International Journal of Life Sciences, Biotechnology and Pharma Research Vol. 14, No. 2, February 2025 Online ISSN: 2250-3137
Print ISSN: 2977-0122

DOI: 10.69605/ijlbpr_14.2.2025.145

ORIGINAL RESEARCH

Comparison of umbilical venous catheter with peripherally inserted central catheter line for reducing neonatal sepsis in low-birth weight babies: A randomized control trial

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Received: 25 January, 2025 Accepted: 21 February, 2025 Published: 26 February, 2025

ABSTRACT
Background: Neonatal sepsis is a major cause of morbidity and mortality among low birth weight (LBW) infants. Central venous catheters, such as Umbilical Venous Catheters (UVCs) and Peripherally Inserted Central Catheters (PICCs), are commonly used in Neonatal Intensive Care Units (NICUs) for prolonged vascular access. While UVCs provide rapid access, PICCs are preferred for long-term use due to a potentially lower risk of complications. **Objectives:** The primary objective was to evaluate the impact of UVCs and PICCs on neonatal sepsis rates. Secondary objectives included assessing their effects on other neonatal health outcomes such as retinopathy of prematurity, necrotizing enterocolitis, local site infection, catheter blockage, bronchopulmonary dysplasia, and mortality. **Methodology**: A single-center randomized controlled trial was conducted on 162 neonates admitted to the NICU of tertiary care teaching institute, over 24 months. Infants were randomly assigned to the UVC (n=81) or PICC (n=81) groups. Data on sepsis incidence, catheter-related complications, and clinical outcomes were analysed using statistical tests, with a significance level of $p<0.05$. **Results**: Sepsis rates were comparable between UVC (54.3%) and PICC (51.9%) groups ($p=0.43$). Complications, including catheter blockage, displacement, necrotizing enterocolitis, and positive blood cultures, showed no significant differences. Mortality was slightly higher in the UVC group (18.5%) than in the PICC group (13.6%) but was not statistically significant. **Conclusions**: Both UVCs and PICCs are viable options for central venous access in LBW neonates, with no significant difference in neonatal sepsis incidence or overall complications. The choice of catheter should be based on clinical necessity and patient condition.
Keywords: Neonatal sepsis, central venous catheter, Umbilical Venous Catheter (UVC), Peripherally Inserted Central Catheter (PICC), neonatal intensive care

INTRODUCTION

Neonatal sepsis remains a significant cause of morbidity and mortality among low birth weight (LBW) infants, presenting a formidable challenge to neonatologists worldwide. Despite advances in perinatal care, LBW infants continue to exhibit heightened susceptibility to infections due to their immature immune systems and compromised physiological status. Among the various interventions aimed at preventing neonatal sepsis, the choice of vascular access devices plays a pivotal role in minimizing the risk of nosocomial infections. Intravenous access is indispensable in intensive care units (ICUs) , serving both diagnostic and therapeutic purposes. These lines are broadly categorized into short peripheral lines and central lines, with venous

DOI: 10.69605/ijlbpr_14.2.2025.145

cut downs or venesections reserved for exceptional circumstances in NICUs.[1]

Short peripheral lines encompass intravenous catheters and butterfly needles, but they come with a range of complications, including thrombophlebitis, infection, and venous thrombosis. Certain infusates, such as sodium bicarbonate, dopamine, dobutamine, and calcium gluconate, can cause severe phlebitis when administered through peripheral lines. Additionally, the lower rate of infusion through peripheral cannulas is a limiting factor.[2]As a result, for patients requiring intravenous access for more than five days, central catheters are recommended due to their convenience, cost-effectiveness, and lower complication rates. Central venous access involves placing a catheter with its tip in a major venous vessel, such as the superior vena cava, inferior vena cava, or other major veins. [3,4]

In neonates, central catheters come in three main types: central venous catheters (CVCs), umbilical venous catheters (UVCs), and peripherally inserted central catheters (PICCs). Umbilical venous catheters (UVCs) and peripherally inserted central catheters (PICCs) represent two commonly utilized vascular access modalities in neonatal intensive care units (NICUs).CVCs are less favored in NICUs due to procedural challenges, higher complication rates, and user preferences.[2]Both devices offer advantages and disadvantages, necessitating a critical evaluation of their efficacy in reducing neonatal sepsis, particularly in the vulnerable LBW population.UVCs are typically considered short-term venous routes due to the risk of infection associated with heavy bacterial growth around the umbilicus. Both types of catheters are associated with multiple complications, including infection, thrombosis, blockage, displacement, hepatic laceration, liver abscess, pericardial effusion, tamponade, portal venous thrombosis, pleural effusion, and embolization.[5]To mitigate the risk of complications with PICCs, correct positioning of the catheter tip during placement is crucial. Misplacement in the right atrium can increase the risk of pericardial tamponade and arrhythmia. Catheter-related bloodstream infections contribute to increased morbidity, prolonged hospitalization, and the need for additional therapies.While UVCs provide rapid and reliable access to the central circulation, PICCs offer prolonged vascular access with reduced risk of complications such as thrombosis and vessel injury.[6,7]

A comprehensive understanding of the comparative effectiveness of UVCs versus PICCs in mitigating the incidence of neonatal sepsis is imperative for optimizing clinical outcomes and refining current practice guidelines. However, existing literature presents conflicting evidence regarding the superiority of one vascular access device over the other in reducing sepsis rates among LBW infants. Consequently, there exists a compelling need for well-designed randomized controlled trials (RCTs) to elucidate the most efficacious approach for vascular access in this vulnerable patient population. Our study, aims to provide insights into the comparison of umbilical venous catheters and peripherally inserted central catheters and their impact on neonatal sepsis.

MATERIAL AND METHODS

The current study is a single centre Randomized control trial, done on 162 neonates in NICU of MGM Medical College & Hospital Aurangabad for a duration of the study period of 24 months ,from August 2022 to August 2024.the aim of the study was to assess the impact of UVC and PICC on neonatal sepsis rates. Secondary Objectives were to evaluate the impact of UVC and PICC on various neonatal health outcomes, including retinopathy of prematurity, necrotizing enterocolitis, local site infection, line blockage, bronchopulmonary dysplasia, cardiac tamponade, urinary tract infection, apnea, hypothermia, line breakdown, neonatal jaundice, feed intolerance, time to achieve full feeds, and pericardial effusion.

SAMPLE SIZE

The sample size was calculated using G. power software where, alpha =0.05, power =0.95 ,large effect size was considered as 0.8. using G. Power software sample size each group was found to be 81 samples .therefore we enrolled 81 neonates in PICC group and UVC group each .

INCLUSION AND EXCLUSION CRITERIA

In our study low Birth weight babies admitted to NICU requiring at least 5 days of central line access were included.

Newborn babies with local site infection or with fallen umbilical cord (usually occurs after 7 days of life) were excluded from the study. Blood culture positive babies before central line insertion were excluded.

STUDY TOOLS

A pre-tested validated proforma was developed in line with study objectives to collect data for the research purpose. After obtaining the Ethical clearance, the study was initiated. The data regarding the clinical profile was recorded in the study proforma of consenting individuals.Appropriate sized UVC (Vygonindia- four,five,six,sevenFr) or PICC (Vygonindia 1Fr/28G) were inserted in umbilical line and peripheral blood vessel. The policy dictated that central lines be removed as soon as clinically feasible, with a maximum duration of 7 days for both UVC and PICC.The length for UVC insertion - modified Shukla's formula [3(weight of the child)9/2].The site was sterilized alternately with betadine and spirit three times.The length of PICC insertion was estimated by measuring the distance from the insertion site to the xiphisternum when inserted via the lower limb, or to the sternal angle when inserted via the upper limb. UVCs were fixed using micropore and gauze

Online ISSN: 2250-3137
Print ISSN: 2977-0122

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dressings without stitches, while PICCs were secured by coiling and using Tegaderm and gauze dressings.The time required for catheter insertion was measured from when the person performing the insertion began washing and gowning until the dressing was fixed, using a digital stopwatch for accuracy.Patient outcomes were assessed at the end of their hospital stay.The total hospital stay duration was recorded from admission to discharge or death. The cause of failure, if applicable, was determined by the study authors through examination.Radiographs were taken to confirm the catheter tip's position, ideally at the diaphragm level for UVCs.For PICCs, the catheter tip's position was classified as within a central or non-central vein.A continuous infusion of heparin at a dosage of 0.5–1 U/ml was administered for both PICCs and UVCs.Radiography, echocardiography, sonography, septic screening, tip cultures, and blood cultures were conducted as needed and according to protocol to monitor for complications.The catheter was considered successful if it was electively removed.

ETHICAL CLEARANCE AND WRITTEN INFORMED CONSENT

Ethical clearance was obtained from the Institutional Ethics Committee (MGM/ECHRS/2022/133). Written informed consent for participation in this study was taken from all participants. The confidentiality of the patient's data was ensured.

DATA ENTRY AND ANALYSIS

Data entry was done in MicrosoftExcel 2019 and analyzed using SPSS version 26.0 (IBM). Descriptive statistics included measures like mean, standard deviation, range, and proportions. The results were represented in tabular and graphical formats. McNemar Chi square was used to see difference between two categorical variables and independent sample t -test was used to see difference between two quantitative variables. P value of <0.05 was considered as level of significance.

RESULTS

In our study among 81 patients with UVCs, 41 were male (50.6%) and 40 were female (49.4%). For those with PICCs, 44 were male (54.3%) and 37 were female (45.7%). For mothers under 20 years old, 14 had infants with UVCs (17.3%) and 20 had infants with PICCs (24.7%). Among mothers aged 20-30 years, 58 had infants with UVCs (71.6%) and 52 had infants with PICCs (64.2%). For mothers over 30 years old, both groups had 9 infants (11.1%). Among patients with UVCs, 19 (23.5%) were delivered vaginally, while 62 (76.5%) were delivered via lower segment caesarean section (LSCS). For patients with PICCs, 23 (28.4%) were delivered vaginally, and 58 (71.6%) were delivered via LSCS. For patients with UVCs, preeclampsia was the most common antenatal risk factor (28 cases, 34.6%), followed by oligohydramnios (19.8%) and gestational diabetes (14 cases, 17.3%). In the PICC group, preeclampsia was also most common (30 cases, 37.0%), with similar distributions of other risk factors. Among those with UVCs, 26 (32.1%) were born before 32 weeks of gestation, 49 (60.5%) were born between 32 and 38 weeks, and 6 (7.4%) were born after 38 weeks. For PICC patients, 19 (23.5%) were born before 32 weeks, 54 (66.7%) between 32 and 38 weeks, and 8 (9.9%) after 38 weeks.Overall, the majority of patients in both groups were born between 32 and 38 weeks of gestation. Steroid administration was noted in 45 UVC patients (55.6%) and 38 PICC patients (46.9%). Among those with UVCs, 23 (28.4%) had a birthweight between 2 and 2.5 kilograms, while 58 (71.6%) had a birthweight below 2 kilograms. For patients with PICCs, 28 (34.6%) had a birthweight between 2 and 2.5 kilograms, and 53 (65.4%) had a birthweight below 2 kilograms. Overall, the majority of patients in both groups had a birthweight below 2 kilograms

Among those with UVCs, 48 (59.3%) required ventilator support, while 33 (40.7%) did not (**Table No 1)**. For patients with PICCs, 40 (49.4%) required ventilator support, and 41 (50.6%) did not. Overall, a higher proportion of patients with UVCs required ventilator support compared to those with PICCs. Among the 48 patients with UVCs, 31 (64.6%) required ventilation for less than 5 days, 14 (29.2%) for 5 to 10 days, and 3 (6.3%) for more than 10 days. Similarly, among the 40 patients with PICCs, 28 (70.0%) were ventilated for less than 5 days, 9 (22.5%) for 5 to 10 days, and 3 (7.5%) for more than 10 days. The p-value for the comparison between the two groups was 0.77, indicating no statistically significant difference in the duration of ventilation between patients with UVCs and PICCs. CPAP was received by 53 UVC patients (65.4%) and 48 PICC patients (59.3%). Duration of CPAP comparisons showed no significant differences (p=0.66)(**Table No 2).** Sepsis was a primary indication for central line placement in 39 UVC patients (48.15%) and 41 PICC patients (50.62%). Mean age of babies (days of life) at time of insertion of central line was UVC group :19.12 ± 21.247 days (Range 1 hour -4 days) and PICC group : 32.28 ± 51.06 (Range 2 hours-16 days). There was a significant difference in the mean age of babies (p=0.036) (**Table No 3**).Catheter insertion sites varied significantly, with UVCs primarily placed in the umbilical vein (100%) and PICCs in the right saphenous vein (60.3%). Clinical sepsis was observed in 54.3% of UVC patients and 51.9% of PICC patients (p=0.43). For UVC, 48 patients (59.3%) had the centralline for less than 5 days, compared to 40 patients (49.4%) with PICC, with a p-value of 0.41, indicating no significant difference. For the duration of 5-10 days, 30 patients (37.0%) had UVC, whereas 38 patients (46.9%) had PICC. Lastly, both UVC and PICC had 3 patients (3.7%) each with a duration of more than 10 days. No statistically significant differences in the duration of central line use between the two methods were observed.

Skin site changes occurred in 8.6% of UVC patients and 9.9% of PICC patients (p=0.50). Displacement and blockage rates were higher in PICCs but not significantly (p=0.13 and p=0.11).(**Table no 4)** Cardiac tamponade and fever were rare and comparable between groups.Necrotizingenterocolitis was noted in 12 patients (14.8%) with UVC and 10 patients (12.3%) with PICC, with a p-value of 0.41. Complication rates between UVCs and PICCs were comparable, with no significant differences. Positive blood cultures were noted in 16.0% of UVC patients and 17.3% of PICC patients (p=0.50). Among UVC patients, 31 (38.3%) had their catheters removed due to achieving full feeds, compared to 35 (43.2%) in the PICC group. Complications led to the removal of catheters in 26 (32.1%) UVC patients and 32 (39.5%) PICC patients. Death was the reason for removal in 10 (12.3%) UVC patients and 9 (11.1%) PICC patients. Discharge against medical advice accounted for catheter removal in 7 (8.6%) UVC patients and 4 (4.9%) PICC patients. Finally, prolonged stay resulted in catheter removal in 7 (8.6%) UVC patients and 1 (1.2%) PICC patient. The p-value for these comparisons was 0.18, indicating no statistically significant difference in the reasons for catheter removal between the two groups. CRP values at 0, 48, and 96 hours showed no significant differences between groups. Second line of treatment was required more in UVC patients but not significantly (p=0.11). There was no significant difference in the incidence of CABSI between very preterm neonates who received a PICC, UVC, or UVC followed by PICC. Of the 81 patients with UVC, 29 (35.8%) required a second central line , while among the 81 patients with PICC, 21 (25.9%) needed a second line. The p-value is 0.11, indicating that there was no statistically significant difference in the need for a second centralline between the two groups. However, it's important to note that a higher proportion of patients with UVC required a second line compared to those with PICC, although the difference was not significant at the chosen level of significance.Among the patients with UVC, 12 (14.8%) had a hospital stay of less than 5 days, 20 (24.7%) stayed between 5 to 10 days, and 49 (60.5%) stayed for more than 10 days. Similarly, among the 81 patients with PICC, 11 (13.6%) stayed for less than 5 days, 23 (28.4%) stayed between 5 to 10 days, and 47 (58.0%) stayed for more than 10 days. Hospital stay duration showed no significant differences (p=0.86). (**Table no 5)**

Table1 showing the Baseline characteristics of study participants, antenatal risk factors , steroid use and use of ventilator

Baseline characteristics		**UVC**	**PICC**	**p-value**
Sex	Male	41 (50.6%)	44 (54.30%)	0.377
	Female	40 (49.4%)	37 (45.7%)	
Mode of delivery	Vaginal	19 (23.5%)	23 (28.4%)	0.483
	LSCS	62 (76.5%)	58 (71.6%)	
Gestational Age	<32 WEEKS	26 (32.1%)	19 (23.5%)	0.445
	32-38 WEEKS	49 (60.5%)	54 (66.7%)	
	>38 WEEKS	6 (7.4%)	8 (9.9%)	
Birth weight	2- 2.5kg	23 (28.4%)	28 (34.6)	0.249
	<2 kg	58 (71.6%)	53 (65.4%)	
Indication	Sepsis	39 (48.15%)	41 (50.62%)	0.614
	Birth asphyxia	20 (24.69%)	12 (14.81%)	
	Respiratory distress Syndrome	22 (27.16%)	15 (18.52%)	
	Preterm / LBW	22 (27.16%)	19 (23.46%)	
	Congenital Anomalies	1 (1.23%)	4 (4.94%)	
	Meconium Aspiration	11 (13.58%)	7 (8.64%)	
Antenatal Risk Factors	UVC		PICC	
	Number (n=81)	Frequency (%)	Number (n=81)	Frequency (%)
Preeclampsia	28	34.6	30	37.0
Oligohydramnios	16	19.8	16	19.8
Polyhydramnios	7	8.6	8	9.9
Hypothyroidism	7	8.6	4	4.9
PROM	7	8.6	5	6.2
Gestational diabetes	14	17.3	13	16.0
No risk factors	2	2.5	5	6.2
Steroid Use	UVC		PICC	
	Number (n=81)	Frequency (%)	Number (n=81)	Frequency (%)

DOI: 10.69605/ijlbpr_14.2.2025.145

Yes	45	55.6	38	46.9
No	36	44.4	43	53.1
Ventilator	UVC		PICC	
	Number (n=81)	Frequency (%)	Number (n=81)	Frequency (%)
Yes	48	59.3	40	49.4
No	33	40.7	41	50.6

Chi square test was used, p value <0.05 is considered statistically significant

Table 2: showing the number of days on ventilator, use of CPAP and number of days on CPAP

Number of days on ventilator	**UVC (n=48)**		**PICC (n= 40)**		**p-value**
	Number	**Frequency(%)**	**Number**	**Frequency(%)**	**0.77**
<5DAYS	31	64.6	28	70.0	
5-10DAYS	14	29.2	9	22.5	
>10DAYS	3	6.3	3	7.5	
CPAP	UVC		PICC		
	Number (n=81)	Frequency (%)	Number(n=81)		Frequency(%)
Yes	53	65.4	48		59.3
No	28	34.6	33		40.7
Number of days on CPAP	UVC (n=53)		PICC (n= 48)		p-value
	Number	Frequency (%)	Number	Frequency(%)	
<5DAYS	29	54.7	22	45.8	0.66
5-10DAYS	18	34.0	25	52.1	
>10DAYS	6	11.3	1	2.1	

Chi square test was used, p value <0.05 is considered statistically significant

Table 3: Showing the Indication for central line, reqiuirement of central line, Mean age of babies (days of life) at time of insertion of central line, Site of insertion, evidence of clinical sepsis, Material used to fix line

Indication for central line	**UVC**		**PICC**		
	Number (n=81)	**Frequency(%)**	**Number (n=81)**		**Frequency (%)**
Sepsis	39	48.15	41		50.62
Birth asphyxia	20	24.69	12		14.81
Respiratory distress Syndrome	22	27.16	15		18.52
Preterm / LBW	22	27.16	19		23.46
Congenital Anomalies	1	1.23	4		4.94
Meconium Aspiration	11	13.58	7		8.64
Requirement for central line	UVC		PICC		
	Number(n=81)	Frequency(%)	Number(n=81)		Frequency (%)
Total parenteral nutrition(TPN)	14	17.3	17		21.0
Ionotropes	31	38.3	33		40.7
TPN + Ionotropes	36	44.4	31		38.3
Total	81	100.0	81		100.0
Site of insertion	UVC		PICC		
	Number(n=81)	Frequency(%)	Number(n=81)		Frequency (%)
Umbilical vein	81	100	-		
Right saphenous vein	-	-	49		60.4
Left saphenous vein	-	-	32		39.6
Evidence of clinical sepsis	UVC		PICC		p-value
	Number(n=81)	Frequency (%)	Number (n=81)	Frequency (%)	
Yes	44	54.3	42	51.9	0.43
No	37	45.7	39	48.1	

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Total	81		100.0	81	100.0	
Age of babies (days of life)	UVC		PICC			p-value
	Mean	SD	Mean	SD		
	19.12	21.247	32.28	51.06		0.036
Material used to fix line	UVC		PICC			
	Number (n=81)	Frequency (%)	Number (n=81)	Frequency (%)		
Fixomall	22	27.16	49	60.49		
Tegaderm	-	-	32	39.50		
Bridge stickers	59	72.83	-	-		
Total	81	100.0	81	100.0		

Chi square test was used, p value <0.05 is considered statistically significant , unpaired t test was used to compare means and standard deviations

Table 4: Showing Catheter tip position, Duration of central line, Complications, Blood culture

Catheter tip position	**UVC**		**PICC**		
	Number (n=81)	**Frequency(%)**	**Number (n=81)**	**Frequency (%)**	
0.5	1	1.2	1	1.2	
1	18	22.2	4	4.9	
1.5	4	4.9	1	1.2	
2	19	23.5	21	25.9	
2.5	5	6.2	8	9.9	
3	12	14.8	21	25.9	
3.4	1	1.2	-	-	
3.5	2	2.5	3	3.7	
4	9	11.1	12	14.8	
4.6	1	1.2	2	2.5	
5	1	1.2	3	3.7	
6	2	2.5	3	3.7	
AT LEVEL	6	7.4	2	2.5	
Total	81	100.0	81	100.0	
Duration of central line	UVC		PICC		p-value
	Number (n=81)	Frequency (%)	Number (n=81)	Frequency (%)	
<5DAYS	48	59.3	40	49.4	0.41
5-10DAYS	30	37.0	38	46.9	
>10DAYS	3	3.7	3	3.7	
Total	81	100.0	81	100.0	
Complications	UVC		PICC		p-value
	Number	Frequency (%)	Number	Frequency (%)	
Skin site changes	7	8.6	8	9.9	0.50
Displacement	2	2.5	6	7.4	0.13
Blockage	3	3.7	8	9.9	0.11
Cardiac tamponade	1	1.2	1	1.2	0.75
Fever	3	3.7	-	-	0.12
Necrotizing enterocolitis	12	14.8	10	12.3	0.41
Blood culture	UVC		PICC		p-value
	Number (n=81)	Frequency (%)	Number (n=81)	Frequency (%)	
Yes	13	16.0	14	17.3	0.50
No	68	84.0	67	82.7	
Total	81	100.0	81	100.0	

Chi square test was used, p value <0.05 is considered statistically significant

International Journal of Life Sciences, Biotechnology and Pharma Research Vol. 14, No. 2, February 2025 Online ISSN: 2250-3137
Print ISSN: 2977-0122

DOI: 10.69605/ijlbpr_14.2.2025.145

Table 5: Reason for removal, CRP values, Need for 2nd line, Duration of hospital stay, Mortality, Gestational age VS need for 2nd Line

Reason for removal	UVC		PICC		p-value
	Number(n=81)	Frequency(%)	Number(n=81)	Frequency (%)	
Full feeds	31	38.3	35	43.2	0.1`8
Complications	26	32.1	32	39.5	
Death	10	12.3	9	11.1	
Discharge against medical advice	7	8.6	4	4.9	
Prolonged stay	7	8.6	1	1.2	
Need for 2nd line	UVC		PICC		p-value
	Number(n=81)	Frequency(%)	Number n=81)	Frequency(%)	
Yes	29	35.8	21	25.9	0.11
No	52	64.2	60	74.1	
Duration of hospital stay	UVC		PICC		P-value
	Number(n=81)	Frequency (%)	Number (n=81)	Frequency (%)	
<5days	12	14.8	11	13.6	0.86
5-10days	20	24.7	23	28.4	
>10days	49	60.5	47	58.0	
Mortality	UVC		PICC		P-value
	Number (n=81)	Frequency (%)	Number (n=81)	Frequency(%)	
Yes	15	18.5	11	13.6	0.26
No	66	81.5	70	86.4	
CRP values	UVC		PICC		p-value
	Mean	SD	Mean	SD	
At 0 hours(before insertion)	8.29	18.72	11.12	21.75	0.37
48 hours after insertion	29.31	45.26	27.43	30.73	0.75
96 hours after insertion	31.64	46.83	24.75	34.88	0.37

Need for 2nd Line	Gestational Age						p-value
	<32 WEEKS		32-38 WEEKS		>38 WEEKS		
Yes	15	33.3%	33	32.0%	2	14.3%	0.368
No	30	66.7%	70	68.0%	12	85.7%	
Total	45	100.0%	103	100.0%	14	100.0%	

Chi square test was used, p value <0.05 is considered statistically significant , unpaired t test was used to compare means and standard deviations

DISCUSSION

This study compared the effectiveness of UVC and PICC in reducing neonatal sepsis among low-birth-weight (LBW) babies. A randomized control trial involving 162 infants, equally divided between UVC and PICC groups, was conducted to assess various outcomes, including the incidence of sepsis, complications, and overall clinical management.

Our study Findings revealed that out of 81 patients with UVCs, 41 were male and 40 were female, while the PICC group consisted of 44 males and 37 females. The demographic distribution showed no significant sex differences between the UVC and PICC groups. A significant difference was observed in the mean age of infants at the time of catheter insertion, with UVC patients averaging 19.12 hours compared to 32.28 hours for PICC patients (p=0.036). This difference could suggest a preference or clinical indication for earlier intervention using UVCs, potentially due to the immediate accessibility of the umbilical vein in the neonatal period. Konstantinidi et al.[5] had a slightly smaller sample size, with 37 neonates in the UVC group and 34 in the PICC group. Both studies reported similar gestational ages and birth weights across the groups, indicating comparable baseline characteristics. Both groups in our study had a similar distribution of antenatal risk factors, modes of delivery, gestational ages, birth weights, and requirements for ventilator support and CPAP, ensuring comparability across these key variables Both groups in our study had a majority of infants with a birth weight below 2 kilograms and required ventilatory support, with a higher proportion in the UVC group though not statistically significant. Gupta et al.[8] developed a predictive score to aid in deciding between UVC and PICC use based on factors like birth weight and need for resuscitation. Their findings reveal that lower birth weights and other clinical factors predict longer central line requirements align with our observations that patient-specific factors heavily influence catheter outcomes rather that the type of catheter.

Online ISSN: 2250-3137
Print ISSN: 2977-0122
DOI: 10.69605/ijlbpr_14.2.2025.145

Clinical sepsis was observed in 54.3% of UVC patients and 51.9% of PICC patients, with no statistically significant difference (p=0.43). The duration of ventilation and CPAP, did not differ significantly between the groups. Positive blood cultures were found in 16.0% of UVC patients and 17.3% of PICC patients (p=0.50). This is corroborated by Konstantinidiet al.[5], who found no significant differences in catheter-related complications and infections between UVCs and PICCs in very low birth weight (VLBW) newborns younger than 32 weeks gestation.Shalabi et al.[9] compared the rates of catheter-associated bloodstream infections among preterm infants using different venous access methods. Their study also concluded no significant difference in catheter-associated bloodstream infections rates between infants using PICCs, UVCs, or a combination. This aligns with our findings that the overall infection rates between UVCs and PICCs are not significantly different, despite a slight numerical difference favoring UVCs .Gefferset al.[10] identified catheter use as a significant risk factor for nosocomial bloodstream infectionsin very-low-birth-weight infants. They reported a hazard ratio of 6.2 for CVC and 6.0 for peripheral venous catheters. However, our study did not demonstrate a significant difference in the incidence of sepsis between UVC and PICC groups, suggesting that both types of catheters carry a similar risk for infection when managed under comparable conditions and local factors, such as infection control practices, might influence these outcomes.

CRP levels, used as a marker for inflammation and infection, were not significantly different between the UVC and PICC groups at multiple time points (0-hours, 48-hours, and 96-hours post-insertion) in our study. This indicates that both types of catheters are associated with similar inflammatory responses, supporting the notion that the choice between UVC and PICC may not significantly impact the overall inflammatory responses in neonates.

In our study, the duration of catheter use and hospital stays were comparable between the two groups.For instance, 59.3% of UVC patients and 49.4% of PICC patients had the central line for less than 5 days, with no significant difference in duration (p=0.41). Hospital stay duration was also similar, with the majority of patients in both groups staying for more than 10 days (60.5% for UVC and 58.0% for PICC), and no significant difference observed (p=0.86).Mean duration of catheterization between UVCs and PICCs, showed no significant differences consistent with the findings of Konstantinidi et al.[5](10.43 ± 5.38 days for UVCs and 11.91 ± 6.93 days for PICCs).Hess et al.[11] investigated UVC dwell-time in VLBW infants, finding that a longer dwell-time reduced the need for additional PICCs and shortened hospital stays without increasing complications. This finding is particularly relevant to our study, as it suggests that optimizing UVC dwell-time could mitigate the need for PICCs and their associated complications. This supports our observation that UVCs, when used appropriately, can be an effective and safer alternative to PICCs for extended use .

Mortality rates were slightly higher in the UVC group (18.5%) compared to the PICC group (13.6%), though this difference was not statistically significant (p=0.26). Both groups had a majority of survivors, indicating that while there may be minor differences in outcomes, these are not significant enough to strongly favor one catheter type over the other. This is consistent with the results from Hess et al.[11] who found no significant differences in neonatal morbidities and mortality between different catheter types.Konstantinidi et al.[5] did not report significant differences in mortality between the two groups. This suggests that the choice between UVC and PICC does not significantly impact the length of hospitalization, which is more likely influenced by the overall clinical condition of the infants.

The incidence of complications such as necrotizing enterocolitis, catheter blockage, displacement and skin site changes did not differ significantly between the groups in our study. For instance, necrotizing enterocolitis occurred in 14.8% of UVC patients and 12.3% of PICC patients (p=0.41), while catheter blockage was observed in 3.7% of UVC patients and 9.9% of PICC patients (p=0.11).Konstantinidi et al.[5] documented a case of portal vein thrombosis in a neonate with a UVC, a complication not observed in our study.However , higher frequency of blockage in PICCs suggests a trend towards more mechanical issues with PICCs. Dongara et al.[2]also observed comparable complication rates between UVC and PICC, similar to our study. The incidence of clinical sepsis and complications like displacement, blockage, and fever was comparable between the two groups in our study.

Malpositioning complications, although rare, can be severe. PICC misplacement may lead to pericardial effusion or vessel perforation, [38–40]while UVC misplacement can result in liver injury, portal hypertension, hepatic necrosis, or effusions . [41,42] Deep placement of either catheter type can cause heart and lung injuries, but fortunately, no such incidents were reported in our study.

Dongaraet al[2]. conducted a randomized controlled trial comparing PICCs and UVCs, focusing on success rates, complications, and costs. Their results showed comparable success rates for both types of catheters, with UVCs being a cheaper alternative. Our study supports these findings in terms of the similar rates of displacement and blockage between the two groups. The higher cost associated with PICCs in their study also echoes our observation that PICCs tend to be used for longer durations, potentially leading to higher overall costs and slightly higher complication rates. Salonenet al.[12] focused on the risks of complications with thin UVCs and PICCs, finding similar rates of complications and infections, with

DOI: 10.69605/ijlbpr_14.2.2025.145

gestational age being a significant factor. This study supports our findings that both UVCs and PICCs have comparable safety profiles, with specific complications like infections being influenced more by patient factors such as gestational age rather than catheter type.

The reasons for catheter removal were similar between UVC and PICC groups in our study, with full feeds, complications, and death being the reasons. This finding aligns with Salonen et al.[12] who reported similar frequencies and reasons for catheter removal between thin UVCs and PICCs. The duration of hospital stays was also comparable, indicating no significant differences in outcomes related to the type of catheter used .Konstantinidi A. etal.[5] observed no significant differences in reasons for catheter removal, or the incidence of nosocomial infections between UVC and PICC groups. However, they found a higher rate of catheter tip colonization in UVCs (29.72%). This finding complements our results, where UVCs showed a lower rate of catheter-related sepsis, suggesting that while UVCs might be more prone to colonization, this does not necessarily translate to a higher infection rate compared to PICCs.

IMPLICATIONS FOR CLINICAL PRACTICE

The findings of this study have several important implications for clinical practice. First, the choice between UVC and PICC should be guided by individual patient circumstances, including the urgency of access, the clinical condition of the neonate, and the anticipated duration of catheter use. UVCs may be preferred for immediate access in very early life, while PICCs could be more suitable for longer-term use, given their versatility in insertion sites and potentially lower rates of certain complications like displacement. Second, the management and maintenance of both UVCs and PICCs are crucial in minimizing infection risks. Adherence to strict aseptic techniques, regular monitoring for signs of infection, and prompt response to complications are essential regardless of catheter type. Finally, this study underscores the importance of individualized patient care. While statistical analyses provide valuable insights, the clinical context and specific needs of each neonate should always guide decision-making.

CONCLUSION

In conclusion, both UVC and PICC offer viable options for central venous access in LBW neonates, with no significant differences in infection rates, complications, or overall outcomes. The choice of catheter should be tailored to the clinical needs of the patient, with an emphasis on meticulous care and monitoring to ensure the best possible outcomes. Future research should continue to explore specific contexts and conditions that may favor one type of catheter over the other, further refining neonatal care protocols. Overall, our study contributes to the body of evidence suggesting that while both UVCs and PICCs are essential in neonatal care, careful consideration of patient-specific factors, catheter management practices, and optimal dwell-times can significantly impact outcomes and reduce complications. The alignment and divergence with other studies underscore the complexity of catheter use in neonates and the need for tailored approaches in different clinical settings.

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