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Original Research Article

Incidence of catheter-related bloodstream infections after removal of peripherally inserted central catheters in preterm neonates

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ABSTRACT

Background: Peripherally inserted central catheter (PICC) have become essential for a safe and reliable long term venous access in all neonatal intensive care units (NICU) for providing long term intravenous fluids and medications. However, they associated with central line blood stream infections (CRBSI) infections and it is postulated that this risk is more on during their removal but the true incidence is not known. The objective was to evaluate the incidence and identify risk factors associated with CRBSI following the PICC removal in preterm neonates.
Methods: This was a retrospective cohort study was done on <37 weeks premature neonates. Data included patient particulars, location of PICC placement, days of PICC, antibiotics and TPN through PICC, infections noted during or within 48 hours of PICC removal.
Results: A total of 238 PICC removals in 215 neonates were analysed which did not show a significant difference in the prevalence of CRBSI within 48 hours of PICC removal. However, there was an increase in odds for sepsis following PICC removal in less than 29 weeks gestation and if it was not used for antibiotic infusion for more than 48 hours preceding its removal.
Conclusions: This study does not support the use of prophylactic antibiotics during PICC removal in neonates as there was no increase in the incidence of CRBSI following PICC removal. However, they may have a role in very low gestation age, low birth weight infants who have not recently received antibiotics prior to PICC removal.

Keywords: Catheter related bloodstream infection, Neonatal sepsis, Peripheral inserted central venous catheters preterm, Prophylaxis

INTRODUCTION

Peripherally inserted central catheter (PICC) have become essential for a safe and reliable long term venous access in modern neonatal intensive care units (NICU) while caring for sick low birth weight (VLBW).[1] Access through PICC not only avoids repeated painful venous cannulations for providing long term intravenous fluids, medications and also has an added advantage of giving essential nutrition for growth in high concentration which cannot be given through peripheral access.[2]

The use of PICC in preterm is however associated with a number of complications, of which the central line blood stream infections (CRBSI) are the most frequent, especially in VLBW due to their immature immune response. The resulting sepsis results in prolonged hospitalization, increased costs, poor growth and neurodevelopment outcome and increased mortality.[3] The Centers for Disease Control and Prevention has defined CRBSI as any bloodstream infection (BSI) that occurs with a central venous catheter in place and up to 48 hours after its removal.[4] These CRBSI are predominantly due to

gram positive bacteria and the commonest organism was found to be coagulase negative *staphylococci* (CONS).[5] The ability of CONS to adhere to the surface of central catheter makes it very efficient in forming biofilms. The other microbes associated are *Staphylococcus aureus, Enterococci spp., Klebsiella, E coli* and *Candida parapsilosis.*[6]

As these PICC lines are prone to colonization with biofilm production by the organisms over their catheter tip, it is postulated that there is a risk of these biofilm being dislodged during the procedure of removal of PICC which leads to bacterial dissemination in bloodstream thereby predisposing the neonate to sepsis.[7] Few studies been done to examine this hypothesis on the incidence of CRBSI following PICC removal and the results have been equivocal.[6-8] Prophylactic antibiotics have been used just before removal to prevent septic dissemination but there is no evidence to support this practice as this may increase antibiotic resistance. In recent years there has been implementation of multidisciplinary, evidence based guidelines which have considerably decreased the CRBSI in the NICU.[9] Hence practices that offer further reductions should continuously be explored and evaluated. Since definite data from previous studies have been equivocal, author conducted a retrospective study of this centre to evaluate the incidence associated with CRBSI following the PICC removal in neonates. This objective was to test if PICC removal within 48 hours resulted in significant CRBSI and clinical deterioration leading to sepsis in preterms and to identify associated risk factors.

METHODS

This retrospective cohort study was done in a tertiary care teaching hospital between June 2014 and May 2016 after approval by the institutional ethics committee. PICC lines of 1Fr and 2Fr of Vygon, Paris, France were used. PICC lines were inserted as per standardized protocol described and were regularly monitored with daily evaluation and other bundle care practices.[9] The PICC was removed when no longer required ensuring maximum sterility. These practices were continued during the entire study period. All preterms (<37 weeks) with PICC were identified and their records reviewed. Data collected included patient gestation, weight, location of PICC placement, length of PICC, type and duration of antibiotics, parenteral nutrition through PICC, any occlusion/ manipulation of PICC, any local infection/ inflammation of insertion site, evaluation of sepsis and clinical infections during the period of PICC indwelling or within 48 hours of PICC removal were noted. Multiple PICC lines insertion in the same patient were counted as independent entities. PICC lines removal were excluded from the study if placed in a neonate with incomplete records, died with indwelling PICC or removed due to occlusion or leak. Data following 48 hours of PICC removal were recorded for any clinical deterioration, episodes of apnea or bradycardia requiring intervention and blood stream infections (BSI). CRBSI is defined as BSI that occurs while central venous catheter is in place or up to 48 hours after its removal central line and manifested as clinical deterioration with single positive blood cultures of pathogenic organism or two sequential positive blood cultures with skin commensal/ contaminant.[4] Clinical features associated were comprised temperature instability (<360C or >380C), lethargy, poor suck or cry, poor perfusion, delayed capillary refill time, hypotonia, absent neonatal reflexes, tachycardia or bradycardia, respiratory distress, apnea, gasping respiration and metabolic acidosis. Culture negative sepsis was taken as clinical features suggestive of sepsis within the period of 48 hours post removal of PICC with any two positive lab criteria comprising sepsis screen in the presence of negative blood cultures. Laboratory criteria for positive sepsis screen were defined as total leucocyte count (TLC) <5000/cmm, absolute neutrophil counts (ANC) as per Monroe's charts, immature/total neutrophil ratio (ITR)> 0.2, micro-ESR > 15 mm/ hour and C- reactive protein (CRP)>1 mg/dl.[6] Any evidence of new onset BSI or clinical sepsis was noted and managed with broad spectrum intravenous antibiotics according to standard unit protocols. In addition, anti-fungal agents were started if there was any evidence of local fungal infection or laboratory investigations suggested fungal sepsis. As a routine protocol 5 cm catheter tip of PICC lines were sent for microbiological culture.

The data for study was collected in pre-designed study proforma and was verified for completeness and consistency before transferring into MS Excel for further analysis using SSPS (21st Version). The continuous variables were expressed as mean and standard deviation (SD). Statistical analysis of the incidence was performed by Fisher's exact test, differences between patient characteristics were compared by Chi-squared test and separate multivariable logistic regression models to compare risk factors. p value of <0.05 was considered statistically significant.

RESULTS

During the study period, a total 215 neonates with 238 PICC line removals met this study criteria and were evaluated for CRBSI and clinical sepsis in 72 hours following PICC removal. 23 neonates required two PICC lines for their management. Since each PICC lines were considered an independent entity, number of PICC days was also counted separately. A total of 2294 PICC days were studied and analysed.

The median gestational age of neonates with PICC lines was 30 week 3 days (SD 7.1 days) and birth weight was 1192.6 gm (SD 116.7). Majority (70%) of the lines were placed by the 5 days of life. Most common site of insertion was found to be upper limbs (82%) with an average in dwelling time duration of 11.8 days (SD 2.6 days). 89.8% of all lines received antibiotics through the

PICC lines with an average duration of 9.6 days (SD 2.3 days). 71.5% of all PICCs had antibiotic free interval of minimum 48 hours before removal of the line. Average number of days no antibiotics were given in PICC lines before 48 hours of their removal was 2.72 days. 159 (66.8%) of the lines were used for giving parenteral TPN and lipid infusion in addition to antibiotics. Only 35 lines were recorded to be manipulated. A total of 47 neonates had concurrent another central venous catheter (umbilical catheter/ PICC) (Table 1).

Table 1: Detailed characteristics of PICC lines inserted during the study period.

Parameters	Mean	(SD /%)
Birth weight(grams)	1192.6	116.7
Gestational age(weeks)	30wk±3days	7.1days
PICC placed on day of life	5 day	1.8
Duration of PICC in days	11.8 days	5.8
Number of days antibiotics used through PICC	9.6 days	2.4
Number of days no antibiotics used before PICC removal	2.7 days	1.1
Site of PICC- upper limbs	195	81.9%
Number of PICC Manipulated	35	14.7%
Number of PICC used for antibiotics	211	88.65%
Previous central venous catheter	47	21.8%
BSI within 48 hours post removal	5/238	2.3%
BSI during PICC indwelling	8/215	3.7%

PICC - Peripherally inserted central catheter,
BSI - Blood stream Infection

Among 22 neonates had sepsis evaluations within 48 hours following PICC removal for suspected sepsis. Comparative information is given in (Table 2). There was no difference found in various associations with sepsis evaluation within 48 hours of PICC removal. There were only five neonates identified to have CRBSI within 48 hours of PICC removal. Two grew CONS, one each grew *Staphylococcus aureus*, *Enterococci sp*. and *E. coli*. Four were present in premature neonates who were not exposed to parenteral antibiotics through PICC line. Most were in <1000 gms (4/5) and <28 week neonates (3/5). Only eight fulfilled the criteria for CRBSI during in-dwelling PICC. There was no difference seen in the rates of CRBSI 48 hours post PICC removal compared to periods of in-dwelling PICC. Majority of the infections were gram negative with in-dwelling PICC; *Escherichia coli*-three, *Klebsiella*-two and others were CONS one, *Staphylococcus* one and one *Candida*.

DISCUSSION

In this retrospective study we analyzed 238 PICC line removals with 2294 PICC days and found no increased incidence of infections. We documented only five cases of CRBSI within 48 hours of PICC removal which was similar to the overall rate CRBSI with the PICC in-dwelling. The findings was in line with previous studies which found no evidence of increase infections following the catheter removals in newborns.[7,10] Casner et al, attributed to the lower incidence of BSI and culture negative sepsis in their study to the implementation of CLABSI monitoring and bundle care.[7] This reduction in BSI rates due to improved bundle care has been reported in other studies.[11,12]

Table 2: Descriptive analysis of CRBSI within 48 hours of PICC removal.

Characteristic		Number of cases evaluated (%)	Chi-square test	p value
Birth wt	<1000gms	3(88)	0.77	0.38
	>1000gms	2(127)		
Gestational age	<29 weeks	4(74)	4.71	0.02*
	>29 weeks	1(141)		
PICC manipulated before removal	Yes	2(35)	2.605	0.106
	No	3(203)		
Antibiotics given within 48 h of PICC removal		2(48)	1.247	0.24
No antibiotics given within 48 h of PICC removal		3(190)		
BSI before placement of PICC		2(47)	1.32	0.25
No BSI before placement of PICC		3(191)		

* p

This study is in contrast to the study by Hemels et al, who reported over 11% rate of BSI within 48 hours of catheter removal.[13] In this prospective interventional study the authors reported a decrease in BSI by using prophylactic anti-staphylococcal antibiotics, Cefazolin at the time of PICC removal and 12 hours later. This protective effect of prophylactic antibiotics was reported earlier by van den Hoogen et al, who also found seven fold lower prevalence of BSI in neonates who received antibiotics at the time of removal of PICC.[13] This beneficial effect of antibiotics preceding PICC removal was not recommended by Booker and Keena hey observed no increase in BSI following catheter removal.[10]

There were five cases identified as CRBSI in this study which occurred within 48 hours of PICC removal and there were eight cases of CRBSI identified during the in-dwelling of catheter during the study period. No difference in the rates of CRBSI between periods of in-dwelling PICC compared to 48 hours post PICC removal were seen. Majority of CRBSI following PICC removal in this study occurred in VLBW neonates, low gestational age who had lack of antibiotic exposure preceding PICC

removal. This was consistent with observation that birth weight was inversely related to BSI.[4] Other studies have also reported highest risk factors associated with sepsis as decreasing birth weight, decreasing gestational age, increased in-dwelling catheter time and infusion of TPN/lipids.[1,5] Cassner et al, reported more than 6.3 fold increase in odds for culture negative sepsis in VLBW with prolonged PICC and no antibiotics exposure before 72 hours of PICC removal.[7] However, this prolonged duration of PICC in-dwelling time as an independent risk factor for BSI has not been reported in recent studies as it has been attributed to more improved bundle care practices during management of PICC lines.[10,14]

The most common organism associated with blood stream infection was Coagulase negative staphylococci (CONS) followed by gram negative bacteria. This is in line with the finding of various other studies.[7,8,15] These BSI were treated with adequate course of antibiotics. One neonate was transferred to surgical centre for management of necrotizing enterocolitis while other neonates recovered.

This study had the strength of single team of specialist with consistent practices followed throughout the study period and significant cohort of patients. But limitations of the study included a retrospective design of a single centre. Secondly difficulty was low incidence of documented BSI in neonates with PICC with difficulty in quantification of results. A future multicentric randomized trial will add to the veracity of the results.

CONCLUSION

To conclude, this study shows there is no increase in risk of CRBSI after PICC removal and was similar to the risk during period of in-dwelling PICC. Hence routine use of antibiotic prophylaxis to reduce the incidence of CRBSI on removal of PICC is not recommended. In our study we identified a subgroup of VLBW neonates who were at increased risk of CRBSI following their catheter removal. They had low gestation and had not received any antibiotics prior to removal of PICC. Although the number of CRBSI was low in this study to recommend universal antibiotic prophylaxis but considering the long term morbidity and mortality associated with such late onset sepsis, we recommend a single dose of antibiotic prophylaxis in less than 1000 gms and less than 29 weeks of gestation who were not exposed to antibiotics prior to pulling out PICC.

A further prospective interventional trail with more standard definition and evaluation may provide further insight to the incidence and prevention of CRBSI following PICC removal in neonates.

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REFERENCES

1. Milstone AM, Reich NG, Advani S, Yuan G, Bryant K, Coffin SE, et al. Catheter dwell time and CLABSIs in neonates with PICCs: a multicenter cohort study. Pediatr. 2013;132(6):1609-15.
2. Ainsworth SB, McGuire W. Peripherally inserted central catheters vs peripheral cannulas for delivering parenteral nutrition in neonates. Jama. 2016;315(23):2612-3.
3. Stoll BJ, Hansen NI, Adams-Chapman I, Fanaroff AA, Hintz SR, Vohr B, et al. National Institute of Child Health and Human Development Neonatal Research Network. Neurodevelopmental and growth impairment among extremely low-birth-weight infants with neonatal infection. JAMA. 2004;292(19):2357-65.
4. O'Grady NP, Alexander M, Dellinger EP, Gerberding JL, Heard SO, Maki DG, et al. Guidelines for the prevention of intravascular catheter-related infections. Centers for Disease Control and Prevention. MMWR. Recommendations and reports: Morbidity and mortality weekly report. Recommendations and reports. 2002;51(RR-10):1-29.
5. De Silva GD, Kantzanou M, Justice A, Massey RC, Wilkinson AR, Day NP, et al. The ica operon and biofilm production in coagulase-negative staphylococci associated with carriage and disease in a neonatal intensive care unit. J Clin Microbiol. 2002;40(2):382-8.
6. Hemels MA, van den Hoogen A, Verboon-Maciolek MA, Fleer A, Krediet TG. Prevention of neonatal late-onset sepsis associated with the removal of percutaneously inserted central venous catheters in preterm infants. Pediatr Crit Care Med. 2011;12(4):445-8.
7. Casner M, Hoesli SJ, Slaughter JC, Hill M, Weitkamp JH. Incidence of catheter-related bloodstream infections in neonates following removal of peripherally inserted central venous catheters. Pediatr Crit Care Med. 2014;15(1):42-8.
8. Reynolds GE, Tierney SB, Klein JM. Antibiotics before removal of percutaneously inserted central venous catheters reduces clinical sepsis in premature infants. The J Pediatr Pharmacol Therapeut. 2015;20(3):203-9.
9. Sacks GD, Diggs BS, Hadjizacharia P, Green D, Salim A, Malinoski DJ. Reducing the rate of catheter-associated bloodstream infections in a surgical intensive care unit using the Institute for Healthcare Improvement Central Line Bundle. The Am J Surg. 2014;207(6):817-23.
10. Brooker RW, Keenan WJ. Catheter related bloodstream infection following PICC removal in preterm infants. J perinatol. 2007;27(3):171.
11. CATHeTeR R. Catheter-associated bloodstream infections in the NICU: getting to zero. Neonat Net. 2009;28(3):151.

12. Bannatyne M, Smith J, Panda M, Abdel-Latif ME, Chaudhari T. Retrospective cohort analysis of central line associated blood stream infection following introduction of a central line bundle in a neonatal intensive care unit. Intern J Pediatr. 2018;2018.
13. Van Den Hoogen A, Brouwer MJ, Gerards LJ, Fleer A, Krediet TG. Removal of percutaneously inserted central venous catheters in neonates is associated with the occurrence of sepsis. Acta Paediatr. 2008;97(9):1250-2.
14. Sengupta A, Lehmann C, Diener-West M, Perl TM, Milstone AM. Catheter duration and risk of CLA-BSI in neonates with PICCs. Pediatr. 2010;125(4):648-53.
15. Parameswaran R, Sherchan JB, Mukhopadhyay C, Vidyasagar S. Intravascular catheter-related infections in an Indian tertiary care hospital. The J Infect Develop Countr. 2011;5(06):452-8.

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