The Use of Peripherally Inserted Central Catheters in a Neonatal Intensive Care Unit

A Utilização do Cateter Central de Inserção Periférica em uma Unidade de Terapia Intensiva Neonatal
El Uso de Catéteres Centrales de Inserción Periférica en una Unidad de Cuidados Intensivos Neonatales

RESUMO

Objetivo: Investigar a utilização do Cateter Central de Inserção Periférica em Unidade de Terapia Intensiva Neonatal. **Método:** Estudo quantitativo, retrospectivo, realizado em maternidade pública de Belo Horizonte, com 168 recém-nascidos que utilizaram o cateter entre janeiro e julho de 2022. A análise estatística foi conduzida no software Stata® 16. As tabelas foram elaboradas no Microsoft Excel® 2019. **Resultados:** Predominou o sexo masculino (53,6%). A maioria dos cateteres foi inserida em prematuros moderados (54,8%), seguidos por prematuros tardios (17,9%). Quanto ao peso ao nascer, destacaram-se recém-nascidos com baixo peso (36,9%) e muito baixo peso (31,6%). A principal indicação para inserção do cateter foi Nutrição Parenteral Total (53,6%). Os principais motivos de retirada foram término da terapia (45,2%) e flebite (24,4%). **Conclusão:** O estudo evidencia a relevância do cateter para a assistência neonatal. Destaca a necessidade de estratégias que qualifiquem sua inserção e manutenção, promovendo maior segurança ao recém-nascido.

DESCRITORES: Cateter de inserção periférico; Enfermagem neonatal; Eventos adversos ou Segurança do Paciente; Unidade de Terapia Intensiva Neonatal.

ABSTRACT

Objective: To investigate the use of Peripherally Inserted Central Catheters (PICC) in a Neonatal Intensive Care Unit. **Method:** Quantitative, retrospective study conducted in a public maternity hospital in Belo Horizonte, Brazil, including 170 newborns who used the catheter between January and July 2022. Statistical analysis was performed using Stata® version 16, and tables were prepared in Microsoft Excel® 2019. **Results:** Male newborns predominated (53.6%). Most catheters were inserted in moderate preterm infants (54.8%), followed by late preterm infants (17.9%). Regarding birth weight, low birth weight (36.9%) and very low birth weight (31.6%) newborns were the most frequent. The main indication for catheter insertion was Total Parenteral Nutrition (53.6%). The primary reasons for catheter removal were completion of therapy (45.2%) and phlebitis (24.4%). **Conclusion:** The study highlights the relevance of the catheter in neonatal care and underscores the need for strategies that improve its insertion and maintenance, thereby promoting greater safety for newborns.

DESCRIPTORS: Peripherally inserted catheter; Neonatal nursing; Adverse events or Patient Safety; Neonatal Intensive Care Unit.

RESUMEN

Objetivo: Investigar el uso del Catéter Venoso Central de Inserción Periférica (PICC) en una Unidad de Terapia Intensiva Neonatal. **Método:** Estudio cuantitativo y retrospectivo realizado en una maternidad pública de Belo Horizonte (Brasil), con 170 recién nacidos que utilizaron el catéter entre enero y julio de 2022. El análisis estadístico se realizó con el software Stata® 16 y las tablas fueron elaboradas en Microsoft Excel® 2019. **Resultados:** Predominó el sexo masculino (53,6%). La mayoría de los catéteres fue insertada en prematuros moderados (54,8%), seguidos por prematuros tardíos (17,9%). En cuanto al peso al nacer, se destacaron los recién nacidos con bajo peso (36,9%) y muy bajo peso (31,6%). La principal indicación para la inserción del catéter fue la Nutrición Parenteral Total (53,6%). Los principales motivos de retiro fueron la finalización de la terapia (45,2%) y la flebitis (24,4%). **Conclusión:** El estudio evidencia la relevancia del catéter en la atención neonatal y destaca la necesidad de estrategias que mejoren su inserción y mantenimiento, promoviendo una mayor seguridad para el recién nacido.

DESCRIPTORES: Catéter de inserción periférica; Enfermería neonatal; Eventos adversos o Seguridad del Paciente; Unidad de Cuidados Intensivos Neonatales.

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INTRODUCTION

Historically, childhood was not always recognized as an integral part of society, and until the 16th century, high rates of infant and premature infant mortality prevailed due to the absence of institutions dedicated to the specialized care of these children[1]. High rates of infant and neonatal mortality motivated the development of specific care practices for newborns.

In recent decades, advances in technology and the expansion of neonatal intensive care have dramatically changed the prognosis for these patients. Very low birth weight (VLBW) newborns, weighing between 401 and 1,500 g, and those requiring prolonged hospitalizations now have significantly higher survival rates, although they continue to require long-term and safe venous support[2].

The *peripherally inserted central venous catheter* (PICC) has established itself as the central venous access of choice after the umbilical catheter, especially in neonates requiring prolonged intravenous therapy. It is a peripherally inserted device whose tip is positioned in the vena cava, available in single or double lumen and made of materials such as polyurethane or silicone, recognized for their biocompatibility and lower thrombogenicity, which confers a lower risk of microbial adhesion and allows prolonged safe permanence.

According to Resolution 258/2001 of the Federal Nursing Council (COFEN), nurses are allowed to insert peripheral central catheters, provided they are trained and/or qualified[5].

Indications for the use of PICC in neonatology include: the need for long-term intravenous therapies, administration of vesicant or hypertonic solutions, parenteral nutrition, prolonged antibiotic therapy, among others, aiming at preserving the peripheral venous network, reducing pain and discomfort, and decreasing stress resulting from multiple punctures[6,7].

However, despite its benefits, the use of PICC is not without complications. Recent studies point to the occurrence of adverse events, such as bloodstream infection, fungal colonization, tip misplacement, obstruction, infiltration, phlebitis, and the need for unplanned catheter removal. Such events can result in ineffective maintenance of venous access, exposure to new punctures, the need for prolonged hospitalization, and increased hospital costs[8-10].

The adoption of institutional protocols, training of nursing staff, and

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the use of complementary technologies, such as noninvasive techniques for checking and repositioning the catheter tip (ultrasound, electrocardiogram, radiography), have been recommended to minimize risks and promote safety in care[11,12].

Considering the relevance of PICC in neonatal intensive care, as well as the importance of safe and evidence-based practices for its insertion and maintenance, it is essential to investigate its use, management, complications, and outcomes in Neonatal Intensive Care Units (NICUs).

Given this context, the present study aims to investigate the use of Peripherally Inserted Central Catheters in a Neonatal Intensive Care Unit. It seeks to contribute to the improvement of neonatal nursing practices and to the safety and quality of care for newborns in Neonatology.

METHOD

This study is part of a project entitled "The use of Peripherally Inserted Central Catheters in a Neonatal Intensive Care Unit." It is a quantitative, longitudinal, retrospective study conducted in a NICU at a philanthropic maternity hospital in Belo Horizonte, Minas Gerais. The information analyzed was obtained from the institutional database on the monitoring of the use of Peripherally Inserted Central Catheters (PICC), which is routinely updated by management and fed by the care team. Previous studies reinforce the importance of structured monitoring databases for the surveillance of complications related to vascular catheters in neonates.

The institution has 50 neonatal intensive care beds, 40 conventional intermediate care unit (UCIco) beds, and 20 kangaroo intermediate care unit (UCICa) beds. The monthly average is 110 neonatal admissions, 75% of which come from the interior of Minas Gerais, and approximately 90 PICCs inserted per month.

With regard to institutional routine, PICC insertion is performed exclusively by nurses specializing in neonatology. Maintenance of access is the responsibility of the Neonatal Intensive Care Unit nursing team.

The study population comprised all neonates admitted to the institution's NICU who used PICC between January and July 2022. The probabilistic sample consisted of 168 newborns, considering a sampling error of 5% and the average number of monthly insertions performed in the service.

The inclusion criteria were defined as: (1) newborns admitted to the NICU; (2) use of a Peripherally Inserted Central Catheter during the study period. The exclusion criteria included: newborns who died during PICC use, making it impossible to fully evaluate the variables of interest.

Data collection was performed using an instrument developed by the researchers, containing sociodemographic and clinical information: sex, date and reason for insertion, type of catheter, gestational age and birth weight, gestational age and weight at the time of insertion, days of life and days of hospitalization at insertion, as well as date and reason for catheter removal.

For the analysis of neonatal variables, the stratification of gestational age and birth weight followed the recommendations of the Guidelines for the Kangaroo Method in Primary Care, published by the Ministry of Health. Thus, the following were considered: (extremely premature: < 28 weeks; moderately premature: 28 weeks to 33 weeks and 6 days; late premature: 34 weeks to 36 weeks and 6 days; full-term newborn: ≥ 37 weeks).

Regarding birth weight, the following categories were adopted: Extremely low birth weight: < 1,000 g; Very low birth weight: 1,000 g to 1,499 g; Low birth weight: 1,500 g to 2,499 g; Adequate birth weight: ≥ 2,500 g.

After collection, the data were entered and organized in *a Microsoft* Excel® 2019 spreadsheet, with double entry to minimize errors. Subsequently, they were exported to Stata® *software*, version 16, in which statistical analyses were conducted. Tables and graphs were prepared in *Microsoft* Excel® 2019.

The research was approved by the Research Ethics Committee of the proposing institution (CAAE: 62101822.4.0000.5132 and Protocol: 5.718.064).

RESULTS

The majority of the population of neonates studied who used the peripherally inserted central catheter (PICC) were male (53.6%), followed by female (46.4%). The single-lumen polyurethane catheter was the most commonly used (89.3%), followed by the single-lumen silicone catheter (10.7%). The average age of newborns at insertion was 9.2 days, and the average length of hospital stay was 8.8 days.

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Table 1. Description of gestational age at birth and gestational age at insertion of the Peripherally Inserted Central Catheter (PICC) in newborns admitted to a Neonatal Intensive Care Unit, Belo Horizonte, Minas Gerais, Brazil, January to July 2022.

Description of variables GA at birth and GA at PICC insertion		
Variables	n=168	%
Birth GA		
Extremely premature (<28 weeks)	21	12.5
Moderately premature (28 weeks to 33 weeks and 6 days)	92	54.8
Late preterm (34 weeks to 36 weeks and 6 days)	30	17.9
RNT (≥37 weeks)	25	*14.9*
IG at insertion		
<30	33	19.6
30 to 33	69	41.1
34a36	30	17.9
>37	36	21.4

Source: Prepared by the authors based on research data (2025).

Most PICCs were inserted in moderate preterm infants (54.8%), followed by late preterm infants (17.9%) and term newborns (14.9%). Regarding gestational age at PICC insertion, it was more prevalent in neonates with <34 weeks (60.7%).

Table 2. Description of birth weight and weight at insertion of the Peripherally Inserted Central Catheter (PICC) in newborns admitted to a Neonatal Intensive Care Unit, Belo Horizonte, Minas Gerais, Brazil, January to July 2022.

Description of variables for birth weight and weight at PICC insertion		
Variables	n=168	%
Birth Weight		
Extremely Low Weight (<1000g)	30	17.9
Very Low Weight (1000g to 1499g)	53	31.6
Low Weight (1500g to 2499g)	62	36.9
Adequate Weight (≥2500g)	25	*14,9*
23	13.7	
Weight at Insertion		
<1000	25	14.9
1000 to 1499	56	33.3
1500 to 2499	61	36.3
>2500	26	15.5

Source: Prepared by the authors based on survey data (2025).

Regarding birth weight and PICC use, 36.9% had low birth weight, followed by neonates with very low birth weight (31.6%) and extremely low birth weight (17.9%). Regarding weight at PICC insertion, it was more prevalent in neonates weighing between 1500g and 2499g (36.3%).

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Table 3. Description of the reasons for peripheral insertion central catheter (PICC) insertion in newborns admitted to a Neonatal Intensive Care Unit, Belo Horizonte, Minas Gerais, Brazil, January to July 2022.

Description of reasons for PICC insertion		
Variables	n=168	%
Reasons for insertion		
ATB	18	10.7
NPT	90	53.6
NPT/ATB	30	17.9
STE TIG>4	14	*8.3*
STE TIG>4/ATB	16	9.5

Source: Prepared by the authors based on research data (2025).

The main reason for inserting a Peripherally Inserted Central Catheter (PICC) was for Total Parenteral Nutrition (53.6%), followed by the need for TPN associated with antibiotic therapy (17.9%) and for antibiotic therapy alone (10.7%).

Table 4. Description of the reasons for removal of the Peripherally Inserted Central Catheter (PICC) in newborns admitted to a Neonatal Intensive Care Unit, Belo Horizonte, Minas Gerais, Brazil, January to July 2022.

Description of reasons for PICC removal		
Variables	n=168	%
Reasons for Removal		
Extravasation	7	4.2
Phlebitis	41	24.4
CS infection	10	6.0
Obstruction	5	*3.0*
Peripheral/malpositioned PICC	16	9.5
Rupture	13	7.7
End of therapy	76	45.2

Source: Prepared by the authors based on research data (2025).

The main reasons for removal of the Peripherally Inserted Central Catheter (PICC) were end of therapy (45.2%), followed by phlebitis (24.4%), peripheral/malpositioned PICC (9.5%), and catheter breakage (7.7%).

DISCUSSION

The findings of this study highlight the epidemiological and clinical profile of neonates who used the Peripherally Inserted Central Catheter (PICC) in the NICU, highlighting a slight predominance of males and a high frequency of use of the device in premature and low birth weight newborns. The literature shows that males are more biologically vulnerable in the neonatal period, with a higher incidence of prematurity, pulmonary immaturity, and need for invasive support, which may result in greater use of intravascular devices, including PICC[13,14] . Although the difference between the sexes does not, in itself, represent a risk factor for catheter complications, this finding reinforces epidemiological trends observed in other Brazilian and international NICUs.

The high proportion of moderate and late preterm infants using PICC (54.8% and 17.9%, respectively) is in line with the literature, which points out that neonates with reduced gestational age have a greater need for prolonged intravenous therapies, such as Total Parenteral Nutrition (TPN), antibiotic therapy, and hyperosmolar solutions[(15)]. Studies show that more than 60% of preterm infants less than 34 weeks old require central access in the first weeks of life, both because of the difficulty of peripheral access and the risk of chemical injuries associated with peripheral venous administration. Thus, the prevalence observed in this study reinforces the role of PICC as an essential technology for the safe therapeutic management of premature infants.

Another relevant finding refers to birth weight, with a predominance of low birth

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weight (36.9%) and very low birth weight (31.6%) neonates, a profile consistent with reports from NICUs in different regions of Brazil and around the world. Newborns weighing less than 2500 g present vascular immaturity, a need for prolonged TPN, and greater hemodynamic fragility, justifying the frequent indication of PICC[17] . International studies indicate that up to 80% of very low birth weight newborns use PICC at some point during hospitalization[(18)]. This corroborates the findings of this study.

In the present study, the main reason for PICC insertion was the administration of Total Parenteral Nutrition (53.6%), a result that is broadly consistent with the literature. TPN requires secure central access due to the high osmolarity and irritative potential of the solutions, with PICC being the catheter of choice in preterm newborns[(19)]. The association between TPN and antibiotic therapy (17.9%) is also frequently reported, as premature infants are at greater risk of early and late sepsis. This combination highlights the central role of PICC in the nutritional and therapeutic support of critically ill neonates.

Regarding the type of catheter, the use of single-lumen polyurethane catheters was predominant (89.3%). This finding is in line with current international recommendations, which indicate polyurethane as the material with greater mechanical resistance, lower risk of rupture, and greater suitability for prolonged infusions when compared to silicone. However, some studies indicate that polyurethane may be more rigid, favoring vascular wall irritation and a higher incidence of phlebitis in very immature neonates[(20)], which is related to the complication results found in this study.

Regarding the reasons for removal, the end of therapy was the most prevalent cause (45.2%), indicating adequate management and satisfactory therapeutic use of the device. However, phlebitis accounted for 24.4% of removals, a percentage higher than that recommended by international guidelines, which establish desirable rates below 5–10% for PICC-associated phlebitis in neonates [16]. This finding suggests the need to review the institutional protocol, with special attention to catheter caliber, insertion technique, stabilization, vessel selection, and daily monitoring using validated scales. Recent studies reinforce that phlebitis is multifactorial and may be associated with the type of catheter material, the osmolarity of the solutions, the length of stay, and the vascular fragility of premature infants[(21)]. Other causes for removal, such as malpositioning (9.5%) and catheter rupture (7.7%), are also noteworthy. The literature describes that positioning errors can occur in up to 15% of procedures, especially in very low birth weight preterm infants due to reduced vascular anatomy and difficulty in measuring the catheter path[(22)]. Rupture, in turn, is often related to improper handling, polyurethane stiffness, and the use of incompatible solutions. The adoption of auxiliary technologies, such as ultrasound for guided insertion, continuous monitoring of the catheter tip, and periodic training, are strategies that significantly reduce such complications[(23,24)].

Finally, the findings of this study reinforce the importance of PICC as an indispensable technology in neonatal care, while highlighting persistent challenges related to mechanical and inflammatory complications. Investments in training the multidisciplinary team, standardizing evidence-based protocols, and systematically monitoring quality indicators are essential to reduce adverse events and promote safe care. Contemporary literature indicates that continuing education programs and process audits result in a significant reduction in phlebitis, extravasation, and malpositioning in the NICU, highlighting the potential for continuous improvement[(25)] .

CONCLUSION

The results of this study highlighted potentialities, especially in providing subsidies for the direction of care provided to newborns using Peripherally Inserted Central Catheters (PICC) in the NICU. They contributed to the improvement of neonatal care by supporting safe practices for catheter insertion, maintenance, and monitoring, favoring the prevention of complications and promoting newborn safety.

However, some weaknesses were identified during the development of the research. Of particular note is the inconsistency in the completion, by health professionals, of the instrument used to feed the institutional PICC monitoring database. This limitation required more time for the collection and validation of information. Another weakness refers to the discontinuity of the record and the periodic removal of information from the physical medical record, which hindered complete access to the data and resulted in sample loss.

In view of these challenges, it is essential to reinforce to the nursing team the importance of adequate, complete, and standardized recording of information regarding PICC insertion and maintenance, as well as to ensure the availability and accessibility of data throughout the hospitalization period and after discharge.

Despite its limitations, the study contributed significantly to understanding the profile of PICC use in the unit, enabling the development of indicators that may guide future analyses on the management of the device. These indicators can support the planning of improvement actions, including staff training, implementation of protocols, and development of quality tools aimed at continuous improvement of care.

The findings also reinforce the need for new studies to deepen knowledge about the use, management, and safety of PICC in neonatology, expanding technical and scientific production and strengthening evidence-based care practices.

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