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RESEARCH ARTICLE
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A Study on Peripherally Inserted Central Venous Catheter in Neonates In Tertiary Care Centre In Maharashtra

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ABSTRACT

Background: Peripherally inserted central venous catheters (PICC) have been extensively used in neonates for administration of total parenteral nutrition (TPN). Placement of a PICC is a potentially lifesaving treatment for neonates with poor peripheral venous access and intolerance to enteral nutrition.

Aims and Objectives: To study utility and complications of PICC along with evaluation of duration of catheter and all the possible factors involving removal of catheter in neonates admitted in NICU of Krishna Hospital, Karad, Maharashta.

Material and Methods: Study design: hospital based observational study. Sample size:47. Study setting: NICU of KRISHNA HOSPITAL, KARAD. Study period: February 2020 to August 2022. Data analysis: SPSS software using relevant statistical method. Descriptive statistics was performed in terms of mean, standard deviation, frequency and percentage. Analytical statistics was done to check the statistical significance.

Results: Total 47 PICC lines were inserted in 47 neonates. Out of 47 neonates with PICC line, 40% were term neonates and 60% were preterm neonates. Median gestational age for PICC line insertion is 30.85 weeks minimum being 26 weeks and maximum being 38 wks. Out of 42.6% were extremely low birth weight (ELBW) ,46.8% were very low birth weight (VLBW), 8.5%were low birth weight (LBW). Mean birth weight of the participants was 1.18 ± 0.32 kgs. In most of the cases PICC line was inserted at 1st attempt (80.8%). Majority of neonates (68.1%) received Infusion of IV fluids, Antibiotics and Aminoven. In most of the patients PICC line was inserted in right long saphenous vein (87.2%). Reason for removal of PICC line was due to achievement of full feed and weight gain (72.4%). The mean catheter duration in our study was 18 days. Total 16 complications were noted. Most common complication observed was Catheter Associated Blood Stream Infection in 14.9% patients followed by Necrotising enterocolitis in 6.3% patients. In our study, out 47 neonates with

PICC line, 31 neonates (66%) with PICC line have no complication.Out of 47 patient, 39 neonates (83.1%) were discharged , 4 (8.5%) were expired, 2 (4.3%) were referred to higher center and LAMA each.

Conclusion: PICC line has become a vital mode of providing medication to neonates especially in extreme preterm neonates. Hence it is important to recognize its utility, complication, durability and factors involved in removal of catheter.

Keywords: *Blood, Infection, Tertiary, Peripherally, complication*

INTRODUCTION

Introduction of central venous catheters (CVCs) in the 1980s has revolutionized the care and quality of life of cancer patients. These devices have also increased the patient satisfaction by minimizing the need for venipunctures and associated emotional trauma. Central venous access devices (CVADs) include open-ended tunneled catheters, tunneled valve catheters, implantable subcutaneous chemo-ports, non-cuffed non-tunneled. CVCs and peripherally inserted central catheters (PICCs). [1]

A peripherally inserted central catheter is a midline long, soft, flexible catheter, usually inserted through peripheral large veins and tip of catheter resides in the central veins. Peripherally inserted central venous catheters (PICC) have been extensively used in neonates for administration of total parenteral nutrition (TPN).

Approximately, 8.3- 33% of neonates admitted to an intensive care unit require PICC insertion.[2,3] Infants admitted to neonatal intensive care units (NICUs) frequently require CVC for medication, nutrition and monitoring. Placement of a CVC is a potentially lifesaving treatment for infants with poor peripheral venous access and gastrointestinal tract intolerance of adequate nutrition. Use of these catheters is associated with complications related not only to catheter insertion, but also to its use.[2]

MATERIAL AND METHODS

Source of Data: The current study was conducted in NICU of Krishna Institute of Medical Sciences, Karad. All the neonates admitted in NICU with PICC lines inserted were selected for the study. Study Design:: Observational Prospective study

Duration of the study: 18 months Neonates admitted in NICU with PICC lines inserted, between February 2020 to August 2022 were included in the study.

Sample size : The study was conducted on 47 patients.

Data Compilation and Statistical Analysis

The documented data was systematically collected and arranged in tabular form and in graphs in Microsoft Excel (version 2021). Statistical analysis was done with Statistical Package for Social Sciences (IBM SPSS Statistic for window, version 21.0. Armonk, NY: IBM Corp.) at 95% CI and 80% power to the study. Kolmogorov-Smirnov test was done to check for normal distribution of the data.Descriptive statistics was performed in terms of mean, standard deviation, frequency and percentage. Analytical statistics was done to check the statistical significance.

Observations And Results

In the present study of 47 neonates with PICC line. Out of 47 neonates with PICC line,40%(24)were term neonates and 60% (36) were preterm neonates. Median gestational age for PICC line insertion is 30.85 weeks minimum being 26 weeks and maximum being 38 wks. In the present study ,of 47 neonates with PICC line,20(42.6%) were extremely low birth weight (ELBW) ,21 (46.8%)were very low birth weight (VLBW), 4(8.5%) were low birth weight (LBW) and 1 (2.1%) were of normal birth weight.

Indication for PICC line insertion

In our study most common indication of PICC line insertion IV infusion in preterm was 36(76.5%),followed by difficult venous access in 6 neonates(12.8%) , prolonged antibiotics administration in 1(2.1%) ,infusion of high concentrated glucose in 2(4.3%) , and for post operative management PICC line were needed in 2 neonates (4.3%).

Attempts taken for insertion of PICC line

During the study period, PICC line insertion success rate was 98% ,1 failure at insertion was noted reason being neonate presented with shock. In 38 neonates (80.8%) PICC line were inserted in first attempt ,7 neonates (14.8%) required 2nd attempt and 3rd attempt was required in 2 neonates (4.4%).

TABLE 1: Attempts for insertion of PICC line

		Frequency	Percent
Number of Attempts	1	38	80.8
	2	7	14.8
	3	2	4.4
	Total	47	100.0

Site of insertion of PICC line

In our study, most commonly used vein was right long saphenous vein in 41 neonates (87.2%) followed by left long saphenous vein. In upper extremity of 2 neonates (4.3%) PICC line was inserted in right basilic vein and in 1 neonate (2.1%) left basilic vein was used.

TABLE 2: Site of insertion of PICC line.

		Frequency	Percent
Site of PICC line	Basilic vein (Right)	2	4.3
	Basilic vein (Left)	1	2.2
	Long saphenous vein (Left)	3	6.3
	Long saphenous vein (Right)	41	87.2
	Total	47	100.0

Infusion given through PICC line

In our study, most commonly PICC line was used for administration of combination of IV fluids, injectable antibiotics and aminovein in 32 neonates (68.1%). In 1 neonate (2.1%) PICC line was used for prolonged administration of injectable antibiotics in culture positive sepsis. PICC line was inserted in 2 neonates for starting of high concentrated glucose in hypoglycemic neonate. In 7 neonates (14.9%).Iv fluids and aminovein was given through PICC line. In 5 neonates (10.6%) PICC line was used for administration of iv fluids and injectable antibiotics.

TABLE 3: Infusion given through PICC line

		Frequency	Percent
Infusion Given	Inj antibiotics (Culture positive sepsis)	1	2.1
	Iv fluids (high concentrated glucose)	2	4.3
	Iv fluids ,aminovein	7	14.9
	Iv fluids ,aminovein,antibiotics	32	68.1
	Iv fluids ,antibiotics	5	10.6
	Total	47	100.0

PICC line dwell time

PICC line dwell time noted in our study was as follows , maximum catheter dwell time was 21 days noted. Catheter dwell time was 16-20 days for 16 neonates (34%), followed by 21-25 days in 9 neonates (19.2%) ,11 -15 days in 10 neonates (21.4%) ,6 -10 days in 7 neonates (14.8%) and 1-5 days in 5 neonates (10.6%).

TABLE 4: PICC line dwell time (days)

PICC line dwell time (days)	**frequency**	**Percentage (%)**
1-5	5	10.6%
6-10	7	14.8%
11-15	10	21.4%
16-20	16	34%
21-25	9	19.2%
Total	47	100%

Indication for removal of PICC line

In our study, we observe that, PICC line electively removed in 36 neonates which includes after achieving of full feed in 34 neonate (72.4%), after completion of antibiotic course (4.3%). In 3 neonates (6.4%) PICC line was removed because of abdominal distension. In 2 neonates (4.3%) discoloration and swelling over limb was noted hence PICC line was removed. In 1 neonate PICC line occlusion alarm was detected hence PICC line was removed.

Lab investigations of neonates with PICC line
C reactive protein (CRP)

In the present study of 47 neonates with PICC line , we have sent C reactive protein and we found that CRP was positive among 12 neonates (25.5%) and negative in 35 (74.5%).

Blood Culture

In the present study of 47 neonates with PICC line, we searched for the Blood Culture reports and observed that cultures were found to be positive among 9 neonates (19.15%).

PICC line tip Culture in neonates with PICC line

In the present study of 47 neonates with PICC line, we have sent PICC line tip Culture and we observed that cultures were found to be positive among 7 neonates (14.9%).

Out of 7 CABSI, 4 neonates (57.15%) culture showed klebsiella followed by candida in 2 cultures (28.5%) and acinetobacter organism in 1 culture (14.28%).

TABLE 5: Organism isolated from blood and tip of PICC line culture of catheter associated blood stream infection. (CABSI)

Organism	Frequency	percent
Klebsiella	4	57.15 %
Candida	2	28.57 %
Acinetobacter	1	14.28 %
Total	7	100 %

Complication observed in the neonates with PICC line

In our study, out 47 neonates with PICC line, 31 neonates (66%) with PICC line have no complication. Total 16 various complications have noted. The most common complication observed was CABSI in 7 (14.9%) patients. The second most common complication was NEC which was observed in 3(6.4%) patients. Phlebitis and Sepsis were observed in 2 (4.3%) patients respectively. There was only 1 patient with occlusion as the complication and in 1

patient removal of PICC line was difficult. In the remaining 31 (66%) patients no complications were observed.

Outcome of Patients with complications

Total 16 various complication have noted.The outcome observed in the study showed that out of 7 patients who had CABSI, 5 patients were discharged and 2 patients were expired. Patient who had Sepsis 1 patient was discharged and 1 left against medical advice. One patient with NEC was expired while the other 2 were discharged. All the patients with occlusion, phlebitis and difficult to remove PICC line complications were discharged. In total 39 patients were discharged, out of which 12.8% had CABSI, 5.1 % had phlebitis and NEC respectively as the complication. Amongst the discharged patients, sepsis, occlusion, difficult to remove were the complications observed in 2.6% patients respectively and the remaining 69.2% were without complications.

TABLE 6: Outcome of neonates with PICC line.

Complication	**Outcome**				
	DISCHARGED N(%)	LAMA N(%)	EXPIRED N(%)	REFERED TO HIGHER CENTER N(%)	Total N(%)
CABSI	5(12.8%)	0	2(50%)	0	7(14.9%)
SEPSIS	1(2.6%)	1(50%)	0	0	2(4.3%)
NEC	2(5.1%)	0	1(25%)	0	3(6.4%)
Phlebitis	2 (5.1%)	0	0	0	2(4.3%)
Occlusion	1 (2.6%)	0	0	0	1(2.1%)
DIFFICULT TO REMOVE	1(2.6%)	0	0	0	1(2.1%)
NO COMPLICATION	27(69.2%)	1(50%)	1(25%)	2(100%)	31(66%)
Total	39	2	4	2	47
Total %	100.00%	100.00%	100.00%	100.00%	100.00%

Distribution of Participants based on Outcome

In our study ,out of 47 patient , 39 neonates (83.1%) were discharged , 4 (8.5%) were expired, 2 (4.3%) were referred to higher center and LAMA each.

DISCUSSION

In the present study, from February 2020 to August 2022, a total of 47 neonates with PICC line were included. During the study period, data has been collected regarding the gestational age of neonates, birth weight, indication for insertion, date of insertion and date of removal, site of insertion, ease of insertion, catheter days, complications and indications for removal as per mentioned in the proforma.In the present study of 47 neonates with PICC line, Gender wise distribution among the neonates was 57.4% were male and 42.6% were females.The median gestational age for insertion of PICC line in our study was 30 weeks. The results showed that the gestational age of majority of the participants admitted in NICU was between 26-35 weeks. In previous study conducted by Purkayastha J et al [4] the median age of the babies was found similar to our study i.e 30 weeks whereas in other studies conducted by Hoang et al [67] and Neubauer A et al[5] the gestational age was found between 28-30 weeks.The median birthweight in present study was 1100 g with most of the participants had birthweight between 700g to 1500gms. In the study conducted by Hoang et al birthweight of the participants was 940g while in the study by Neubauer et al the birthweight was 1330g. [5] The primary indication for PICC in our study was securing Iv access in preterm neonates which was 76.5% followed by difficult venous access (12.8%). This finding of our study was similar to the previous studies conducted by Uygun I et al , Hoang et al and Neubauer et al. Uygun I et al which reported IV access as the most common indication for insertion of PICC followed by injectable antibiotics (25%), TPN (12%), irritant

agents (3%). The success rate of PICC line insertion at first attempt in our study was 80.8%. The success rate of insertion varied between 88-95% in previous studies. [5,6] In the study by Neubauer et al. [6] the success rate at first attempt was 63.6%. In a study by Njere I et al. the success rate at first attempt was 71%. [7]The site of insertion preferred in current study was right long saphenous vein. Commonly used veins for PICC insertion are the saphenous and popliteal in the lower extremities and the basilic, cephalic, and axillary veins in the upper extremities. [8,9] The PICC line inserter selects an insertion location based on the quality of the vein, the infant's condition, and the inserter's skill and preference. To achieve maximum benefit from a PICC line, the catheter tip should be centrally located within the body. [10] Hoang V et al. compared lower limb vs. upper limb insertion for TPN and found that lower limb PICC lines ha lower CABSI, longer time to first complication and lower cholestasis hence they suggested that lower extremity PICC lines should be inserted for TPN. [10] In this study, we could not compare lower limb vs. upper limb PICC line insertion since majority of PICC lines were inserted in lower extremity. Long saphenous vein becomes prominently visible by day 2 of life in extremely premature babies once the oedema subsides hence the bias for lower extremity PICC line in our study.Out of 47 study participants,3 PICC line were inserted in upper extremity. Tip of catheter was confirmed by Xray to prevent complications like arrhythmias,cardiac tamponade , pericardial effusion. In the present study, 1 PICC line tips was in right atrium,1 PICC line tip was crossed midline noted in X-ray and was subsequently pulled out. There was no incidence of pericardial effusion in the present study.In our study median catheter duration was 18 days. Hoang V et al., the median catheter duration was 13 days (8-22 days). Neubauer et al, reported the median catheter duration of 22 days. In our study the most common complication found was catheter associated blood stream infection (CABSI) which was 14.9%.This is similar to our findings Hoang et al also reported CABSI as the major complication of PICC line insertion. Freeman et al reported decreased birth weight, gestational age, and longer length of stay increases the chances of CABSI.[11] .Hoang et al [5] reported that placement of PICCs in either the upper extremity or the lower extremity has no difference in catheter-related complications. Most of the studies reported most common infection as Coagulase negative Staphylococcus[5,7]. In our study Out of 7 CABSI , 4 babies (57.3 %) culture showed klebsiella followed by candida (28.5%).In our study, we noted 3 cases of necrotizing enterocolitis in neonates with PICC line. No such complication has been reported in previous literature. PICC line could also have caused vasospasm followed by thromboembolic phenomenon, which can cause reduced intestinal perfusion or bacterial invasion and translocation. These 3 neonates also had additional risk factors for development of NEC, like prematurity and low birth weight. Intestinal immaturity plays an important role in the pathogenesis of NEC:increased permeability of the intestinal epithelium, decreased motility, a thinner mucus layer, low or absent levels of secretory IgA, and lack of regulatory adaptation of the intestinal mucosal immune system.[12]The other frequent complication reported in our study was phlebitis. This finding was consistent with the study conducted by Kambam K et al were the phlebitis was found in 5.4% babies. [13]In our study only 1 case was noted with the occlusion as the complication of PICC line. In contrast Kambam K et al . [13] reported occlusion as the major complication in their studies. The findings of our study are in consensus with those reported by other investigators. Subhani et al [14] postulated that a higher infection rate in the extremely low-birth-weight neonates could reflect functional immaturity of the immune system.In present study PICC line was electively removed in 76.7% neonates ,in 23.3 % PICC line was removed because of complication and in 10.5% PICC line was removed because of death or LAMA. Njere I et al., reported elective removal of 53.7%, complications-36.9%, abnormal position-1.4%, after death1%.

LIMITATIONS

Our study includes a heterogeneous patient population and larger studies are required for identifying risk factors in specific groups of patients. Comparison between upper limb and lower limb was not done since we have chosen long saphenous vein in most of the neonates, these are the limitations of our study.

CONCLUSION

PICC line has become a vital mode of providing medication to neonates especially in extreme preterm neonates. Hence it is important to recognize its utility, complication, durability and factors involved in removal of catheter. In our study most common indication of PICC line insertion was securing IV access in preterm neonates. In our study, most of the PICC line was electively removed. PICC line catheter was kept in situ for 14 to 21 days. Most common complication observed in neonates with PICC line was CABSI. Other complications observed were phlebitis, occlusion, and difficulty in removal, sepsis and necrotizing enterocolitis. In our study most of the neonates with PICC line were discharged, even those who developed complication.

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