

Local complications in the peripheral venous catheterization in newborns: prospective cohort

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ABSTRACT

The objectives were to assess the incidence of complications related to the use of the first PIC in newborns and to identify risk factors associated to it. This is a prospective observational cohort, with a quantitative approach; it was developed at the Neonatal Intensive Care Unit of a teaching hospital in a capital city at the South of Brazil; the data collection occurred between February and June of 2013. It totaled 134 PICs. The incidence of complications was 41.01%. Females ($p=0.0152$) presented the lowest risk to develop complication and, it occurs higher risk to develop complication ($p=0.0296$) in the first 48 hours after puncture. The evidence resulting from this study underlies a quality care, benefiting the study population.

Descriptors: Neonatal Nursing; Technology; Clinical Nursing Research; Catheterization, Peripheral; Complications.

INTRODUCTION

The Neonatal Intensive Care Unit (NICU), constitutes a therapeutic environment to treat high risk newborns⁽¹⁾. The use of diversified equipment, a trained team, specific protocols and high-end

technology attributes to the assistance for this clientele.

One of the activities performed daily in these units is the intravenous therapy (IV)⁽²⁾. To implement it, the nursing team needs intravascular catheters, characterized as hard technology, and they are broadly used⁽²⁻³⁾.

Catheters can be classified as central or peripheral, according with the location of the end of the

intravenous device. A study conducted in the state of Rio de Janeiro proved that 99.6% of newborns used the venous via during their admittance in NICUs and from those, 49.2% were peripheral intravenous catheters (PICs)⁽⁴⁾. Other studies reinforce the broad use of this device in the therapy of patients admitted in health establishments⁽⁵⁻⁶⁾.

The PIC is indicated for the administration of fluids and electrolytes, parenteral nutrition, medication and blood sampling for exams. Considered as an invasive procedure, it presents lower risk when compared to central catheters in relation to occurrence of infections⁽³⁾.

Although the IV propitiates benefits to the newborn, there are innumerable worries related to its practice, due to the risk of complications to which patients are exposed to⁽³⁾. The complications associated to IV are classified according to the dimension of its systemic and local effects.

Systemic ones are those offering risk to the patient's life, as sepsis, circulatory overload, pulmonary edema, gas embolism. The local ones are characterized by lesions around the puncture region and are passive of recognition through direct observation of the location⁽⁷⁾. The examples include: bruises, thrombosis, phlebitis, thrombophlebitis, infiltration, extravasation and local infection⁽⁸⁻¹¹⁾.

A study conducted in the NICU highlights the occurrence of complications concerning the drug administration and related to intravascular catheters⁽¹²⁾. Another study conducted at the same scenario points local complications as motive to remove the IV in 48% of newborns, reinforcing the nursing role to avoid complications and to reduce health risks⁽¹⁰⁾.

It lacks national publications about local complications of IV related to the first PIC use in newborns, a fact that stimulated the development of this study.

Thus, based on the exposed, the objective was to assess the incidence of local complications related to the first PIC use in newborns, as well as to identify associated risk factors.

METHODS

A prospective observational cohort study, conducted in a NICU of a teaching hospital in a capital at the South of Brazil. The study participants were all newborns admitted at the NICU submitted to the punctuation of the first PIC, during the data collection (February 1st to June 30th of 2013). Newborns presenting fragility of the venous network impeding the puncture with PIC were excluded from the study.

The data collection occurred daily, without interruption, in the presence of two researchers, through the reading the information containing in the newborns' medical registers and direct observation of the dispositive, using a proper instrument, created with closed questions addressing sociodemographic and clinical data; and the instrument was related to the insertion, manipulation and removal of the catheter.

Intending to standardize the data collection, the team of researchers had daily training, accompanied and guided by a master's student responsible for the study, during a three-month period. The researchers participated in meetings, where the concepts were standardized based on the scientific literature. The punctuation and the manipulation of devices were conducted by the unit's nursing team, trained for such

procedure. The newborns were accompanied since admittance until the outcome of their hospitalization in the NICU (discharge, transference, or death).

We entered the data in electronic spreadsheets of the Microsoft Excel[®] program and analyzed using the Biostat[®] program. The occurrence of complications was the variable research answer (or outcome). In the analysis of factors that could interfere in the outcome, we used the Chi-Squared test and the William's G test to explain categorical variables (gender, type of delivery, motive for hospitalization, Apgar, Parkin, weight at birth, punctuated limb, the professional who executed the procedure, time of stay) and the Mann-Whitney U test for quantitative explaining variables. In all tests, the level of significance adopted was 5%. We calculated the relative risk (RR) to measure the association level. The category considered as reference is indicated in the result's table with the value 1.0, in the column for RR values.

The project was approved by the Ethics Committee of the institution, as follows the protocol nº 165.675, and the ethical aspects involving research with human beings were respected, according with the Brazilian legislation. The parents or responsible ones signed the Free and Informed Consent Term, authorizing the participation of newborns in the study.

RESULTS

During the study, 134 catheters were observed and had their inclusion registered. From those, 79 (58.96%) did not develop complications and 55 (41.04%) did. From the 79 catheters that did not develop complications, 28 (20.90%) had elective removals; eight (5.97%) had accidental removals; and 43 (32.09%) cases were not informed.

The most predominant complication was the infiltration/extravasation representing 76.36% (n=42) of cases, 16.36% (n=9) of catheters were removed due to obstruction and 7.27% (n=4) due to phlebitis.

Regarding the risk factors associated to complications when using the PIC, it was found statistical significance for the variable gender, showing that females presented lower risk to develop PIC complications ($p=0.0152$; $RR=0.60$) (Table 1).

When analyzing the distribution of catheters with complication according to the newborn gender, it was noted that 25 (45.40%) catheters used in male newborns were removed do to infiltration/extravasation, five (9.10%) due to obstruction and four (7.20%) due to phlebitis (Figure 1).

When relating risk factors associated with use of catheters, a data analysis proceeded by grouping and comparison between catheters with presence (n=55) or absence of complications (n=79). It was seen a higher risk to develop complication in the first 48 hours after punctuation ($p=0.0296$; $RR=1.69$) (Table 2). There were no significant associations with other analyzed variables.

Infiltration was the most prevalent motive for catheter removal 65.45% (n=36), there were five (9.09%) catheters removed by obstruction and one (1.80%) by phlebitis before 48 hours (Figure 2).

Table 1: Analysis of newborn variables associated with the occurrence of complications by the use of peripheral intravenous catheter (n=134). Curitiba, PR, Brazil, 2013.

Variable	Complication				p-value	RR	CI [95%]
	Yes		No				
	N	%	N	%			
Gender	n = 55		n = 79				
Female	21	38.18	47	59.49	0.0152¹	0.60	[0.39;0.92]
Male	34	61.82	32	40.51		1	
Type of delivery	n = 55		n = 79				
C-section	42	76.36	58	73.42	0.6999 ¹	1.1	[0.68;1.78]
Vaginal	13	23.64	21	26.58		1	
Motive of admittance	n = 55		n = 79				
Prematurity	24	43.64	35	44.30	0.9390 ¹	1.03	[0.81;1.31]
Others	31	56.36	44	55.70		1	
Apgar1'	n = 51		n = 77				
< 7	19	34.55	24	30.38	0.4754 ¹	1.17	[0.76;1.81]
≥ 7	32	58.18	53	67.09		1	
Apgar5'	n = 51		n = 77				
< 7	4	7.27	4	5.06	0.5612 ²	1.28	[0.62;2.64]
≥ 7	47	85.45	73	92.41		1	
Parkin	n=55		n=76				
<36	31	56.36	49	62.03	0.4754 ¹	0.82	[0.76;1.81]
>36	24	43.64	27	34.18		1	
Weight at birth	n=78		n=54				
<1500	17	21.52	11	20.00	0.9300 ¹	0.98	[0.56;1.71]
>2500	36	45.57	24	43.64		1	-
1500<p >2500	25	31.65	19	34.55		1.08	[0.68;1.71]

FOOTNOTES: ¹ Chi-Squared test; ² William's G test; RR – Relative risk; CI [95%] – Interval with 95% of confidence; C-section – Transversal Segmental Cesarean

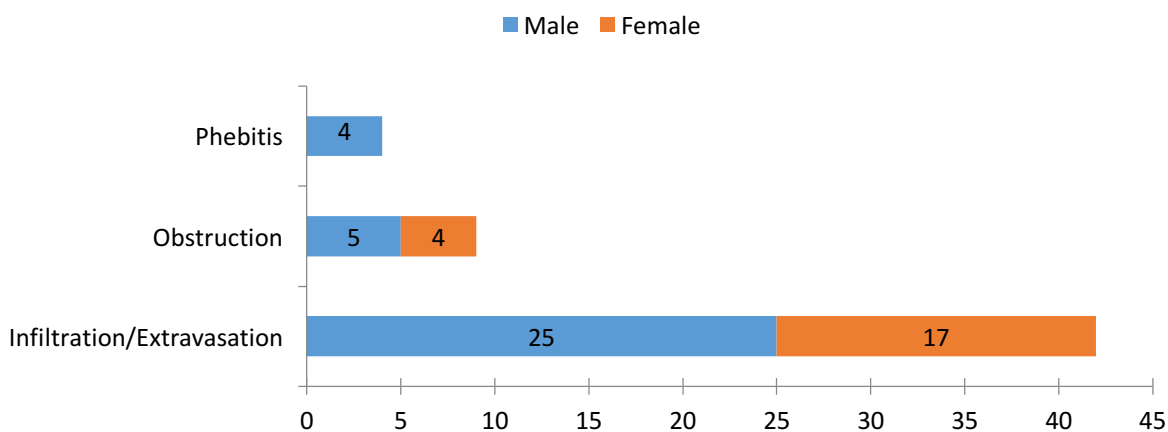


Figure 1: Distribution of catheters with complications according to newborn gender. Curitiba, PR, Brazil, 2013.

Table 2: Analysis of variables related to catheter and its use associated with occurrences of complications (n=134). Curitiba, PR, Brazil, 2013.

Variable	Complication				p-value	RR	CI [95%]
	Yes		No				
	n=55	%	n=79	%			
Procedure performed by							
Nurse	15	27.27	22	27.85	0.9416 ¹	1	[0.64;1.61]
Assistant/Technician	40	72.73	57	72.15		1.02	
Weight on the punctuation day							
<1500	11	20.00	17	21.52	0.9592 ¹	0.97	[0.55;1.68]
1500<p<2500	20	36.36	27	34.18		1.05	[0.66;1.65]
>2500	24	43.64	35	44.30		1	
Punctuated limb							
Cephalic	1	1.82	2	2.53	0.5936 ²	0.781	[0.16;3.92]
Upper limbs	50	90.91	67	84.81		0.67	-
Lower limbs	4	7.27	10	12.66			[0.28;1.57]
Type of infusion							
Continuous	23	41.82	40	50.63	0.2919 ²	1	
Intermittent	2	3.64	6	7.59		0.68	[0.20;2.37]
Both	30	54.55	33	41.77		1.30	[0.86;1.98]
CVC							
No	46	83.64	68	86.08	0.6966 ¹	1	
Yes	9	16.36	11	13.92		1.12	[0.65;1.90]
IC							
No	54	98.18	76	96.20	0.5210 ²	1	
Yes	1	1.82	3	3.80		0.60	[0.11;3.33]
OI							
No	38	69.09	62	78.48	0.2192 ¹	1	
Yes	17	30.91	17	21.52		0.72	[0.50;1.60]
Surgery							
No	53	96.36	78	98.73	0.4038 ²	1	[0.72;3.77]
Yes	2	3.64	1	1.27		1.65	
Basic plan							
No	3	5.45	7	8.86	0.2491 ²	1	
Yes	31	56.36	33	41.77		1.61	[0.61;4.30]
Exclusive use	21	38.18	39	49.37		1.17	[0.43;3.20]
TPN							
No	51	92.73	71	89.87	0.5734 ²	1	
Yes	4	7.27	8	10.13		0.80	[0.35;1.82]
ATM							
No	29	52.73	51	64.56	0.1696 ¹	1	
Yes	26	47.27	28	35.44		1.33	[0.89;1.98]
Transfusion							
No	52	94.55	75	94.94	0.9232 ²	1	
Yes	3	5.45	4	5.06		1.05	[0.43;2.52]
Others							
No	38	69.09	59	74.68	0.4763 ¹	1	
Yes	17	30.91	20	25.32		1.17	[0.76;1.80]
Catheter time of permanence							
<48h	42	76.36	46	58.23	0.0296¹	1.69	[1.01;2.81]
>48h	13	23.64	33	41.77		1	

Footnote: ¹ Chi-Squared Test; ² William's G test ; RR – Relative risk; CI [95%] – Interval with 95% of confidence; Central venous catheter (CVC); Indwelling catheters (IC); Orotracheal intubation (OI); Total parenteral nutrition (TPN); Antimicrobial (ATM).

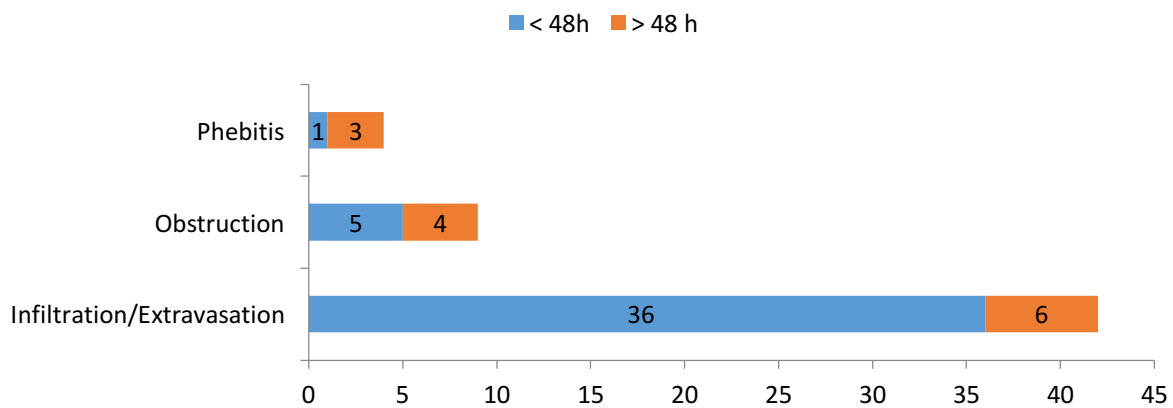


Figure 2: Distribution of catheters with complications according to motive for removal and permanence time. Curitiba, PR, Brazil, 2013.

DISCUSSION

The occurrence of complications as motive to remove PICs present lower values (41.04%) than the ones described in the literature with a similar population, presenting variability between 47.44 and 83%^(8,13-15).

Other observed motives for removal were the elective removal (20.90%) and, less frequently, accidental removal (5.97%). Catheters with elective removal presented more satisfactory percentage when compared to data in the literature describing percentages of 18% to 24%^(8,15). The literature presents 14% of catheters with accidental removal, lower values than the ones described in this study⁽⁸⁾.

Within the complications related to the use of PICs, infiltration/extravasation (76.36%) was predominant, followed by obstruction (16.36%) and phlebitis (7.27%). In a study developed with 36 newborns admitted in a NICU of a public maternity in the Southeast of Brazil, aimed to described the occurrence of phlebitis, infiltration and extravasation, it was seen the predominance of infiltration as the removal cause for peripheral intravenous devices with 79.2%, followed by 16.7% of phlebitis cases⁽⁸⁾. In the present study, the value for infiltration/overflow was similar to the study mentioned above, but when comparing phlebitis cases, our findings were inferior.

Regarding infiltration/ extravasation (76.36%), we considered the percentage high when compared with national and international studies⁽¹³⁻¹⁶⁾ that presented values between 25 and 56%.

The newborns were likely to have an occurrence of infiltration/ extravasation, due to flexibility characteristics of the subcutaneous tissue, causing its distension with the presence of liquid, and still, by having the venous integrity affected, facilitating the capillary leak. Characteristics, such as the physiology of newborns and their clinical fragility are predisposing factors to develop infiltration and overflow complications⁽¹⁷⁾.

The fluids with determined characteristics increase the risk of overflow, being those: osmolality (number of particles by kilogram of solvent); vase activity (ability to cause vase constriction); cytotoxicity (ability to provoke cellular damage or death) and extreme of potential Hydrogen (pH) (inferior to five and

superior to nine). Disregarding the administered solution, there are characteristic changes in function of the medication concentration and the diluent used in the preparation of the intravenous mixture, resulting in cellular damage or tissue death in the vessel⁽¹⁸⁾.

Independent of the infused solution, vigilance should be recurrent because the infiltration, even of physiological solution, can result in serious damage to the patient⁽¹⁹⁾. Thus, it is reiterated that the adequate way to prevent infiltration and overflow is to constantly observe the punctation location, intended to identify signals early, as well as immediate interventions after its occurrence.

Another observed complication in this study was the obstruction of catheters (16.36%) that can be related to poor maintenance of the access via, after administering medications without washing the catheter. Complication rates by obstruction described in the literature vary between 7.1 and 39%⁽¹⁴⁻¹⁵⁾, a data convergent from the one found in this study.

When considering phlebitis complication (7.27%), we observed an inferior percentage than the one described in the literature varying between 9 and 16.7%^(8,14-15). This complication comes from factors: chemical, related to characteristics of the infused solutions; mechanical, caused by continuous movements of this clientele who are difficult to control; or infectious, characterized by wrong practices of catheter manipulation.

Aiming the prevention of phlebitis, there are practices that should be contemplated during puncture and manipulation of intravenous devices, which are: hand hygiene through hand washing with soap and conventional technique, or rubbing with alcohol 70%, and the ready removal of the catheter on the presence of phlogistic signals⁽⁹⁾; as well as, the early identification of this complication appearance through constant vigilance practice of the PIC insertion site⁽¹⁹⁾.

In general, when avoiding the appearance of complications related to the PIC use, interventions are applied before, during and after the peripheral catheterization. But, the knowledge of nursing professionals is reinforced as an important factor, because they are employees who conduct continuous newborn care, as well as, being the ones responsible for the punctation, manipulation and maintenance of catheters.

Education is one of the pillars for training of health professionals, due to complex changes while caring and continuous insertion of new technologies⁽²⁰⁾, which create gaps of professional knowledge, needing constant updating. For this, the professional needs to base himself on the evidence available in studies and specialists' recommendations, as well as, guidelines and intervention and treatment protocols, aimed to reduce serious potential complications^(19,21-22).

The continuous visualization of the insertion site is the earliest way to recognize signs and symptoms of complications related to PIC use. It should be emphasized that the PIC presence in newborns needs hourly assessments of the intravenous devices, through observation and touch, considering a clientele who cannot provide information⁽²³⁾.

Thus, the fixation should be removed when presenting possible clinical signs of infection, such action aims an adequate visualization of the device insertion site^(9,23). Such interventions can minimize pain and

suffering that IVs cause in newborns.

Concerning the PICs, the clinical and epidemiological variables related to the newborn (type of delivery, motive for admittance, Apgar at the first and fifth minute, Parkin, weight at birth) did not present themselves as risk factors. The only epidemiological variable that presented higher likelihood to develop a complication was the male gender ($p=0.0152$; $RR=1$). Related to the PIC use, we found that on the first 48 hours after the catheter punctuation, there is a higher risk for developing complications ($p=0.0296$, $RR=1.69$). This period equally corresponds to the first 48 hours of the newborn's life, because when born, they are directly taken to the NICU when necessary, and they have the peripheral catheterization as routine when admitted. Therefore, the adopted conducts referring to PIC vigilance should be modified, especially on the first 48 hours of life, when the newborn presents hemodynamic instability and it was observed an increase in the development of complications. After being submitted to the procedure of intravenous therapy, the neonate presenting clinical and physiological fragilities receive therapy that stabilizes and balance general conditions, a motive that can explain the decrease of complications during this period.

CONCLUSIONS

The incidence of complications occurrence related to the first PIC in newborns hospitalized in NICUs was high. Among the complications, we observed higher incidence of infiltration/extravasation, followed by obstruction and phlebitis. The variables presenting statistical significance to develop complications were the male gender and, the 48-hour period after the punctuation.

The peripheral intravenous therapy is extremely important to assist critical newborns and the nursing team is responsible for procedures involved with this technology. Evidence resulting from this study give basis for a quality care, benefiting the study population.

Limiting factors of this study are related to incomplete registration regarding the motive for catheter removal, as well as the absence of information to determine the degree of complications.

The development of similar studies to contemplate degrees of phlebitis, infiltration, and extravasation, as well as to compare risks and benefits with other technologies of peripheral intravenous catheter, are needed to generate better evidence in the neonatal nursing care.

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