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Comparing the Complications of Peripherally Inserted Central Venous Catheters and Peripheral Intravenous Catheters in Neonates With Less Than 1250 g Birth Weight in Izadi Hospital, Qom Province, Iran

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<u>ABSTRACT</u>



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Background and Aim: One of the critical differences between outpatient and inpatient treatment is to have appropriate vascular access. Hospitalization usually begins with a venipuncture. Considering the lack of documented and sufficient studies in this field, the present study was designed to determine the difference between peripherally inserted central venous catheters (PICCs) and peripheral intravenous (PIV) in terms of complications during hospitalization, such as sepsis and other possible complications caused by venipuncture.

Materials and Methods: In this cross-sectional-analytical study, the files of patients and neonates with less than 1250 g birth weight who had PICC or PIV were examined based on the inclusion criteria. Confounding variables, such as birth weight, gestational age, the need for resuscitation, birth Apgar score, premature rupture of membranes (PROM) >18 hours, method of delivery, leukopenia at birth, positive C-reactive protein (CRP) on admission, and positive culture at admission were assessed.

Results: Death rate due to infection, pneumothorax, need for patent ductus arteriosus (PDA) treatment, positive blood culture, C-reactive protein (CRP) >6 mg/dL, the need for antifungal treatment, the need for intravenous immunoglobulin (IVIG) prescription due to malaise, the prevalence of respiratory diseases, such as pneumonia and arrhythmia, tamponade, vein rupture, and chemical burns caused by the release of drugs showed no significant difference in the PICC and PIV groups; however, the rate of surfactant administration and referral for the cause of retinopathy of prematurity (ROP) was significantly higher in the PICC group, which seems logical considering the lower birth age and lower weight of this group.

Conclusion: The lack of significant difference in many variables (especially the lack of significant difference in the rate of infection) in the two groups indicates that PICC, despite being a central catheter with easy insertion, does not increase the risk of infection compared to conventional venipuncture, and considering the rest aspects, it can be considered as a reliable and low-risk method to access the central vessels.

1. Introduction



eonates with very low birth weight need an intravenous catheter for feeding and antibiotic injection. However, the use of these catheters is challenging. The weak muscular system interfering with the vessels, as well as the small diameter of the vessels,

leads to endothelial damage during the placement of the catheter [1, 2]. Meta-analysis studies have shown that the average rate of sepsis in surgeries with central venous catheters was 3.5 times higher than subcutaneous catheters [3]; however, a difference was not observed between central venous catheters through the peripherally inserted central venous catheters (PICCs) and subcutaneous catheter [4]. Pettit et al. reported no difference between the occurrence of sepsis in neonates with PICCs and peripheral intravenous (PIV) and subcutaneous catheters [5]. The literature review indicated the prevalence of sepsis in different studies with different rates. The level of these differences depends on the type of study, the type of definition of infection, and the weights of the neonates. Therefore, the use of PICC or PIV in very low birth weight neonates is still discussed. Due to the lack of documented and sufficient studies in this field, the present study was designed to compare the complications of the central venous catheter through a PICC and PIV in neonates with <1250 g birth weight in Izadi Hospital of Qom University of Medical Sciences, Qom Province.

2. Materials and Methods

The statistical population of this cross-sectional analytical study was patients and neonates with <1250 g birth weight with PICC or PIV admitted to Izadi Hospital of Qom University of Medical Sciences, from 2018 to 2019. According to Janes et al. [1] and the sample size formula and considering the type I and II errors of 5% and 20%, respectively, and the mean number of catheters utilized in the PICC or PIV groups (3.6±4.8 and 4.2±8.0, respectively), the sample size was considered 23 people in each group, which was considered 30 people for normal distribution and parametric analysis. Sampling was based on census and all eligible neonates <1250 g birth weight with PICC or PIV were examined. After making the necessary coordination with the medical record department, the researcher separated the files containing the necessary information, and the desired information was extracted. The inclusion criteria included the records of all children hospitalized in Izadi Hospital of Qom University of Medical Sciences who weighed <1250 g and had a peripheral or central catheter, and neonates with congenital anomalies, such as encephalopathy, bilateral agenesis of the kidneys, etc., chromosomal disorders, major and life-threatening heart diseases, such as hypoplastic left heart and transposition of large vessels, bleeding disorders, generalized skin problems, and skin infection at the catheter insertion site, and the exclusion criterion included neonates without vital signs.

Then, two groups of patients with PICC and peripheral catheters were considered. The confounding variables, such as birth weight, gestational age, the need for resuscitation, birth Apgar score, premature rupture of membranes (PROM)>18 hours, method of delivery, leukopenia at birth, positive CRP on admission, and positive culture on admission) were assessed. The data were analyzed by SPSS software, version 22 using independent t-test, chi-square test, and analysis of variance (ANOVA) at P<0.05.

3. Results

In this study, 77 neonates were examined, of whom 39 were in the PIV group and 38 were in the PICC group. The average birth age was 28 weeks in neonates with PICC and 28.9 weeks in neonates with PIV. The frequency of female gender in the PICC and PIV groups was 15 cases (39.5%) and 17 cases (43.6%), and the frequency of male gender in the PICC and PIV groups was 23 cases (60%) and 22 cases (56.4%), respectively. The average birth weight in neonates with PICC was 1046 g and in neonates with PIV, it was 1233 g. The average birth age was reported to be 28 weeks in neonates with PICC and 28.9 weeks in neonates with PIV. The weight at discharge was reported to be 1527 g for neonates with PICC and 1424 g for neonates with PIV. The length of hospital stay in neonates with PICC was 56.6 days and in neonates with PIV, it was 27.57 days. The length of hospitalization in the neonatal intensive care unit (NICU) was reported as 47.8 days in neonates with PICC and 20.6 days in neonates with PIV. The longer length of hospital stay in neonates with PICC is probably due to their younger birth age and lower birth weight. Apgar score at birth was 5.3 in neonates with PICC and 5.47 in neonates with PIV. The fifth-minute Apgar score was 7.26 in neonates with PICC and 7.29 in neonates with PIV. Intraventricular hemorrhage grade was reported as 0.97 in neonates with PICC and 0.47 in neonates with PIV. Stage retinopathy of prematurity (ROP) was reported to be 1.29 in neonates with PICC and 0.66 in neonates with PIV. Among the investigated variables, the two groups showed a statistically significant difference regarding birth weight (P=0.00), length of hospital stay (P=0.00), length of hospitalization in the NICU (P=0.00), IVH grade (P=0.29), stage and zone ROP (P=0.00), (Table 1).

Variables	Mean±SD			F	D**
	PIV	PICC	Total	r	P
Birth weight (g)	1233.21±208.71	1046.05±223.42	1140.84±234.42	14.436	0.0000
Gestational age (week)	28.9±2.1	28.03±2.6	28.47±2.4	2.580	0.1120
Weight at discharge* (week)	1424.17±445.41	1527.08±369.64	1475.63±409.74	1.138	0.2900
Length of hospital stay (d)	27.57±16.62	56.63±17.62	42.29±22.44	53.888	0.0000
Length of hospitalization in the NICU (d)	20.62±13.09	47.82±18.62	34.4±21.07	53.253	0.0000
First-minute Apgar score	5.47±2.78	5.37±1.96	5.42±2.39	0.036	0.8500
Fifth-minute Apgar score	7.29±2.48	7.26±1.76	7.28±2.13	0.003	0.9580
IVH grad	0.47±0.92	0.97±1.02	0.72±1	4.990	0.0290
Stage	0.66±0.9	1.29±0.65	0.97±0.84	12.095	0.0010
Zone ROP	0.71±0.98	1.68±0.93	1.2±1.07	19.595	0.0000

Table 1. Demographic variables of the two groups (PIV, PICC)

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Abbreviations: PIV: Peripheral intravenous; PICC: Peripherally inserted central venous catheter; NICU: Neonatal intensive care unit; ROP: Retinopathy of prematurity.

**T-test

The two groups showed no significantly significant difference in the number of, the rate of intrauterine growth restriction (IUGR) (P=0.19), the rate of PROM (P=0.61), gender (P=0.8), the level of need for cardiopulmonary resuscitation (P=0.62), the rate of death due to infection (P=0.49), pneumothorax occurrence rate (P=0.3), the need for patent ductus arteriosus (PDA) treatment (P=1), positive blood culture rate (P=0.4), CRP >6 mg/dL (P=0.15), the need for anti-fungal treatment (P=0.13), the need for intravenous immunoglobulin (IVIG) (P=0.06), and endotracheal intubation (P=0.81) (Table 2).

4. Discussion

This study is the first study comparing two vascular access methods (PICC and PIV) in Qom Province, in which many variables were compared between the two groups, some of which were confounding. It was tried to select the studied population so that in terms of confounding variables, the cases were matched and adjusted as much as possible to not affect the results of the study. Consistent with the studies conducted by Annibale et al. [6], Cairns et al. [7], Parellada et al. [8], and Shulman et al. [9], no significant difference was observed in the incidence of sepsis in the PICC and PIV groups. However, Puntis et al. [10] reported a lower incidence of sepsis caused by PICC compared to PIV, which is not consistent with our results. Comparing the results of the two studies, the research design, the target population, the weight of the neonates, the level of personnel training, and the preparation of the performing team should be considered. Also, in our study, no case of asphyxiation, arrhythmia, tampotare, vein rupture, or drug extravasation was reported in the groups. However, some variables showed a significant difference between the two groups. The frequency of surfactant administration was reported in 35 out of 38 people in the PICC group and 26 out of 39 people in the PIV group, indicating the greater need for surfactant administration in the PICC group. Considering that in the PICC group, the average birth weight was about 200 g< PIV group, this result can be justified. The frequency of referral to another hospital due to ROP was ten out of 38 people in the PICC group and two out of 39 people in the PIV group, which showed a significant difference. However, in other studies, no comparison of these variables and their relationship with PICC was performed, and the researcher did not consider this result far from expected due to the age and lower birth weight. This study only compared some measurable complications in the two groups, while some complications, such as pain tolerance caused by repeated venipuncture and compliance with the principles of the Table 2. A comparison of the variables between the two groups (PIV, PICC)

Variables		No. (%)			D
		PIV	PICC	Total	Р
Need for CPR	Negative	26(66.7)	28(73.7)	54(70.1)	0.62
	Positive	13(33.3)	10(26.3)	23(29.9)	0.62
Endotracheal tube	Negative	27(69.2)	25(65.8)	52(67.5)	0.81
	Positive	12(30.8)	13(34.2)	25(32.5)	0.81
Number of twins	Negative	31(79.5)	29(76.3)	60(77.9)	0.79
	Positive	8(20.5)	9(23.7)	17(21.7)	0.78
IUGR	Negative	32(82.1)	26(68.4)	58(75.3)	0 104
	Positive	7(17.9)	12(31.6)	19(24.7)	0.194
PROM >18 (h)	Negative	30(76.9)	27(71.1)	57(74)	0.61
	Positive	9(23.1)	11(28.9)	20(26)	0.61
Asphyxia	Negative	38(100)	38(100)	76(100)	1
Necrotizing enterocolitis (NEC)	Negative	38(100)	37(97.4)	75(98.7)	0.21
	Positive	0(0)	1(2.6)	1(1.3)	0.31
Positive blood culture	Negative	38(100)	36(94.7)	74(97.4)	0.40
	Positive	0(0)	2(5.3)	2(2.6)	0.49
CRP>6 (mg/dL)	Negative	11(28.9)	5(13.2)	16(21.2)	0.15
	Positive	27(71.1)	33(86.8)	60(78.9)	0.15
Surfactants	Negative	13(33.3)	3(7.9)	16(20.8)	0.01
	Positive	26(66.7)	35(92.1)	61(79.2)	0.01
PDA	Negative	35(89.7)	34(89.5)	69(89.6)	1
	Positive	4(10.3)	4(10.5)	8(10.4)	Ť
Antifungal agent use	Negative	35(89.7)	29(76.3)	64(83.1)	0.11
	Positive	4(10.3)	9(23.7)	13(16.9)	0.11
IVIG	Negative	33(84.6)	25(65.8)	58(75.3)	0.06
	Positive	6(15.4)	13(34.2)	19(24.7)	0.00
Outcome	Death	6(15.8)	5(13.2)	11(14.5)	
	Discharge	30(78.9)	23(60.5)	53(69.7)	0.04
	Referral	2(5.3)	10(26.3)	12(15.8)	

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Abbreviations: PIV: Peripheral intravenous; PICC: Peripherally inserted central venous catheter; NICU: Neonatal intensive care unit; CPR: Cardiopulmonary resuscitation; IVIG: Intravenous immunoglobulin; PDA: Patent ductus arteriosus; IUGR: Intrauterine growth restriction.

*Chi-square test

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Newborn Individualized Developmental Care and Assessment Program (NIDCAP) approach could not be measured. In our study, an attempt to insert a PICC was on average once during the hospitalization period, but an attempt to establish PIV or the same angioket was on average between 2.5 and three times a day. As mentioned, in our study, no report of the drug leaving the vein and resulting chemical burns was observed in the two groups. However, according to the reports recorded in the center, from which the data were extracted, phlebitis and local complications caused by venipuncture with a prevalence of about one were recorded in 40 cases in the PIV method, which should be considered due to its irreparable complications. The researcher suggests designing a clinical trial with a long-term follow-up in this field. Also, with the help and benefit of psychiatric experts and following the principles of the NIDCAP approach, this issue should be investigated and evaluated in terms of neurological complications caused by repeated pain and trauma in the first months of life. It is also suggested to design studies considering cost-effectiveness to make a more comprehensive comparison between the two studied methods.

5. Conclusion

Despite being a central catheter with easy insertion, the PICC does not pose a higher risk of infection compared to conventional venipuncture. This is evident from the lack of significant difference in many variables, including the infection rate, between the two groups. Therefore, considering all other aspects, the PICC can be considered a dependable and low-risk approach for accessing central vessels.

Ethical Considerations

Compliance with ethical guidelines

This study was approved by the Qom University of Medical Sciences (Code: IR.MUQ.REC.1398.062).

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Authors' contributions

All authors contributed to the design, running, and writing of all parts of the research.

Conflict of interest

The authors declared no conflict of interest.

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