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Original research article

STUDY OF CULTURE AND ANTIBIOTIC SENSITIVITY PATTERNS IN PICC LINE INSERTION AMONG NEONATES

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Abstract

Standard of PICC line maintenance and care has changed since then. An extensive national survey of NICU PICC practices in USA suggested that there is wide variation in multiple aspects of PICC line insertion and maintenance in different centres. Approximately 87% of blood stream infections are associated with the presence of some type of intravascular device. CLABSI is the most life-threatening of all health care acquired infections. Data was entered into Microsoft excel data sheet and was analyzed using SPSS 22 version software. Categorical data was represented in the form of frequencies and proportions. Continuous data was represented as mean and standard deviation. Among neonates who developed CLABSI, 12.5% had shown staph aureus, 37.5% had shown *E. coli*, 43.75% had shown *Klebsiella*, 6.25% had shown pseudomonas.

Keywords: Microbiological profile, PICC line, CLABSI

Introduction

PICC lines are associated with a number of insertion and maintenance problems, including clotting, catheter fracture, phlebitis, occlusion, oozing, swelling, malposition and catheter line associated bloodstream infection (CLABSI). CLABSI is potentially life-threatening and carries risks of mortality or morbidity. The reported rates of CLABSI range from 4.8-16.5 per 1000 catheter-days in the NICU, with the smallest and most premature infants being at the greatest risk. In 1973, Shaw described a technique for inserting a silicone catheter into the central veins of neonates. Since then, the practice of inserting Peripherally Inserted Central Catheter (PICC) has been increasing because of improvements in catheter technology and insertion devices [1, 2].

Standard of PICC line maintenance and care has changed since then. An extensive national survey of NICU PICC practices in USA suggested that there is wide variation in multiple aspects of PICC line insertion and maintenance in different centres.

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Approximately 87% of blood stream infections are associated with the presence of some type of intravascular device. CLABSI is the most life-threatening of all health care acquired infections [3].

Infections associated with the use of intravascular catheters represent around 10-20% of all nosocomial infections and cause a substantial morbidity and mortality. More than 250,000 intravascular catheter-related bacteremia and fungemia occur annually in developed countries like USA with a attributable mortality of 12-25%.

The microorganisms that colonize an intravascular catheter and subsequently disseminate into blood stream, causing blood stream infection, can gain access to the device through 4 different routes [4].

1. Invasion of the skin insertion site.
2. Contamination of the catheter hub.
3. Haematogenous spread from a distant site of infection.
4. Infusion of contaminated fluid through the device.

The first 2 sources of infection are the most important. The microrganisms that gain access through the skin insertion site tend to migrate along the external surface of the catheter, organisms inoculated into the hub migrate along the internal lumen of the catheter [5].

The risk of such infections also depends on the characteristics of host, the number of interventions, invasive procedures, asepsis of techniques, the duration of hospital stay and inappropriate use of antimicrobials.

Most often the endogenous flora of the patient, may be altered because of hospitalization, that might be the reason for nosocomial infections. The characteristic flora migrating to the catheter surface from the skin site include Coagulase negative staphylococcus (CONS) and Staphylococcus aureus, while nosocomial pathogens such as Stenotrophomonas, Pseudomonas, Enterococci, Candida and Staphylococci can reach the hub site via the hands of health care personnel [6].

Though studies on BSI related to central catheter are available, studies on BSI related to PICCS in neonates are scanty With widespread use of PICCS in the NICU, it is imperative to know the association of CLABSI in relation with PICCS as this will help in understanding the burden of such infections, correct use of antibiotics according to their sensitivity patterns and also to formulate preventive measures for the same.

Methodology

Source of data

Data was collected from all neonates including PNC cases with PICC inserted in NICU.

Type of study

It is a Hospital based Prospective Observational Study.

Place of study

This study was conducted at NICU, Department of Paediatrics.

Inclusion criteria

All neonates including PNC cases with PICC inserted for any cause at NICU

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Exclusion criteria

This study excludes

1. Patients with previously diagnosed bacteremia and septicemia
2. PICCS terminated within 48 hours of insertion.

Sample size

Based on the previous studies observed that incidence rate of PICC line associated infection was 19% (throughout the observation period) To estimate the true incidence of PICC line associated infections with 8% error and 95% confidence interval, sample size estimated is minimum of 93.

$$n=\frac{z^2 pq}{d^2}=93$$

z = 1- 96 at 95% confidence interval d = Margin of error = 8%.
p = Incidence of CLABSI = 19%.
Data was entered into Microsoft excel data sheet and was analyzed using SPSS 22 version software. Categorical data was represented in the form of frequencies and proportions. Continuous data was represented as mean and standard deviation.

Statistical analysis

Graphical representation of data: M S Excel and MS word was used to obtain various types of graphs such as diagram, bar diagram.
P value (probability that the result is true) of < 0.05 was considered as statistically significant after assuming all the rules of statistical tests.

Statistical Software: MS Excel, SPSS version 22(IBM SPSS Statistics, Somers NY, USA (was used to analyze data.

Catheter insertion method

The Insertion and maintenance of catheters were performed according to the following protocol. The catheters were inserted with the following sterile-barrier precautions: use of large sterile drapes around the insertion site, surgical antiseptic hand wash, and sterile gown, gloves, mask and cap. The skin insertion site was first disinfected with povidone - iodine and 70% alcohol. The catheters were percutaneously inserted using the modified Seldinger technique and were fixed to the skin with the help of tegaderm.
After the line insertion, the area surrounding the catheter was cleaned with sterile gauze soaked with povidone iodine and a dry sterile gauze occlusive dressing covered the site. No topical antimicrobial ointment was applied to insertion sites.
The percutaneous entry sites were examined for the presence of local inflammation and purulence, and were cared for in the same manner the percutaneous entry sites were examined daily.
The decision to remove the catheter was made by the attending clinician, Catheters were removed when they were no longer needed or if a systemic or local complication occurred. All catheter tips removed were routinely cultured.

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Results

Table 1: Demographic profile of neonates

		n Total	%
SEX	Male	53	48.18
	Female	57	51.82
Birth Weight	<1.5 Kg	37	33.6
	1.5 - 2.5Kg	38	34.5
	>2.5Kg	35	31.81
Gestational Age	28-32 wks.	29	26.36
	32-34 wks.	22	20.00
	34-37 wks.	15	13.64
	>37 wks.	44	40.00
Age of insertion	1-3 days	77	70.00
	3-7 days	30	27.27
	7-12days	03	2.73
	>12 days	00	00
Indications for PICC line	Difficult IV access	68	61.81
	RDS	10	9.09
	MAS	10	9.09
	HIE	17	15.49
	NEC	1	0.91
	AKI	4	3.64
Site of insertion	LL	106	96.36
	UL	04	03.64
Dwell Time	>2 days - <4 days	10	9.09
	4 - 7 days	37	33.64
	7 - 10 days	51	46.36
	10 - 15 days	11	10.00
	>15 days	01	0.91

Among the 110 neonates in our study 48.18% were male, 51.82% were female with M: F ratio 1:1.1.

In our study median birth weight was 1.9 kg. Maximum cases belonged to 1.5-2.5 kg 34.5% followed by < 1.5 kg 33.6% and > 2.5 kg [31.81%.].

The median gestational age was 35 wks., maximum cases belongs to >37 wks. 40%, followed by 26.36% neonates were 28 to 32 wks., 20% were 32 to 34 wks., 13.64% were 34 to 37 wks. of gestational age.

The mean insertion day of life in our study was 2.44 days, 70% were inserted between 1 to 3 days of life, 30% were inserted between 3 to 7 days, 2.73% were inserted between 7 to 12 days of life.

Indications for PICC line insertion - 61.81% was difficult IV access, followed by 15.49% was HIE 9,09% RDS and MAS cases each, 3.64% was AKI, 0.91%was NEC.

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Site of insertion for PICC line - 96.36% were inserted in lower limb, 3.64% were inserted in upper limb.

In our study median dwell time was 9.7 days, maximum cases was 46.36% were 7 to 10days, 33.64% cases was between 4 to 7 days, 10% was 10 to 15 days, 9.09% was >2to<4days and 0.91% was >15 days.

Among the 110 neonates, 14.55% of the blood culture was positive, 14.55% of the catheter tip culture positive and catheter tip colonization only present in 6.36%.

Table 2: Rate of complications per thousand catheter days

Complications	No of neonates	Rate per 1000
CLABSI	16	(37/906)*1000 = 40.83 per 1000
Non-CLABSI	21	
Total	37	

In our study total catheter days was 906 days, the rate of complication was 40.83 per 1000 catheter days. Among that CLABSI was 17.6 per 1000 catheter days, Non CLABSI was 23.2 per 1000 catheter days.

Table 3: Status of microorganism wise distribution of CLABSI neonates

Micro organism	Blood culture Positive	%
Staph aureus	2	12.50
E. Coli	6	37.50
Klebsiella species	7	43.75
Pseudomonas	1	6.25

Among neonates who developed CLABSI, 12.5% had shown staph aureus, 37.5% had shown *E. coli*, 43.75% had shown *Klebsiella*, 6.25% had shown pseudomonas.

Table 4: Percentage of gram positive and gram negative microorganism causing CLABSI

micro organisms	With CLABSI	%
Gram Negative		
E. Coli	6	37.50
Klebsiella species	7	43.75
Pseudomonas	1	6.25
Total	14	87.50
Gram positive		
Staph aureus	2	12.50

Among the CLABSI Gram positive organisms were 12.5%, gram negative organisms were 87.5%.

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Table 5: Association between antibiotic sensitivity and status of CLABSI of neonates

Antibiotic	Micro organisms				Total	%
	Staph areous	*E. coli*	*Klebsiella* species	pseudomonas		
Ampicillin	0	0	0	0	0	00
Ofloxacin	0	1	1	1	3	18.75
Cefotaxime	1	2	2	1	6	37.5
Piperacillin	2	4	6	1	13	81.25
Amikacin	2	5	7	0	14	87.5
Meropenem	2	2	6	1	11	68.75
Vancomycin	2	2	7	1	12	75
Linezolide	2	1	7	1	11	68.75

Among neonates with CLABSI, none of them were sensitive to ampicillin, 18.75% were sensitive to ofloxacin, 37.5% were sensitive to cefotaxime, 81.25% were sensitive to Piperacillin + tazobactam, 87.5% were sensitive to amikacin, 68.75% were sensitive to meropenam,75% were sensitive to vancomycin, 68.75% were sensitive to linezolide.

Table 6: Association between antibiotic resistance and status of CLABSI of neonates

Antibiotic	Micro organisms				Total	%
	Staph areous	*E. coli*	*Klebsiella* species	pseudomonas		
Ampicillin	2	6	7	1	16	100
Ofloxacin	2	5	6	0	13	81.20
Cefotaxime	1	4	5	0	10	62.5
Piperacillin	0	2	1	0	3	18.75
Amikacin	0	1	0	1	2	12.5
Meropenem	0	4	1	0	5	31.25
Vancomycin	0	4	0	0	4	25
Linezolide	0	5	0	0	5	31.25

In CLABSI, 100% were resistant to ampicillin, 81.2% were resistant to ofloxacin, 62.5% were resistant to cefotaxime, 18.75% were resistant to Piperacillin + tazobactam, 12.5%were resistant to amikacin, 31.25% were resistant to meropenam, 25% were resistant to vancomycin, 31.25% were resistant to linezolide.

Table 8: Catheter colonization wise distribution of neonates

Cath colonization	No of neonates	% of neonates
CONS	2	1.81
E. coli	2	1.81
Klebsiella	3	2.72
Percentage of catheter colonization=6.34%		

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Among total neonates with catheter tip colonization 1.81% has grown CONS, 1.81% had shown *E. coli*, 2.72% had shown *Klebsiella*. Percentage of catheter colonization was 6.34%.

Table 9: Electively removed wise distribution of neonates

Electively removed	No of neonates	% of neonates
No	15	13.64
Yes	95	86.36
Total	110	100.00

In 86.36% the PICC was removed electively

Discussion

In this study among the 110 neonates all the PICCS inserted were single lumen, 96.36% of PICCS were 2 Fr in size and 3.63% were 1 Fr. Almost all the PICCS were inserted at single attempt 93.63%, 3.63% were second attempt, 2.72% were inserted at third attempt. We could not compared status of CLABSI in relation with the number of attempts of insertion of PICCS and size of PICCS line used, since majority of the PICCS were inserted at single attempt and 2Fr PICCS were inserted predominantly.

In the present study, in 96.36% of neonates PICC line was inserted in lower limb (long sephenous vein), in 3.64% of neonates PICC line was inserted in upper limb. Which was similar to the study conducted by Jayashree *et al*. [7] where PICC was inserted in the long sephe nous vein in 91.1% neonates, Long Saphenous vein becomes prominently visible by day 2 of life in premature babies once the oedema subsides hence the bias for lower extremity PICC line [7]. Neonates in whom PICC line was inserted in lower limb, 15.09% developed CLABSI, in neonates in whom PICC line was inserted in upper limb none of them developed CLABSI. There was no statistical significance between site of insertion and status of CLABSI of neonates (p=0.9).which was similar to the study conducted by DD Wrightson *et al*. [8] where there was no significant difference between upper limb and lower limb CLABSI. However, a study conducted by Hoang v *et al*. [9] found that lower limb PICC lines had lower CLABSI.

In our study PICC line tip was confirmed by X-ray, following an insertion. All the PICC line tips were central in position (100%), which was similar to the Uygun I *et al*. [10].

Median dwell time in this study was 9.7 (range of 3-17days) days. Which was similar to study conducted by jayashree *et al*., [7] where the median dwell time was 11 days. In another study conducted by Aarnab sengupta *et al*. [11] the median dwell time was 12 days. In neonates whose dwell time was between >2-4 days, none of them developed CLABSI, In neonates whose dwell time was 4-7 days 18.92% of neonates developed CLABSI, 13.73% of neonates developed CLABSI whose dwell time was between 7-10 days, 18.18% of neonates developed CLABSI whose dwell time was between 10-15 days, none of the neonates developed CLABSI whose dwell time was more than 15 days. There was no statistical significance between dwell time and status of CLABSI of neonates. Many recent studies have shown catheter duration as a risk factor for

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CLABSI. However, evidence for prevention of CLABSI through routine replacement of catheters is lacking. Previous studies focused mainly on central catheters in general and not exclusively on PICCS. A study by Stenzel *et al*. showed no difference between duration of catheterization and daily probability of developing infection [12].

In our study the rate of complication was 40.83 per 1000 catheter days. The rate of incidence of CLABSI was 14.55% (16), 17.6 per 1000 catheter days. These results were concordant with the data of other publications, which was similar to the study conducted by Njere *et al*. [13] where the rate of CLABSI was 17 per 1000 catheter days. Some studies reported infection rate of 12-15.1% this was in contrast to data reported in the NHSN report in which the CLABSI ranged from 3.1-6.4 per 1000 catheter days. This high rate could be related to increased number of VLBW (33.6%), LBW (34.5%) neonates in our study who needs frequent handling, ventilation, underlying patient condition, physical environment have shared this highrate.

Among the CLABSI 87.5% were gram negative,12.5% were gram positive microorganisms the predominant microorganism was *Klebsiella* species (43.75%),followed by *E. coli* (37.5%),staph. aureus (12.5%) and pseudomonas was 6.25%. Which was similar to study conducted by Kamel YMN *et al*. [14] where was 46.2% at MUCH. Also Shouman *et al*. [15] found that nearly 50% of neonatal sepsis in MUCH NICU was, this could be due to hospitalized neonates are often colonized with, enterobacter species at high rates when compared with the babies at home in whom *E. coli* is the main bowel flora [14]. The risk of stool colonization with these species is increased with over three days of antibiotic use and with length of hospital stay, it was found that the colonized babies are the commonest reported source of infection with gut colonization as the major reservoir [14]. Among the isolated organisms 81.25% were sensitive to piperacillin and Tazobactum, 87.5% sensitive to amikacin, all are resistant to ampicillin. In our study the rate of non CLABSI related complication was 23.2 per 1000 catheter days. Among total of 110 neonates, 2.73% developed redness at insertion site, 0.91% developed swelling at insertion site, 1.82% developed oozing, occlusion was seen in 13.64% of neonates, 14.55% of neonates developed CLABSI. Among non CLABSI related complication most common was occlusion (13.64%) which was similar to the study conducted by Njiere *et al*. [13] where the most common non CLABSI related complication was occlusion which accounted for 23%.In another study conducted by Alessandra *et al*. [16] the rate of occlusion was 19.9 percent.

Conclusion

- Among CLABSI, 87.5% were Gram Negative and 12.5% were Gram Positive Microorganisms. The Predominant Microorganism was Klebsiella Species followed by E Coli, Staph.Aureus and Pseudomonas
- Among the isolated organisms, most of them were sensitive to piperacillin + tazobactum, and amikacin but all are resistant to ampicillin

References

1. Storti A, Manzato AJ, Pizzolitto AC, Pizzolitto EL. Assessment of central venous catheterassociated infections using semi-quantitative or quantitative culture methods. Journal of Basic and Applied Pharmaceutical Sciences, 2006 Sep 1, 27(3).
2. Hadaway L. Flushing vascular access catheters: risks for infection transmission.

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Infection Control Resource. 2007;4(2):1-8.

3. O'Grady NP, Alexander M, Dellinger EP, Gerberding JL, Heard SO, Maki DG, *et al*. Guidelines for the prevention of intravascular catheter-related infections. MMWR Recomm Rep. 2002;51:1-29.
4. Sengupta A, Lehmann C, Diener-West M, Perl TM, Milstone A. Catheter duration and risk of CLA-BSI in neonates with PICCS. Pediatrics. 2010;125:648-53.
5. Mermel LA, Allon M, Bouza E. Clinical practice guidelines for the diagnosis and management of intravascular catheter-related: 2009 Update by the Infectious Diseases Society of America. Clin. Infect Dis. 2009;49:1-45.
6. Linck DA, Donze A, Hamvas A. Neonatal peripherally inserted central catheter team. Evolution and outcomes of a bedside-nurse-designed program. Adv Neonatal Care. 2007;7:22-29.
7. Badr RI, Hammad E, Salama MF, Shouman B, Abdel-Hady H, Nasef N, *et al*. Central venous catheter-related blood stream infections in a neonatal care unit. International Journal of Infection Control; c2013. p. 9.
8. Wrightson DD. Peripherally inserted central catheter complications in neonates with upper versus lower extremity insertion sites. Advances in Neonatal Care. 2013 Jun 1;13(3):198-204.
9. Hoang V, Sills J, Chandler M, Busalani E, Clifton-Koeppel R, Modanlou HD, *et al*. Percutaneously inserted central catheter for total parenteral nutrition in neonates: Complications rates related to upper versus lower extremity insertion. Pediatrics. 2008 May 1;121(5):e1152-1159.
10. Uygun I, Okur MH, Otcu S, Ozturk H. Peripherally inserted central catheters in the neonatal period. Acta Cirúrgica Brasileira. 2011 Oct;26(5):404-411.
11. Sengupta A, Lehmann C, Diener-West M, Perl TM, Milstone AM. Catheter duration and risk of CLA-BSI in neonates with PICCS. Pediatrics. 2010 Apr 1;125(4):648-653.
12. Stenzel JP, Green TP, Fuhrman BP, Carlson PE, Marchessault RP. Percutaneous central venous catheterization in a pediatric intensive care unit: A survival analysis of complications. Critical care medicine. 1989 Oct 1;17(10):984-988.
13. Njere I, Islam S, Parish D, Kuna J, Keshtgar AS. Outcome of peripherally inserted central venous catheters in surgical and medical neonates. Journal of pediatric surgery. 2011 May 1;46(5):946-950.
14. Kamel YM, El Nagdy MM, Hwas SA, El Dakar MA, Shouman BO. CD11b, E-Selectin and PCR versus conventional blood culture for diagnosis of neonatal sepsis. The Egyptian Journal of Medical Microbiology. 2012 Apr;38(1229):1-2.
15. Shouman B, Badr R. Regulated on activation, normal T cell expressed and secreted and tumor necrosis factor-α in septic neonates. Journal of Perinatology. 2010 Mar;30(3):192-196.
16. Franceschi AT, Cunha ML. Eventos adversos relacionados con el uso de catéteres venosos centrales en recién nacidos hospitalizados. Revista Latino-Americana de Enfermagem. 2010 Apr;18(2):196-202.
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