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ORIGINAL ARTICLE

The use of peripherally inserted central venous catheter in the Neonatal Intensive Care Unit

A utilização de cateteres venosos centrais de inserção periférica na Unidade Intensiva Neonatal

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ABSTRACT

To analyze the use of peripherally inserted central venous catheter in newborns hospitalized in the Neonatal Intensive Care Unit. Retrospective, descriptive and quantitative research, carried out in 80 medical records of a federal maternity school in Rio de Janeiro, in the period April to July 2018. The use of the device was higher in preterm newborns (83%), the predominant weight was below 1,500 grams (60.9%), the most frequent indication for catheter insertion was low weight, associated or not with prolonged intravenous therapy (35.2%) and the length of stay was over five days (81.8%). The occurrence of adverse events was present in 31.8% of cases. It should be emphasized the importance of correct indication, handling, care in the use of the device, beyond identification of adverse events to establish prevention measures and training of the team in order to reduce risks and promote the safety of newborns.

Descriptors: Infusions, Intravenous; Patient Safety; Catheterization, Central Venous; Intensive Care Units, Neonatal; Neonatal Nursing.

RESUMO

Analisar a utilização dos cateteres centrais de inserção periférica em recém-nascidos internados na Unidade de Terapia Intensiva Neonatal. Pesquisa retrospectiva, descritiva e quantitativa, realizada em 80 prontuários de uma maternidade escola federal do Rio de Janeiro, no período de abril a julho de 2018. A utilização do dispositivo foi maior em recém-nascidos pré-termo (83%), o peso predominante foi abaixo de 1.500 gramas (60,9%), a indicação mais frequente para a inserção do cateter foi o baixo peso, associado ou não a terapia intravenosa prolongada (35,2%) e o tempo de permanência foi superior a cinco dias (81,8%). A ocorrência de eventos adversos estava presente em 31,8% dos casos. Ressalta-se a importância da correta indicação, manuseio, cuidado no uso do dispositivo, além de identificação dos eventos adversos, para que se estabeleçam medidas de prevenção e treinamento da equipe, a fim de diminuir os riscos e promover a segurança dos recém-nascidos.

Descritores: Infusões Intravenosas; Segurança do Paciente; Cateterismo Venoso Central; Unidades de Terapia Intensiva Neonatal; Enfermagem Neonatal.

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INTRODUCTION

Intravenous therapy is becoming an increasingly safe and quality practice thanks to the technological resources that are increased in your daily life, from intravenous catheters (peripheral and central), accessories with safety devices, to the latest generation infusion pumps. In addition to these resources, the qualification of the professional, especially the nurse, becomes a key point for the promotion of safer care regarding the use of technologies employed in this therapy[1].

The Peripherally Inserted Central Venous Catheter, from the English *Peripherally Inserted Central Catheter* (PICC) has been used as an alternative for stable and effective venous access for neonates. However, its insertion involves a highly complex procedure requiring specific knowledge[2].

The use of PICC is intended to promote intravenous therapy for a long time and in a safely way, preserving the peripheral venous network, in addition to reducing pain and stress from repeated punctures. It is indicated in cases that require venous access for a period longer than six days and administration of hypertonic and/or vesicant solutions, such as total parenteral nutrition (osmolarity above 600 mlOsmol/L or glucose serum with concentration above 12.5%). Its indication requires expertise, technique, capacity of clinical judgment and conscious, safe and effective decision making by the health professional[3].

Despite its benefits, PICC is not exempt from adverse events. After its insertion, some problems are reported, such as inadequate location of the catheter tip (intracardiac), which may cause cardiac alterations, requiring immediate traction. Other complications culminate in the need for non-elective catheter removal, such as leakage, accidental catheter removal, external rupture, occlusion and infection[4].

Some studies have presented high percentages of unscheduled withdrawal from the PICC, with values above 40%[4]. One of these studies, which aimed at analyzing adverse events occurring in newborns up to 28 days of life in the Health Surveillance Notification System in the years 2007 to 2013, presented a 40.3% rate of unplanned removal[5], indicating that problems with the maintenance of this device have been recurrent in many Neonatal Intensive Care Units (NICU) in the country.

It becomes clear that even with the numerous benefits achieved with the use of PICC, adverse events related to the procedure are still reported and may occur at the time of its insertion, maintenance or removal. For this reason, studies related to the use of PICC and follow-up of results obtained in each clinical scenario are important for a better care structuring, allowing interventions for the individual management of the newborn to be elaborated, promoting catheter removal upon discharge from treatment and preventing complications that may compromise the quality of intravenous therapy[6].

When PICC is related to the care of the newborn in NICU, some particularities that involve both the newborn and the procedure are highlighted, due to singular characteristics that may significantly influence the effectiveness of the use of this device, and the professional should be aware of the responsibility of the procedure. Thus, the nurse is one of the main responsible for the evaluation of the PICC indication, as well as its insertion, follow-up and evaluation. This professional has a fundamental role in the prevention of complications, an essential factor for the rehabilitation of the NB and the success of the treatment[7].

It is worth highlighting that intravenous therapy should be initiated with the objective of providing optimal care to neonates, with property and capacity to increase success in obtaining venous access, prioritizing the patient's safety, with reduction of physical and psychological damages and adverse events, seeking increased satisfaction with the care and assistance of the team[8].

Thus, faced with the need for a long-term and safe venous access for the newborn's therapy, the wide use of PICC in NICU and the possible occurrence of adverse events during the use of this device, the study aimed to analyze the use of PICC in newborns hospitalized in a Neonatal Intensive Care Unit.

METHOD

Descriptive, quantitative, retrospective research carried out in medical records of newborns who were hospitalized in a NICU of a Maternity School of the Federal University of Rio de Janeiro (ME–UFRJ), located in the municipality of Rio de Janeiro, a reference for high fetal risk, which admits newborns coming from the own institution, from other units in the municipality or state of Rio de Janeiro that needs specialized and intensive care.

All newborns whose PICC insertion took place between September 1, 2016 and September 1, 2017 were included. Newborns with PICC who had been transferred to another institution were excluded from the study due to the impossibility of obtaining information regarding the outcome variables. Data were collected from April to July 2018.

Data were collected from 80 medical records however, four newborns were submitted to more than one PICC insertion process, resulting in 88 central venous catheterization procedures of peripheral insertion for analysis.

For data collection an instrument was used that recorded information, containing the variables of the study regarding the characterization of the population: gender; gestational age corrected at the date of insertion; weight at the date of insertion; medical diagnosis at hospitalization. Besides other variables related to the process of central venous catheterization of peripheral insertion: reason for insertion of the catheter;

length of stay of the device; reason for removal of the catheter; and the most prevalent adverse events.

The descriptive data analysis was presented in the form of tables, with the variables described by absolute and relative frequencies. The information obtained from the medical records and recorded in the data collection instrument were typed and processed in a specific database, using the IBM Statistical Package for Social Sciences (SPSS) software version 21.

The study waived the use of Free and Informed Consent Term, but a Data Use Commitment Term was used, preserving the privacy of patients in relation to the disclosure of the collected data. Thus, the present study met the ethical requirements of Resolution 466/12 of the National Health Council and the opinion in favor of its undertaking was under No. 2,402,646.

RESULTS

Regarding the characterization of the participants who underwent the procedure (Table 1), it can be seen that newborns were predominantly male (51.25%), followed by females with 48.75%.

Regarding the diagnosis at the time of hospitalization, prematurity was the main cause, responsible for 67 (83.75%) of the newborns whose medical records were analyzed in the study; followed by acute fetal distress with three (3.75%); hydrocephaly and hypoglycemia with two newborns each (2.5%); and cardiac malformations, neonatal sepsis, hyperbilirubinemia, postoperative correction of gastroschisis, Down syndrome and neonatal asphyxia with one each (1.25%).

Of the four newborns who were undergo more than one PICC insertion procedure, two were female and two were male. All were submitted to two insertion procedures each. Regarding the need for a new insertion of PICC, the reasons were adverse events that occurred in the anterior catheter, three of which were due to hyperemia and a palpable cord in the path; and one was due to obstruction of the device.

Regarding the PICC implantation procedure (Table 2), it can be seen that newborns classified as very low weight (<1,500 g), with prolonged intravenous therapy, and the use of hyperosmolar, vesicant and irritant solutions were the main reasons for catheter insertion, totaling 28.4%; the PICC length of stay was five to 10 days (36.4%) and the end of therapy predominated for the catheter removal decision (67%).

Regarding adverse events, Table 3 shows an index of 31.8%, among which hyperemia and palpable cord predominated in the path (21.4%), mechanical phlebitis and obstruction — both with 17.8%, followed by catheter rupture (10.7%) and infiltration (7.1%). Removal due to adverse events was represented by 26.1% of total PICC removals.

Table 1. Sociodemographic and clinical characteristics of newborns using PICC in the NICU. Rio de Janeiro, RJ, Brazil, 2017.

Sociodemographic and clinical characteristics	N* (%)
Gestational age corrected during insertion**	
Extreme preterm newborn (20 weeks to 27 weeks + 6 days)	13 (14.8)
Very preterm newborn (28 weeks to 31 weeks + 6 days)	30 (34.1)
Moderate/late preterm newborn (32 weeks to 36 weeks + 6 days)	30 (34.1)
Term (37 to 42 weeks)	15 (17.0)
Weight in grams on insertion	
Under 1,000 g	26(29.5)
1,005 g to 1,500 g	28 (31.9)
1,505 g to 2,500 g	22 (25.0)
Acima de 2,505 g	12 (13.6)

*The same newborn has suffered multiple PICC insertions, resulting in 88 procedures, with each insertion having corrected and different gestational age and weight.
**Classification of Prematurity[9].

DISCUSSION

Regarding the epidemiological profile of newborns submitted to PICC insertion, in relation to weight, studies mention that this population would be between 652 and 2,826 grams, which is close to the findings in our study where the great majority of insertions were performed with newborns under 2,500 grams. This occurs because extreme low birth weight is a factor associated with prematurity and one of the main causes of hospitalization in NICU[7]. This study corroborates other studies[7,9-11] that point out prematurity as one of the main reasons for the use of the catheter, being this one of the causes of hospitalizations in neonatal units, responsible for the high morbidity and mortality rates affecting newborns in the neonatal period. Additionally, the premature newborn usually requires intravenous therapy through safe access for longer periods[7].

The criteria found as reasons for PICC insertion in the present study reinforce those described in the literature (need for intravenous therapy for a period longer than seven days; antibiotic therapy, need for total parenteral nutrition, antivirals, vasoactive drugs, solutions that are considered vesicant and irritant; weight less than 1,500 g), which places as main indications prematurity and use of intravenous therapy[7,10-11].

The survey of indications for insertion of the PICC makes it possible to previously identify a population of newborns hospitalized in the NICU who will need this device, providing the nurse with the possibility of planning his assistance.

Depending on the gestational age, weight and basic pathology, this newborn has a good chance of using PICC.

At that the nurse can preserve the venous network of the upper limbs for the procedure, talk to the parents and plan in advance non-pharmacological pain relief methods to be used during catheter insertion and the best time to insert it.

A similar study performed with neonates indicated an average length of stay equal to 13 days ranging from one to 79 days[7]. Data from a study carried out in a school hospital in the south of Brazil indicate a mean catheter utilization of 11.7 days, with a minimum of one and a maximum of 38 days[10] and another study demonstrated that the mean catheter length of stay was 14.82 days and standard deviation of 15.06, with a minimum of zero and a maximum of 78[11].

These values are close to the results of the present study, where the PICC length of stay was mostly between five and 15 days, thus confirming its indication for intravenous therapies with prolonged time.

Regarding catheter removal, the end of therapy was the main indication (67.1%), followed by the occurrence of adverse events (26.1%). The end of therapy also appears in other studies[7,10-11] as a reason for the removal of PICC, however in a much smaller proportion than that found in the present study, not reaching 28% of cases. The removal of the device for a reason not related to its complications portrays a situation in which the PICC is correctly handled and has a promising durability.

However, it is observed that newborns sometimes need to undergo more than one procedure, as occurred in a similar study where neonates (11%) were submitted to two or more PICC insertions[12], which in this study occurred due to adverse events.

The incidence of adverse events was higher than the removal of catheters for this reason. This occurred because in some cases, even with the identification of the adverse event, it was preferable to maintain the access in the newborn because of the severity of its clinical condition and the difficulty in obtaining another viable venous access.

Table 2. Characterization of procedures for implantation of PICC in the NICU. Rio de Janeiro, RJ, Brazil, 2017.

Characterization of Procedures for Implantation of (PICC)	N (%)
Reason for insertion of PICC*	
Long-term intravenous therapy	14 (15.9)
Use of hyperosmolar and vesicant and irritant solutions	8 (9.1)
Very low weight <1,500 g	6 (6.9)
Very low weight <1,500 g; Long-term intravenous therapy and Use of hyperosmolar, vesicant and irritant solutions.	25 (28.4)
Long-term intravenous therapy and use of hyperosmolar, vesicant and irritant solutions	17 (19.3)
Very low weight <1,500 g and Long-term Intravenous Therapy	9 (10.2)
Very low weight <1,500 g and Use of hyperosmolar, vesicant and irritant solutions	8 (9,1)
Not Informed by the nurse on the form	1 (11)
Length of Stay of PICC in days	
<5	16 (18.2)
5 to 10	32 (36.4)
11 to 15	23 (26.1)
16 to 20	6 (6.8)
21 to 25	6 (6.8)
>25	2 (2.3)
Not informed by the nurse on the form	3 (3.4)
Reason for PICC Removal	
End of therapy	59 (67.1)
Adverse Events	23 (26.1)
Death	6 (6.8)

*Each item refers to combination of indications present for the newborn at the time of insertion.

Table 3. Prevalence of adverse events in PICC used in the NICU. Rio de Janeiro, RJ, Brazil, 2017.

Prevalence of adverse events	N (%)
Presence of adverse events	
No	60 (68.2)
Yes	28 (31.8)
Identified adverse events	
Hyperemia and Palpable Cord in the path	6 (21.4)
Mechanical Phlebitis	5 (17.8)
Obstruction	5 (17,8)
Rupture of catheter	3 (10.7)
Infiltration/ Leakage	2 (7.1)
Hyperemia of path	1 (3.6)
Hyperemia and edema in limb	1 (3.6)
Edema in limb	1 (3.6)
Phlebitis and displacement of catheter	1 (3.6)
Great amount of bleeding	1 (3.6)
Exteriorization of catheter	1 (3.6)
Catheter-associated bloodstream infection	1 (3.6)

It is worth noting that the institution's conduct of identifying adverse events is the first step in building a system of care designed to avoid errors. Outcome indicators such as adverse events are fundamental quality tools, as they point out aspects of care that can be improved, making patient care safer[13].

Regarding the occurrence of notifications of adverse events related to the use of vascular catheter received by the NOTIVISA system from January 2007 to June 2016, the PICC was the first in the notification rate (40%)[14]. This high number of notifications may be linked to the fact that it is one of the procedures widely used in hospital environment[7].

Hyperemia and the palpable cord on the path were the most prevalent adverse events. Such symptomatology is related to mechanical phlebitis, in which the signs and symptoms coincide[15]. The index of phlebitis-related phlogistic signs in another study was considered much lower (2.9%)[16], culminating in the need to understand the causes of this change in order to plan measures for treatment and prevention of this event.

Mechanical phlebitis may be related to irritation of the venous wall, which may occur by the use of a very calibrated catheter in relation to the vessel, trauma at the time of insertion, use of a catheter produced with rigid material and minor trauma caused by movement of the catheter inside the vessel. Thus, if possible, a safe catheter with a stabilizing device should be used, avoiding bending areas. If this is not possible, it is necessary to stabilize the joint. Among other measures, it is recommended to apply heat, lift the limb and monitor for 24 to 48 hours; if signs and symptoms persist after 48 hours, consider removing the catheter[15].

In general, for all types of phlebitis, prevention consists in prioritizing some practices such as: hand hygiene in handling the catheter, appropriate selection of the caliber; preferential selection of upper limbs for insertion, use of disposable tourniquets or their disinfection after use; use of dust-free gloves for handling the catheter, use of sterile, waterproof and transparent dressing; identification of the insertion site (date, time and professional responsible for insertion); use of protocols to standardize nursing practices; implementation of educational activities and sensitization of nurses for phlebitis risk factors[17].

Regarding obstruction rates, there was a significant variation in other studies in which the percentage ranged from 2.2%[11], 9.7%[16] and 27.7%[17]. This event is closely related to mechanics, which occurs when there are kinks or compression of the catheter lumen. Besides this, there are also those related to fibrin accumulation and other deposits, such as drugs fixed to the intraluminal catheter wall[18].

In order to avoid obstruction, PICC maintenance protocols should be elaborated and consolidated; moreover, the intravenous therapy group's performance deserves to be highlighted in this process[19]. Among other measures that the nurse should perform are: Catheter washing with 0.9% Physiological Solution with 10 ml syringes or higher volume, especially after drug administration and blood reflux, using positive pressure (whirling) and closing the clamps after the procedure[18,20]; use twice the minimum value of catheter priming to minimize blood return to the PICC lumen[20]; exchange cannulas, connectors, extenders and equipment immediately in the presence of clots, and every 72 to 96 hours in case they remain intact, identifying the date of device exchange[20]; careful evaluation and indication of the nurse when there is need for administration of hemoderivatives in catheters used by newborns (3 or 4 French Gauge)[19].

In relation to the PICC rupture, the index is also high when compared to other studies that identified indexes of 1.8%[16] and 2.2%[11]. In order to reduce the risk of rupture, one should test the permeability for each handling, utilize syringes with appropriate gauge, exchange cannulas, connectors, extensors and equipment in case of clots and at pre-established intervals, and utilize the recommended and safe protocol for catheter clearance[20].

Another adverse event observed in the study was infiltration/leakage. As this catheter is not sutured in the skin, but stabilized by the dressing, solution or medication overflow may occur around the catheter insertion site, due to traction.

In this study, the infiltration presented a percentage of 7.1%, which is lower than the study conducted in Curitiba in 2014, which identified an index of 18.1% and associated this complication to traction and overflow. The authors suggest reinforcing nursing care related to maintenance and manipulation of the catheter as daily routines for assessment of the insertion site, performance of dual dressings, use of non-pharmacological methods to relieve the newborn baby's pain during the dressing to maintain the state of tranquility and comfort, avoiding agitation and consequent movements of the limbs, and increased care in the manipulation of this newborn (weight measurement, transportation, breastfeeding)[11].

It is noteworthy that catheter-associated bloodstream infection presented a lower percentage when compared with another similar study, in which the rate was 25.4%[20].

A designated infusion team responsible for catheter insertion increases the first attempt cannulation success rate and decreases bloodstream infections, occlusions and accidental removal. This team should be responsible for catheter management, including daily evaluation, dressing changes and/or access, in order to decrease bloodstream infections associated with the catheter and related costs, phlebitis and infiltration. Another important measure is the collection, monitoring and recording of data regarding length of stay, reasons for removal and complications such as phlebitis, infiltration/extraction, and bloodstream infection associated with catheter use[15].

In addition to a specialized team, other clinical care to reduce the risk of infection has been related: hand hygiene before and after handling utilizing antiseptic solution; inspection of catheter integrity and its functioning daily and when there is an adverse event or technical complaint during infusion; disinfection of cannulas and connectors with 70% alcohol; testing of permeability with each handling; utilization of syringes with appropriate caliber; adequate performance and maintenance of dressings; replacement of cannulas, connectors, extenders and equipment in case of clots and at pre-established intervals[20].

Another important point is the lack of relevant information related to the PICC. One study identified 17.5% of index related to the absence of registration of the reason for catheter insertion[16], which reinforces the importance of the utilization of pre-established protocols for this activity[12]. The quality of the records is an important step in the recovery of the PICC's history of care and surveillance, pointing to the need to make the teams aware of the effort to keep the records updated, complete and adequately filled. The use of standardized forms is recommended, with closed and categorized questions, periodic training and encouragement to the teams in relation to adherence to the protocol and filling out the form[20].

Thus, health professionals who provide direct assistance to newborns undergoing the PICC insertion procedure have a great responsibility in the prevention of adverse events. When caring for a patient using this device, professionals should understand and ensure its correct maintenance, seeking to improve its effectiveness, prolonging its stay and reducing complications[10].

The need for permanent education in the health services is highlighted, in order to develop these capabilities in the teams, stimulating professional development and implementing specific care routines based on scientific evidence. The institution, and the teams responsible for permanent education must perform constant training, updates on insertion, maintenance, the main problems that may occur throughout the therapy.

The limitation of the study is related to the fact that the research was carried out in a single NICU, a university hospital with pre-established protocols, which contributes to specific results that cannot be generalized to other studies, however, this research aims to contribute to the construction of knowledge in the area and the improvement of newborn care using PICC.

CONCLUSION

The study showed that PICC was mostly used in the group of preterm and low weight newborns. The catheter length of stay (>5 days) and its elective removal in the great majority of newborns are positive indicators for the quality of nursing care.

This fact reflects the protocol established in the institution researched, where the reasons for indicating the PICC are well defined and its maintenance has been satisfactory.

Nevertheless, the occurrence of adverse events is still present and may lead to the non-elective removal of the device. The prevalence rate of adverse events points to the need for the continuous implementation of institutional policies aimed at their prevention and control, in the constant search for quality assistance and safety of newborns.

To that end, the literature points to the importance of a specialized team dedicated to the management and handling of catheters, and intravenous therapy in the NICU; and a series of preventive measures, where a single measure is applied in the prevention of numerous adverse events, such as the use of protocols, education and training related to PICC care.

Regarding the central venous catheter of peripheral insertion, the nurse plays a fundamental role, as he is responsible for the entire process, from insertion, maintenance and removal of the catheter, so he needs to be able to recognize the adverse events arising from the use of the device, the proper conduct in relation to it and the resolution in the face of each situation. It is important to emphasize that scientific knowledge is an important strategy to conduct safe care, avoiding adverse events and, consequently, damage to the newborn's health.

It is hoped that this study will encourage health professionals to reflect on the care process related to the implementation of PICC, on the importance of this device in relation to the newborn's therapy, as well as stimulate the constant improvement of knowledge in search of achieving excellence in care. It is important to emphasize that the standardization of health care practices must be continuously modified in order to follow the evolution of science and technology, with the purpose of reducing the rates of adverse events in the NICU and ensure patient safety.

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