC-related BSI. In this study, patients admitted to MICU and SICU patients who required PICC during the study period were assessed and the infection rates were determined in both group. Rate of infection in MICU was lower than the rate of infection in SICU. Infection was significantly associated with the place of the patient when PICC intervention took place (medical or surgical). This association can be explained by more than one factor: extra manipulation of surgical patients during wound dressing changes; also surgical patients have additional possible ports of infection like wounds and drainages catheters. Furthermore, a group of patients at SICU were head and spinal cord injury victims that spent more time in ICU and had longer hospital stays, which is another factor leading to a higher risk of central line infections in our cohort. In these cases, the possibility of catheter infection increased significantly as the duration of PICC increased. This association between duration of catheter and risk of CLABSI was found in different earlier studies [11-14]. Staph species were found to be the most common organisms grown form blood and catheter tip cultures followed by Klebsiella Pneumoniae then Enterococcus species.

Gunst M et al. studied CLABSI association with PICC compared with antiseptic CVCs in a group of patients admitted in Parkland Memorial Hospital in Texas from July 2005 to July 2006. They found lower rates of PICC infection as compared with CVC infection. In CVC, they reported 6 infections per 1000 catheter days and for PICC, 2.2 infections per 1000 catheter days. They concluded that PICC might reduce the risk of CLABSI [15]. Al-Tawfiq JA et al studied the rate of infection in PICC, and they revealed a BSI rate of 4.5 per 1000 catheters days in Internal Medicine Unit, Dhahran Health Center, Dhahran, Saudi Arabia [16].

Several studies have indicated that the risk of infection could be reduced by practicing maximum barrier precautions during insertion of central lines compared with standard precautions [13, 16, 17, 18]. Other preventive methods have also been attempted, like agent used for skin preparation and type of catheter dressing [19, 20]. In our cohort, all procedures as mentioned above were performed using an intervention radiology suit

under fully aseptic techniques by a specialized intervention radiologist as mentioned earlier. Overall, the rate of central line-related infections in both MICU and SICU at our institution has been reduced as rate of infection per catheter days compared to the reported range of infection in the literature [8, 13, 14].

The purpose of this study was to analysis the bloodstream infection rate associated with PICCs in a tertiary university hospital care setting, and we was found that the rate of infection was not higher than the rate of infection reported in the literature and surgical patients carry higher risks . However, there were some limitations to this study. For instance, there was no cutoff value for duration of PICC intervention. Additionally, the comparison between PICC versus CVC might have provided a better picture of which procedure had a higher risk of infection since this important outcome is still questionable. Additionally, different staff is covering medical and surgical intensive care units with different experience which might lead to suboptimal care in different occasions.

5. Conclusion

The use of PICCs still carries risk of infections. Our results showed that the risk of infection is higher in patients admitted to the SICU compared with those admitted to the MICU. Knowing the retrospective nature of the study we recommend prospective type of study to confirm this results. Further, based on the results of our study, we found that the risk of infection increased with prolonged duration of the central line. Therefore, more rigorous control of the infection rate at surgical ICU is necessary at our institution. To evaluate the source of infection, we recommend that the adherence to precautions and infection control measures in all medical and surgical critically ill patients and to revisit the surgical patients' team adherence to infections control measures.

6. Limitations & Recommendations

This study was retrospective in nature and the finding was limited to be generalizable because of the small sample size.

A prospective study with larger sample size to investigate the cause-effect observation noticed in our cohort is recommended. Meanwhile applying the infection control measures bundle for all patients who are having peripherally inserted central catheter is mandatory as the risk of infection is continuously exist.

References

[1] Cardella JF, Cardella K, Bacci N, Fox PS, Post JH. Cumulative experience with 1,273 peripherally inserted central catheters at a single institution. J VascIntervRadiol, vol 7, pp.5-13, 1996

[2] Walshe LJ, Malak SF, Eagan J, Sepkowitz KA. Complication rates among cancer patients with peripherally inserted central catheters. J ClinOncol, vol. 20, pp.3276-3281, 2002.

[3] Levy I, Bendet M, Samra Z, Shalit I, Katz J. Infectious complications of peripherally inserted central venous catheters in children. Pediatr Infect Dis J, vol. 29, pp. 426-429, 2010.

[4] Fong NI, Holtzman SR, Bettmann MA, Bettis SJ. Peripherally inserted central catheters: outcome as a function of the operator. J VascIntervRadiol, vol. 12, pp.723-729, 2001.

[5] http://www.cdc.gov/nhsn/pdfs/pscmanual/4psc_clabscurrent.pdf1. Accessed [September 26, 2014].

[6] Smith JR, Friedell ML, Cheatham ML, Martin SP, Cohen MJ, Horowitz JD. Peripherally inserted central catheters revisited. Am J Surg, vol. 176, pp. 208-211, 1998.

[7] Abedin S, Kapoor G. Peripherally inserted central venous catheters are a good option for prolonged venous access in children with cancer.Pediatr Blood Cancer, vol. 51, pp. 251-255, 2008.

[8] Safdar N, Maki DG. Risk of catheter-related bloodstream infection with peripherally inserted central venous catheters used in hospitalized patients. Chest, vol.128, pp. 489-95, 2005.

[9] http://www.cdc.gov/hicpac/pdf/guidelines/bsi-guidelines-2011.pdf ,Accessed September 25, 2014

[10] Chopra V , O'Horo C, Mary A. Rogers M, Dennis G, Safdar N, The Risk of Bloodstream Infection Associated with Peripherally Inserted Central Catheters Compared with Central Venous Catheters in Adults: A Systematic Review and Meta-Analysis .Infect Control Hosp Epidemiol,vol.34(9), pp.908-918, 2013.

[11] Al Raiy B,Fakih MG,Bryan-Nomides N,Hopfner D,Riegel E,Nenninger T,et al.Peripherally inserted central venous catheters in the acute care setting: A safe alternative to high-risk short-term central venous catheters. Am J Infect Control, vol.38, pp. 149-153, 2010.

[12] Weber DJ, Sickbert-Bunnett EE, Brown V, Rutala WA. Comparison of hospital wide surveillance and targeted intensive care unit surveillance of healthcare associated infections. Infect Control HospEpidemiol, vol. 28, pp.1361-1366, 2007.

[13] Aloul B, Adabag AS, Goussous TY, Weinert CR. Medical resident's self-reported adherence to guidelines during placement of central venous catheters. Infect Control HospEpidemiol, vol. 9, pp. 86-88, 2008.

[14] Taylor RW, Palagiri AV. Central venous catheterization. Crit Care Med, vol. 35, pp. 1390-1396, 2007.

[15] Gunst M, Matsushima K,Vanek S, Gunst R, Shafi S, Frankel H. Peripherally inserted central catheters may lower the incidence of catheter related blood stream infection in patients in surgical intensive care units. Surg Infect (Larchmt) , vol. 12, pp. 279-282, 2011.

[16] Al-Tawfiq JA, Abed MS, Memish ZA. Peripherally inserted central catheter bloodstream infection surveillance rates in an acute care setting in Saudi Arabia. Ann Saudi Med, vol. 32(2), pp. 169-73, 2012.

[17] O'Grady NP1, Alexander M, Dellinger EP, Gerberding JL, Heard SO, Maki DG, et al. Guidelines for the prevention of intravascular catheter-related infections.MMWR Recomm Rep, vol. 51, pp. 1-29, 2002.

[18] Mermel LA, McCormick RD, Springman SR, Maki DG. The pathogenesis and epidemiology of catheter-related infection with pulmonary artery Swan-Ganz catheters: A prospective study utilizing molecular subtyping. Am J Med, vol. 91, pp. 197s-205s, 1991.

[19] Raad II, Hohn DC, GilbreathBJ.Prevention of central venous catheter-related infections by using maximal sterile barrier precautions during insertion. Infect Control HospEpidemiol, vol. 15, pp. 231-238, 1994.

[20] Maki DG, Ringer M. Evaluation of dressing regimens for prevention of infection with peripheral intravenous catheters: Gauze, a transparent polyurethane dressing, and an iodophor-transparent

dressing. JAMA, vol. 258, pp. 2396-2403, 1987.

[21] Hoffmann KK, Weber DJ, Samsa GP, Rutala WA. Transparent polyurethane film as an intravenous catheter dressing: A meta-analysis of the infection risk. JAMA, vol. 267, pp. 2072-2076, 1992.