



ORIGINALES

Non-elective removal of Peripherally Inserted Central Catheter: cross-sectional study

Remoção não eletiva do Cateter Central de Inserção Periférica: estudo transversal
Retiro no electivo del Catéter Central de Inserción Periférica: estudio transversal

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ABSTRACT:

Introduction: Peripherally Inserted Central Catheter is an intravenous device that has become increasingly necessary due to its numerous benefits, especially for children.

Objective: Describing the prevalence and causes of non-elective removals of Peripherally Inserted Central Catheters inserted in a Pediatric Intensive Care Unit.

Methods: This is a cross-sectional study, with a quantitative approach, conducted in a Pediatric Intensive Care Unit of a teaching hospital in Natal, Rio Grande do Norte, between January 2017 and December 2019. Data were obtained from the record book of catheters present in the study sector.

Results: A high rate of non-elective removals of this catheter was observed in the studied years: 56.6%, 41.6% and 40%, respectively, highlighting, in all years, obstruction as the main complication that caused removal, followed by rupture and traction.

Conclusions: Identifying the main complications and training the nursing team on preventive strategies are actions aimed at reducing this prevalence.

Keywords: Catheters; Catheterization, Central Venous; Intensive Care Units, Pediatric; Catheter Obstruction; Nursing Care.

RESUMO:

Introdução: O cateter central de inserção periférica é um dispositivo intravenoso que vem se mostrando cada vez mais necessário diante dos inúmeros benefícios, sobretudo para as crianças.

Objetivo: Descrever a prevalência e causas de remoções não eletivas dos Cateteres Centrais de Inserção Periférica inseridos em uma Unidade de Terapia Intensiva Pediátrica.

Métodos: Trata-se de um estudo transversal de abordagem quantitativa, realizado em uma Unidade de Terapia Intensiva Pediátrica de um hospital de ensino de Natal, Rio Grande do Norte, entre janeiro de

2017 e dezembro de 2019. Os dados foram obtidos do livro de registro de cateteres presente no setor do estudo.

Resultados: Observou-se elevado índice de remoções não eletivas desse cateter nos anos estudados: 56,6%, 41,6% e 40% respectivamente, destacando-se, em todos os anos, a obstrução como a principal complicação que causou a retirada, seguida de ruptura e tração.

Conclusões: Identificar as principais complicações e capacitar a equipe de enfermagem sobre estratégias preventivas são ações que visam obter uma redução dessa prevalência.

Palavras-chave: Cateteres; Cateterismo Venoso Central; Unidades de Terapia Intensiva Pediátrica; Obstrução do Cateter; Cuidados de Enfermagem.

RESUMEN:

Introducción: El catéter central de inserción periférica es un dispositivo intravenoso que se ha vuelto cada vez más necesario por sus numerosos beneficios, especialmente en los niños.

Objetivo: Describir la prevalencia y causas de retiros no electivos de Catéteres Centrales de Inserción Periférica insertados en una Unidad de Cuidados Intensivos Pediátricos.

Métodos: Se trata de un estudio transversal, con enfoque cuantitativo, realizado en una Unidad de Cuidados Intensivos Pediátricos de un hospital universitario de Natal, Rio Grande do Norte, entre enero de 2017 y diciembre de 2019. Los datos se obtuvieron del libro de registro de catéteres presentes en el sector de estudio.

Resultados: Se observó una alta tasa de retiros no electivos de este catéter en los años estudiados: 56,6%, 41,6% y 40% respectivamente, destacándose, en todos los años, la obstrucción como la principal complicación que provocó su retiro, seguida de la rotura y la tracción.

Conclusiones: Identificar las principales complicaciones y capacitar al equipo de enfermería en estrategias preventivas son acciones que apuntan a reducir esta prevalencia.

Palabras clave: Catéteres; Cateterismo Venoso Central; Unidades de Cuidado Intensivo Pediátrico; Obstrucción del Catéter; Atención de Enfermería.

INTRODUCTION

Peripherally Inserted Central Catheter (PICC) is a long and flexible intravenous device that, when inserted through a peripheral venipuncture, progresses to the central site, inserting itself through the upper limbs; and, at the level of the diaphragm, in the inferior vena cava, inserting itself through the lower limbs⁽¹⁾.

Its insertion was regulated by Resolution N° 258/2001 of the Brazilian Federal Nursing Council⁽²⁾. Since then, its use has become increasingly necessary due to its numerous benefits, especially from the point of view of humanizing care, relieving pain and reducing the number of venipuncture procedures, as it enables safe and prolonged venous access⁽³⁻⁵⁾.

Among the benefits of this type of catheter, the following stand out: maintenance of long-term therapy; minimization of pain due to multiple peripheral venous punctures; time optimization; and possibility of being inserted by skilled nurses at the bedside. In addition, due to its peripheral insertion, it reduces the risk of pneumothorax and hemothorax, avoids venous dissection and is associated with a lower rate of infections, compared to surgically inserted catheters. It is still considered the catheter of choice for intravenous therapy in pediatrics⁽⁶⁻⁹⁾.

The use of PICC is not free from risks and complications, requiring specific knowledge and techniques for it to be inserted and maintained in operation, in order to avoid complications that could result in the early loss of venous access and undermine the patient's general condition. Regarding complications, these occur less frequently than with other central catheters. Among the most common, one can mention obstruction,

rupture, infection, infiltration, thrombosis, inadequate positioning, traction or accidental release, which result in removal before the end of treatment^(1,10-12).

The early removal of this catheter causes distress to the child, the family and the health team, due to having to subject the child to a new puncture process, which is considered limited and difficult, in addition to increasing costs. This outcome generates a feeling of frustration among the team members, and is often associated with inadequate handling of the device. Therefore, nursing has a fundamental role in terms of minimizing this suffering, since it can help to reduce these complications.

The literature review has revealed a notable lack of research that directs nurses' clinical practice in relation to preventive strategies for non-elective catheter removal. Furthermore, it is important to mention that the existing literature focuses mainly on the application of PICC in the field of neonatology. Therefore, this study addresses a relevant gap by covering the safety of pediatric patients using PICC and its preventive strategies^(1,3,7,10-18).

Accordingly, this study has the objective of describing the prevalence and causes of non-elective removal of Peripherally Inserted Central Catheter in a Pediatric Intensive Care Unit.

METHODS

Cross-sectional observational study, with a quantitative approach, guided by the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE®) tool, with a sample of 116 PICCs inserted in children admitted to a Pediatric Intensive Care Unit (PICU) in a teaching hospital located in Natal/Rio Grande do Norte, between January 2017 and December 2019.

The PICU that served as the study site has five beds for children from 30 days to 14 years of age and its nursing team is made up of 13 nurses and 11 nursing technicians. All nurses are certified through a training course for PICC installation, which is why they are responsible for indicating, inserting, handling, maintaining, dressing and making decisions regarding complications and removal of the catheter. The nursing technician is responsible for handling and maintaining this device.

The sample consisted of 116 PICCs. All children who underwent the insertion procedure for this device were included. Conversely, children who were discharged from the PICU while the PICC was still in use or those who died while the catheter was in use were excluded.

The data were obtained from the record book of the inserted PICCs. After that, monthly forms were filled out, containing clinical variables characterizing the PICC, with the aim of evaluating the length of time the catheter remained in site and complications associated with its non-elective removal. The data collected were: PICC insertion date, indication, puncture site, catheter tip site, date and reason for PICC removal.

The frequency of PICC losses, due to complications, was evaluated by measuring the indicator of non-elective PICC removal, using a formula recommended by the

International Life Sciences Institute (ILSI) – Brazil and by the Hospital Quality Commitment Program (CQH).

The collected data were entered into Microsoft Office Excel®, which obtained, through the application of the aforementioned formula, the percentage of non-elective PICC losses and the complications resulting from the use of this catheter in the PICU environment, being presented in the form of tables and charts, and then discussed according to literature relevant to the topic.

This article originated from the dissertation “Educational intervention to prevent non-elective removal of Peripherally Inserted Central Catheter in pediatrics”. In compliance with Resolution N° 196/96 of the Brazilian National Health Council, the research project was authorized by the Teaching and Research Management of the studied hospital and approved by the Research Ethics Committee of the Federal University of Rio Grande do Norte, under registration CAAE n° 17590919.8. 0000.5537.

RESULTS

It was observed that, among the 116 PICCs inserted in children admitted to the PICU, there was a high rate of non-elective removals. Furthermore, there was an increase in the number of devices inserted over these years; however, on the other hand, there was a reduction in the frequency of complications and, consequently, in non-elective removals. Despite this positive trend, it is important to highlight that the number of non-elective removals still remains at high levels, as evidenced in Chart 1.

Chart 1 – Percentage (%) of Peripherally Inserted Central Catheters non-electively removed due to complications and distributed by year – Natal/Rio Grande do Norte, Brazil – 2020.



Source: Professional Master’s Dissertation in Health and Education Practices – Godeiro (2020)

In 2017, 30 PICC insertions were carried out. Among these cases, 17 PICCs (56.67%) were removed before the end of treatment due to complications. Obstruction was the most prevalent complication, occurring in 13 cases (43.3%). Subsequently, it was

found that there were three cases of rupture (10%) and only one case of phlebitis (3.3%).

In 2018, 36 PICC insertions were carried out. Among these cases, 15 PICCs (41.67%) had to be removed before the end of treatment due to complications. Once again, obstruction was the main cause, occurring in nine cases (25%). Subsequently, it was found that there were of rupture (8.3%), in addition to one case for each of the following complications: accidental traction, infiltration and inadequate site, representing 2.8% each.

In 2019, 50 PICC insertions were carried out. Among these cases, 20 PICCs (40%) had to be removed before the end of treatment due to complications. Once again, obstruction was the main cause, occurring in six cases (12%). Subsequently, it was found that there were five cases of rupture (10%) and three cases of accidental traction (6%). Furthermore, there was a single case of complications for each of the following situations: infiltration, thrombosis, phlebitis and bending, representing 2% each.

Among the complications evidenced by the use of PICC, obstruction appears as the main cause, followed by catheter rupture, as shown in Table 1.

Table 1 – Quantity of complications that led to the non-elective removal of PICC per year in the Pediatric Intensive Care Unit – Natal/Rio Grande do Norte, Brazil. – 2020.

| Complication | 2017 (n=30) | 2018 (n=36) | 2019 (n=50) | Total (n=116) |
|---|-------------------|-------------------|-----------------|-------------------|
| Obstruction | 13 (43.3%) | 9 (25%) | 6 (12%) | 28 (24.1%) |
| Rupture | 3 (10%) | 3 (8.3%) | 5 (10%) | 11 (9.4%) |
| Traction | 0 | 1 (2.7%) | 3 (6%) | 4 (3.4%) |
| Infection | 0 | 0 | 2 (4%) | 2 (1.7%) |
| Infiltration | 0 | 1 (2.7%) | 1 (2%) | 2 (1.7%) |
| Phlebitis | 1 (3.3%) | 0 | 1 (2%) | 2 (1.7%) |
| Thrombosis | 0 | 0 | 1 (2%) | 1 (0.8%) |
| Inadequate site | 0 | 1 (2.7%) | 0 | 1 (0.8%) |
| Bending | 0 | 0 | 1 (2%) | 1 (0.8%) |
| Total non-electively removed PICCs | 17 (56.6%) | 15 (41.4%) | 20 (40%) | 52 (44.8%) |

Source: Professional Master's Dissertation in Health and Education Practices – Godeiro (2020)

The site of the catheter tip represents one of the factors that influence the occurrence of complications; because, if it is peripheral, it favors the occurrence of phlebitis, infiltration and thrombosis. In the intracardiac position, it can cause arrhythmias, effusion and pericardial tamponade.

After radiography, it was observed that 86.2% of the catheters inserted in the three studied years had their tip well located in the distal third of the superior vena cava, while 7.7% had an intracardiac site, requiring traction. Another 6% of all studied catheters had their tip peripherally located, as shown in Table 2.

Table 2 – Catheter tip site, after insertion of Peripherally Inserted Central Catheters, verified by x-rays, in the Pediatric Intensive Care Unit per year – Natal/Rio Grande do Norte, Brazil – 2020.

| Catheter tip site | 2017 (n=30) | 2018 (n=36) | 2019 (n=50) | Total (n=116) |
|-----------------------|-------------|-------------|-------------|---------------|
| Central | 25 (83.3%) | 31 (86.1%) | 44 (88%) | 100 (86.2%) |
| Central with traction | 5 (16.6%) | 1 (2.7%) | 3 (6%) | 9 (7.7%) |
| Peripheral | 0 | 4 (11.1%) | 3 (6%) | 7 (6.0%) |

Source: Professional Master's Dissertation in Health and Education Practices – Godeiro (2020)

The puncture site can also influence the occurrence of complications. In this regard, there was a prevalence of catheter insertion in the external jugular vein in all studied years, as shown in Table 3.

Table 3 – Quantity of punctured sites for insertion of Peripherally Inserted Central Catheters in the Pediatric Intensive Care Unit in 2017, 2018 and 2019 – Natal/ Rio Grande do Norte, Brazil – 2020.

| Puncture site | 2017 (n=30) | 2018 (n=36) | 2019 (n=50) | Total (n=116) |
|---------------|-------------|-------------|-------------|---------------|
| LEJV | 10 (33.3%) | 10 (27.7%) | 17 (34%) | 37 (31.8%) |
| REJV | 7 (23.3%) | 9 (25%) | 8 (16%) | 24 (20.6%) |
| Cephalic | 3 (10%) | 5 (13.8%) | 3 (6%) | 11 (9.4%) |
| RUL | 3 (10%) | 5 (13.8%) | 8 (16%) | 16 (13.7%) |
| RAV | 4 (13.3%) | 1 (2.7%) | 4 (8%) | 9 (7.7%) |
| LUL | 0 | 2 (5.5%) | 6 (12%) | 8 (6.8%) |
| LAV | 2 (6.6%) | 2 (5.5%) | 3 (6%) | 7 (6.0%) |
| RLL | 1 (3.3%) | 1 (2.7%) | 0 | 2 (1.7%) |
| LLL | 0 | 1 (2.7%) | 1 (2%) | 2 (1.7%) |

Codes: cephalic – head vein; LEJV – left external jugular vein; REJV – right external jugular vein; RAV –right axillary vein; LAV – left axillary vein; RUL – right upper limb; LUL – left upper limb; RLL – right lower limb; LLL – left lower limb.

Source: Professional Master's Dissertation in Health and Education Practices – Godeiro (2020)

When analyzing the average PICC length of stay, the pattern described below was found. In 2017, the average time was 5.6 days, ranging from 1 to 22 days of catheter use. In 2018, the average time increased to 10.9 days, ranging from 1 to 31 days. In 2019, the catheter remained inserted, on average, for 8.8 days, ranging from 1 to 28 days. These data demonstrate the average duration of PICC use over the evaluated years.

DISCUSSION

A reduction in catheter losses was observed, possibly related to the increase in insertion practice. This increase in experience led nurses to develop greater technical skill, which is why staff members became more familiar with the device.

National studies have indicated high percentages of unscheduled PICC removal, showing that problems with the length of stay of this device are frequent in many ICUs in the country. In studies that outlined the profile of PICC use in Neonatal ICUs, percentages of 41.6% and 48.8% of PICCs non-electively removed due to complications were found^(1,10). This reinforces the importance of improving PICC

management practices, aiming to mitigate unplanned or unwanted removals, consequently impacting the quality of care provided to the patient.

International studies show lower rates of non-elective PICC removal. In one hospital in China, only 10% of PICCs were non-electively removed. In Baltimore, USA, non-elective removals represented 26.2%. Furthermore, in a study carried out in a French university hospital with 91 PICCs in pediatric patients, 14.4% of catheters were non-electively removed⁽¹⁹⁻²¹⁾.

Regarding the complications that led to the unplanned removal of the studied PICCs, the authors identified the most common occurrences and their respective percentage ranges: obstruction (5.55% to 21.4%), infection (1.85% to 23.5%), rupture (1.1% to 13.04%), infiltration (4.34% to 12.03%) and accidental traction (2.4% to 11.11%)^(1,3,10,12,22). These results highlight the complications related to the use of this device and, consequently, the importance of adopting measures to minimize these complications and allow greater patient safety.

As shown in Table 1, other complications associated with PICC removal were observed in the study, although less frequently, but no less important, such as infiltration, phlebitis, infection and thrombosis. Corroborating this finding, a study conducted in a Neonatal ICU in 2020 should be cited, which indicates an infiltration rate when using a PICC of 6%. The author found a significant association ($p < 0.001$) between the non-central positioning of the catheter and its non-elective removal due to this complication⁽¹²⁾.

The reduction in phlebitis is related to the use of small-caliber catheters and more flexible materials, avoiding mechanical irritation of the blood vessel. It is recommended to use catheters with stabilizing devices to avoid areas of flexion. Additional measures include applying heat, elevating the limb and monitoring for 24 to 48 hours. If signs and symptoms persist after 48 hours, catheter removal should be considered⁽²⁷⁾.

In this study, suspected infection led to PICC removal in two cases in 2019 (Table 1). In general, the literature indicates a lower incidence of sepsis with the use of PICC compared to other types of catheter. The Center for Disease Control and Prevention (CDC) defines Catheter-Related Bloodstream Infection (CRBSI) when confirmed by laboratory examination after PICC use for at least 48 hours before the onset of infection. Contributing factors include improper handling of the catheter and its connections, contamination of intravenous solutions and colonization of the catheter due to migration of skin flora from the insertion site inward⁽⁵⁾.

Studies have shown that one way to prevent this contamination is to implement a package of measures (bundle) aimed at its installation and maintenance, including: educating and training health professionals who insert catheters to use sterile barrier precautions; using skin preparation with alcoholic chlorhexidine for antisepsis; avoiding routine replacement of central venous catheters; preventing disconnecting the infusion system; and reviewing the need for catheter maintenance on a daily basis^(5,13).

With respect to the most serious complications, the present study did not identify the occurrence of pleural effusion, cardiac tamponade or arrhythmias. This fact may be related to the catheter traction procedure, carried out after identifying the intracardiac site.

One study found, among other findings, that the most used insertion site was the jugular vein, corresponding to 37.5% of insertions. Moreover, this fact is attributed to the difficulty in terms of accessing the most frequently recommended veins, resulting from the fragile venous network in seriously ill newborns, due to a long period of hospitalization and repeated venous punctures, making it necessary to use alternative vessels⁽¹³⁾.

In this setting, an organizational culture of early evaluation of PICC indication becomes increasingly necessary. Currently, its indication is still considered a secondary resource for intravenous practice, being used late, when the child's venous network is already precarious, which makes it impossible to insert the catheter or leads, in most cases, to its insertion into little recommended veins, such as jugular and axillary.

In order to reduce complications associated with PICC insertion and make venous network evaluation easier and safer, products have been developed to facilitate the procedure and handling, for example, the use of devices like ultrasound and techniques like Modified Seldinger, also called micropuncture. These innovations have made the evaluation of the venous network easier and safer, which increases the assertiveness index, allowing the insertion of a catheter in deeper veins not visible to the naked eye, as well as better fixation of the dressing in areas with less natural colonization and use of catheters with an appropriate caliber for the vein diameter⁽⁶⁾.

Nonetheless, the PICC insertion technique most used in Brazil is still through direct puncture, known as the traditional puncture method, which consists of measuring the length of the catheter necessary to reach the central site, performing the venipuncture in a visible peripheral vein with an introducer and progressing the entire length of the measured catheter. Having said that, a dressing must be applied and, subsequently, the positioning must be confirmed using radiography^(1,6). The researched setting uses this insertion technique, as it does not yet have the aforementioned technology.

Regarding the PICC length of stay in the studied sector, the results are lower than those of other studies that presented an average of 12.6, 13 and 14.8 days, respectively^(1,10,24).

The goal of therapy is for the PICC to be removed at the end of treatment. Based on the collected data, it was possible to notice that this fact has not been a constant in the studied sector. It must be considered that the responsibility for catheter care is shared by the nursing team. Therefore, it is noteworthy that all professionals who manipulate this catheter must receive training in relation to the PICC maintenance procedure, promoting strategies aimed at improving care, with a consequent reduction in the frequency of hasty removal of catheters and complications related to its use, thus favoring the child's safety.

The applicability and implementation of continuing education for health professionals should be combined with patient safety policies. When it comes to the use of catheters, where a reduction in non-elective removal rates is sought, the nursing team must be trained in terms of PICC catheter maintenance care. Therefore, given the findings described in this study, the importance and need to enhance the knowledge of the nursing team regarding the management and use of PICC stand out, in order to favor an increasing improvement in the use of this device.

CONCLUSION

The use of PICC has become an integral and extremely important part of pediatric nursing care, as it is a fundamental access for prolonged intravenous therapy. In the studied sector, a high rate of non-elective removals of this type of catheter was noted in all years, where obstruction appears as the main cause, followed by catheter rupture, among the highlighted complications. Nursing care must prioritize the prevention and early detection of complications related to its use, so that it is successful until the end of the treatment. This requires a team that has knowledge and mastery of catheter management techniques, where it is essential that procedures are standardized and professionals are involved, with a view to providing children in the PICU environment with quality care that is free from harm.

This study presents important elements to reflect and discuss the practice related to unplanned PICC removal, including its prevalence, reasons and preventive measures. This will contribute to systematizing care, strengthening nursing as a science, as well as promoting the use of this device as a humanization strategy.

Furthermore, this material can serve as a reference for further research on the topic, seeking to improve knowledge and train the nursing team in terms of caring for patients with PICC. This will bring benefits to the profession and society in general, improving the quality of care provided and providing comfort and safety to pediatric patients.

As for limitations, the collection was limited to the information contained in a record book designed to control the PICCs inserted in the sector, without consulting the medical charts, which may have compromised the wealth of information obtained on the causes of non-elective removals of the studied PICCs.

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