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Journals
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Duration time and reasons for removal of peripheral venous catheter in a neonatal unit

Tempo de permanência e motivos de retirada de cateter venoso periférico em unidade neonatal

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ABSTRACT | INTRODUCTION: To identify the mean length of stay of the peripheral venous catheter, describe the reasons for removing the peripheral venous catheter in newborns using a peripheral venous catheter admitted to a neonatal unit. **METHOD:** Quantitative research with newborns who were hospitalized in a Neonatal Unit between December 2021 and May 2022. Data were obtained from electronic medical records and the daily classification form of peripheral intravenous devices filled out in the neonatal unit, subsequently organized into spreadsheets for descriptive analysis. **RESULTS:** The average weight of newborns was 2312.68 grams, the main reasons for hospitalization were respiratory distress and prematurity. There were 132 punctures analyzed, the most frequent catheter permanence time was one day with 40.9%, it was also observed that 9.8% did not last 24 hours. Continuous infusion is used in 50.8% of cases, with infiltration and extravasation being the main reasons for withdrawal, while obstruction is predominant in intermittent therapies. **FINAL CONSIDERATIONS:** Catheters have low permanence in neonates and are removed due to the end of treatment or complications. Identifying risks allows us to develop protective barriers in peripheral intravenous therapy and contribute to the practice of daily care.

KEYWORDS: Hospitalized Child. Peripheral Venous Catheterization. Neonatal Intensive Care Unit. Neonatal Nursing.

RESUMO | INTRODUÇÃO: Identificar o tempo médio de permanência do cateter venoso periférico, descrever os motivos de retirada do cateter venoso periférico dos recém-nascidos em uso de cateter venoso periférico internados em uma unidade neonatal. **MÉTODOS:** Pesquisa quantitativa com recém-nascidos que estiveram hospitalizados em uma Unidade Neonatal entre dezembro de 2021 a maio de 2022. Os dados foram obtidos a partir dos prontuários eletrônicos e da ficha de classificação diária dos dispositivos intravenosos periféricos preenchidos na unidade neonatal, posteriormente organizados em planilhas para a análise descritiva. **RESULTADOS:** O peso médio dos recém-nascidos foi de 2312,68 gramas, os principais motivos de internação foram desconforto respiratório e prematuridade. Foram 132 punções analisadas, o tempo mais frequente de permanência do cateter foi de um dia, com 40,9%; observou-se também que 9,8% não duram 24 horas. A infusão contínua é utilizada em 50,8% dos casos, sendo os principais motivos de retirada infiltração e extravasamento, enquanto que a obstrução é predominante em terapias intermitentes. **CONSIDERAÇÕES FINAIS:** Os cateteres apresentam baixa permanência nos neonatos e são removidos por fim de tratamento ou complicações. Identificar os riscos nos permite desenvolver barreiras de proteção na terapia intravenosa periférica e contribuir para a prática de cuidados diários.

PALAVRAS-CHAVE: Criança Hospitalizada. Cateterismo Venoso Periférico. Unidade de Terapia Intensiva Neonatal. Enfermagem neonatal.

Submitted 03/14/2023, Accepted 08/17/2023, Published 09/29/2023

J. Contemp. Nurs., Salvador, 2023;12:e5122

<http://dx.doi.org/10.17267/2317-3378rec.2023.e5122>

ISSN: 2317-3378

Editor assigned: Tassia Macedo

How to cite this article: Vilvert G, Martello NV, Schulz LF. Duration time and reasons for removal of peripheral venous catheter in a neonatal unit. J Contemp Nurs, Salvador, 2023;12:e5122. <http://dx.doi.org/10.17267/2317-3378rec.2023.e5122>



Introduction

Neonates who present serious complications or who are at risk of developing severe conditions are hospitalized and cared for, and they typically use a peripheral venous catheter (PIVC) during treatment.¹ This device has the advantage of being easily handled and cost-effective, aiming to facilitate the intravenous infusion of medications, nutrients, solutions, and blood derivatives.²

The high frequency of peripheral venous puncture is justified as it is one of the most frequently performed procedures by the nursing team, with 80% of hospitalized patients requiring intravenous therapy as part of the treatment essential for their survival.³ In the United States, over 200 million devices are used each year.⁴ In Spain, 50% of hospitalized patients use some type of venous catheter, of which 95% are for peripheral insertion.⁵ A study conducted in Rio de Janeiro on vascular access evaluated 252 neonates from five neonatal units and found that 238 of them used a PIVC during their stay.⁶

One of the competencies and responsibilities of the nursing team in a hospital setting is the insertion of the catheter using an aseptic technique, ensuring the correct needle size and proper vein selection. It also includes consistent inspection of the insertion site to identify complications early on and maintaining the PIVC with dressings and fixations that extend its duration while preventing contact with microorganisms that can cause infections.⁷ It is recommended to use smaller gauge catheters to prevent mechanical phlebitis caused by irritation to the vessel wall and to allow a higher blood volume circulation, thus reducing the risk of chemical phlebitis.⁸

A strong cultural emphasis is placed on the technique of inserting the PIVC, but there is a low adherence to its maintenance, leading to a failure in the consistent inspection of the device and, consequently, the loss of access and venous impairment.⁹ While intravenous therapy is essential, it is not without adverse effects. The occurrence of phlebitis, infiltration, extravasation, and catheter obstruction is not uncommon, and in these cases, its replacement becomes necessary.¹

Quality indicators associated with the PIVC allow for the evaluation of practices, processes, and care services to determine whether the outcomes are desirable or not. They also assess the need for ongoing education and training for the team, aiming for quality in care and the reduction of adverse events associated with the catheter.⁷ Analyzing and evaluating the reasons for the removal of the peripheral catheter by nursing can lead to continuous improvements in neonatal care protocols. By identifying risk factors and occurrences related to the catheter, nurses can propose strategies that support the enhancement of care practices for neonates.

Given the aforementioned, this study aims to identify the average duration of PIVC retention and describe the reasons for the removal of PIVC in neonates using PIVC who are hospitalized in a neonatal unit.

Methods

The study is of a descriptive, retrospective nature with a quantitative approach, carried out in the neonatal unit of a public maternity hospital that is a reference in the Northeast region of Santa Catarina for high-risk pregnancies and neonatal care. The Neonatal Unit encompasses the neonatal intensive care unit (NICU) and the intermediate neonatal care units, which are referred to as UCINCO for conventional units and UCINCA for kangaroo units.¹⁰ It has 10 ICU beds, 8 UCINCO I beds, 6 UCINCO II beds, and 2 beds dedicated to the kangaroo method.

The study participants are neonates admitted to the Neonatal Unit and using PIVC during the period from December 2021 to May 2022, characterizing a random time frame with an intentional sample.

Inclusion criteria were neonates who used the PIVC. Exclusion criteria were neonates exclusively using a central or umbilical catheter, those transferred to other institutions, admissions after 28 days of life, and those who passed away.

The research adhered to all the stipulations mentioned in Resolution 466/2012 of the National Health Council, ensuring the rights to privacy, confidentiality, anonymity, and non-disclosure for participants. The use and signing of the Informed Consent Form (ICF) by the participant were not necessary since this is a retrospective study using data from the electronic medical record. Data collection took place between July and August 2022 after approval by the Ethics in Research Committee of the Hans Dieter Schmidt Regional Hospital, CAAE 59212822.3.0000.5363.

The study data were collected from the electronic records of the neonates available in the SGS hospital system and from the daily classification form of the peripheral intravenous devices, completed in the neonatal unit by resident nurses after the physical examination of the neonates. This form is located in the Microsoft® Office Excel system named "Daily Classification of Peripheral Intravenous Devices", in the shared folder of the Neonatal Unit. The information was also organized in a spreadsheet using the Microsoft® Office Excel program, and the analysis of the results was descriptive. These were calculated based on absolute (n) and relative (%) frequency and presented in tables. Biological characteristics were grouped in table 1, wherein gestational age, birth weight, and Apgar score variables were grouped and separated according to the nomenclature and classification of the Ministry of Health.¹¹ Data related to peripheral venous catheterization were compiled in table 2.

Results

A total of 48 neonates (NNs) using a peripheral venous catheter (PIVC) participated, with 54.2% being male. The age of the neonates was classified according to the gestational age (GA) at birth. Specifically, 8.3% were extremely preterm, 14.6% were very preterm, 10.4% were moderately preterm, 25% were late preterm, 39.6% were full-term, and only 2.1% were post-term. The weight ranged from a minimum of 580 grams (extremely preterm) to a maximum of 4325 grams (post-term). The Apgar score <7 at the 1st minute was recorded for 35.4% of the neonates, reducing to 8.3% at the 5th minute of life, as described in table 1.

Table 1. Clinical and demographic characteristics of neonates using a peripheral venous catheter admitted to the neonatal unit of a maternity hospital in Santa Catarina, from December 2021 to May 2022 (to be continued)

Variables	N	%
Delivery route		
Cesarean	24	50.0
Vaginal	24	50.0
Sex		
Female	22	45.8
Male	26	54.2
Gestational age (weeks)		
< 28	4	8.3
28 to 31+6	7	14.6
32 to 33+6	5	10.4
34 to 36+6	12	25.0
37 to 41+6	19	39.6
> 42	1	2.1

Table 1. Clinical and demographic characteristics of neonates using a peripheral venous catheter admitted to the neonatal unit of a maternity hospital in Santa Catarina, from December 2021 to May 2022 (conclusion)

Variables	N	%
Weight		
<1000g	5	10.4
1000g to <1499g	4	8.3
1500g to <2499g	17	35.4
2500 to <3999g	19	39.5
>4000g	3	6.2
Apgar		
< 7 (1 st min)	17	35.4
> 7 (1 st min)	29	60.4
No information (1 st min)	2	4.2
< 7 (5 th min)	4	8.3
> 7 (5 th min)	42	87.5
No information (5 th min)	2	4.2
Reasons for hospitalization*		
Respiratory distress	40	83.3
Prematurity	27	56.2
Presumed Early Neonatal Infection	25	52.0
Neonatal jaundice	20	41.6
Metabolic Disorder	15	31.2
Others**	7	14.5

Source: Daily classification form of peripheral intravenous devices and Hospital Services Management System - SGS, 2022.

*The value of n is greater than 48 as most NNs had more than one reason for admission associated.

**Periventricular hemorrhage, Pulmonary hemorrhage, and Pulmonary hypertension.

Regarding the use of peripheral venous catheters, 132 venous punctures were performed on the 48 neonates, and all were punctured with a 24-gauge catheter. The right upper limb was used in 37.8% of cases, followed by the left upper limb in 26.5%, the right lower limb in 19.7%, and the left lower limb in 15.9%. Of these, 81% used a splint for fixation, 8% did not use one, and information on splint use was missing for 11% of the recorded peripheral venous punctures, as shown in table 2.

Table 2. Variables related to the use of peripheral venous catheters in the neonatal unit of a maternity hospital in Santa Catarina, from December 2019 to May 2020

Variables	N	%
PIVC retention time		
0 day	13	9.8
1 day	54	40.9
2 days	27	20.5
3 days	17	12.9
4 days	8	6.1
5 days	3	2.3
6 days	2	1.5
No information	8	6.1
Punctured limb and side		
Right upper limb	50	37.9
Left upper limb	35	26.5
Right lower limb	26	19.7
Left lower limb	21	15.9
Use of a splint for fixation		
Yes	107	81.0
No	11	8.0
No information	14	11.0
Type of infusion		
Intermittent	46	34.8
Continuous	67	50.8
Mixed	19	14.4
Medication characteristics		
Non-irritating	88	66.7
Irritating	43	32.6
Vesicant	1	0.7
Grounds for removal		
Elective removal	28	21.2
Infiltration	24	18.2
Extravasation	15	11.4
Obstruction	15	11.4
Edema	11	8.3
Phlebitis	6	4.5
Other*	11	8.3
No information	22	16.7

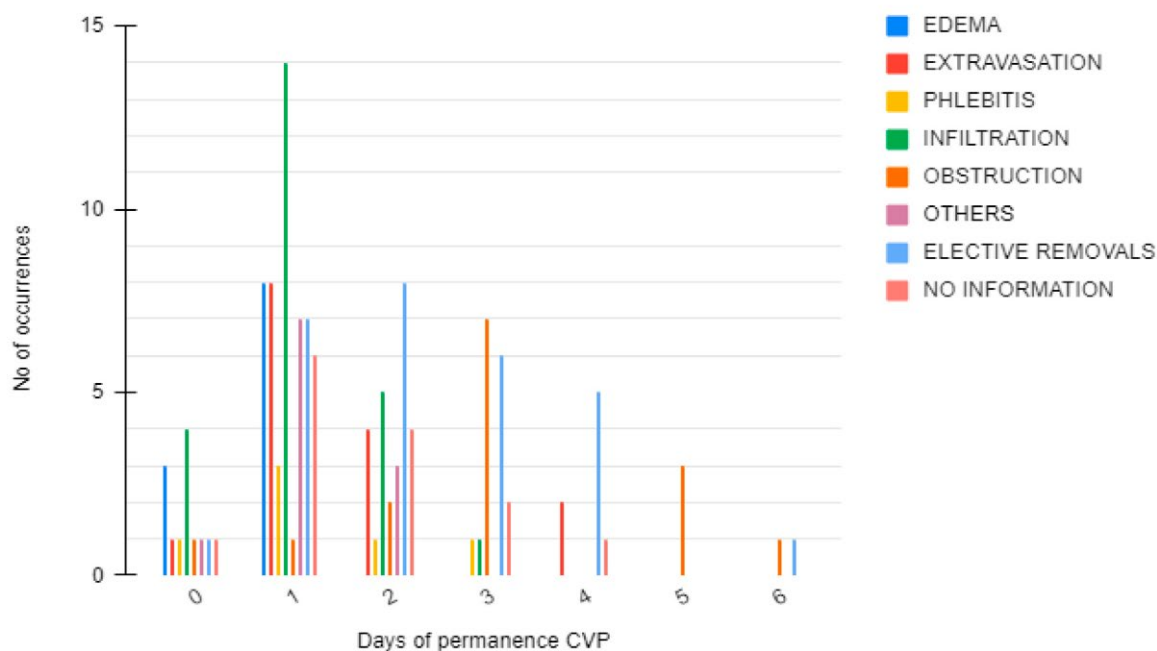
Source: Daily classification form of peripheral intravenous devices and Hospital Service Management System - SGS, 2022.

*Locked sealing device, accidental traction, loss of PVA, and replacement by the Peripherally inserted central catheter.

The duration of the PIVC was assessed in days, with the majority lasting for one day at a rate of 40.9%, followed by two days at 20.5%. A significant percentage of 9.8% were removed in less than a full day. Continuous solutions are the most commonly used, accounting for 50.8% of the cases, in addition to mixed-use when the catheter is employed to infuse both continuous solutions and intermittent medications.

Regarding the reasons for removal, elective removal stands out at 21.2%, followed by infiltration at 18.2%, extravasation at 11.4%, and obstruction at 11.4%, among others as detailed in table 2. However, 16.7% of the removed catheters had no information on the reason for removal, both in the daily classification form and in the investigated medical records.

Chart 1. Comparison between reasons for removal and days of peripheral venous catheter retention in the neonatal unit of a maternity hospital in Santa Catarina, from December 2019 to May 2020



Source: Daily classification form of peripheral intravenous devices and Hospital Services Management System - SGS, 2022.

The chart above illustrates the comparison of the frequency of reasons for removal against the number of days the PIVC remains in place. It's observable that infiltration, extravasation, and edema are predominant up to the 2nd day, while obstruction prevails after the 3rd day of insertion. Elective removals occur most frequently between the 2nd and 3rd days.

Discussion

Technological advancements and the development of new therapeutic resources in neonatology have led to a significant increase in the survival of critically ill newborns, especially preterm and low-birth-weight infants.¹² Intravenous medications are essential for patient improvement, and for this reason, peripheral catheterization is one of the most frequently performed procedures by the nursing staff. This requires attention and care, as it's common for the catheter to have a short duration due to complications, especially in children under one year of age.¹³

The reasons for catheter removal align with the findings of Danski in their research involving 145 neonates and 677 punctures, revealing that infiltration and extravasation are the most prevalent complications (69.8%).¹⁴ This is also consistent with Nakandakari's study, which observed a 40.6% infiltration rate among the 54 punctures performed in the neonatal unit, followed by extravasation (29.2%), obstruction (19.8%), and phlebitis (8.3%).¹

The high occurrence of these events may be related to the neonate's fragile and impaired venous network, which promotes capillary leakage, as they are typically premature, underweight, or clinically unstable.¹⁴ Other associated factors include the type of catheter chosen, improper insertion technique, type of medication, failure in daily inspection, among others.¹

Regarding phlebitis, the rate is below the 5% threshold, characterized as a quality indicator by international clinical practice guidelines. Similar studies report occurrences ranging from 2.7% to 14%.¹⁴ Some suggested actions to prevent this event include proper hand hygiene, selecting the smallest caliber catheter, and generally infusing solutions according to blood osmolarity and pH. It's important to emphasize that the team needs to possess theoretical knowledge and be trained to use phlebitis assessment tools.¹³

It's noteworthy that the risk of developing harm related to the PIVC requiring removal is higher up to the second day post-puncture and is linked to continuous or mixed infusion. Equivalent findings were observed in other studies, underscoring the importance of continuous inspection of the device and palpation at the catheter insertion site.¹⁴ After the third day, there was a prevalence of obstructions for intermittent medications. This impedes the administration of intravenous therapy, affecting the infusion rate per minute and the efficacy of the medication. Additionally, there's a risk of infection to the patient due to the potential proliferation of microorganisms in clotted blood.¹⁵ To prevent obstruction, the use of saline solution before and after medications is recommended to maintain catheter permeability, as well as securing it in a way that avoids kinking.¹⁶ Thus, neonates on intermittent medications present lower complication risks, while therapies related to continuous or mixed infusion exhibit higher infiltration and extravasation rates.¹⁴

It was observed that newborns weighing less than 1500 grams used PIVC less frequently (18.7%). This data aligns with the recommendations from the Ministry of Health regarding the preference for the use of peripherally inserted central venous catheters in this weight range when medications are needed for more than 7 days.¹⁷

The splint for movement restriction of the punctured limb is used in 81% of the punctures. Its use should be discouraged among nursing professionals and only applied when it's absolutely necessary to place the catheter in the joint region, as a means to maintain venous permeability. Moreover, the splint can negatively interfere with the visualization of the limb and impair circulation.¹⁸ To stabilize the catheter, it is advisable to use a specific adhesive device for stabilization, eliminating the use of non-sterile adhesive tapes.¹⁷

In this study, there was a preference for using the upper limbs for peripheral venous puncture. Similar results were presented in a study on peripheral venous access in hospitalized children, where he states that the first choice for puncture location also begins with the upper limbs; the author suggests that this preference might be related to the professional's skill in PIVC insertion or even the ease of positioning the arm during the procedure.¹⁹

The records regarding reasons for removal were absent in 16.7% of the catheters, which implies a failure in communication among care providers and directly affects the maintenance of the PIVC, since documented progress notes in the patient's chart are a way to monitor the patient's progress in response to the procedures performed.²⁰

One of the core competencies of neonatal nurses is the monitoring and management of intravenous therapy in healthcare institutions, aiming to implement preventive measures and establish indicators concerning the occurrences associated with the use of the PIVC. To this end, it's essential that professionals make accurate records to generate data related to the care provided.^{13,16}

Study limitations

The lack of information found in the medical records and in the daily classification sheet of peripheral intravenous devices regarding the reasons for removal and the duration of the catheter was a limitation of this study. The absence of records can be explained by a lack of routine in noting such details in the records or due to the high workload of professionals during their daily routine.¹³

Contributions to practice

We believe that the results presented here can assist in the development of improvement actions for the nursing practice, such as the development of educational strategies and continuous care assessment.

Conclusion

From this study, it was possible to determine that the use of PIVCs in the neonatal unit has a short duration, with most being maintained for just one day. The reasons for removal are either elective or due to complications, mainly related to infiltration, extravasation, edema, and obstruction. Full-term neonates are the ones who use the PIVCs the most, and the primary purpose of the device is for the infusion of continuous solutions, followed by intermittent and mixed ones. The use of immobilization splints is widely applied, which neither prevents the complications caused by the catheter nor prolongs its durability.

It is essential to understand the complications and their risk factors to prevent them, as well as to provide guidance regarding the monitoring of PIVCs. Continuous education among the nursing team ensures the consistency of quality work and the prevention of unfavorable events for the newborn.

Contributions of the authors

Vilvert GR was involved in the conception of the research question, methodological design, search and statistical analysis of the research data, interpretation of the results, and writing of the scientific article. Martello NV and Schulz LF participated in the methodological design, statistical analysis of the research data, interpretation of the article's results, critical review of the article, and final approval of the version to be published. All authors reviewed and approved the final version and agree with its publication.

Conflicts of interest

No financial, legal, or political conflict involving third parties (government, private companies, and foundations, etc.) was declared for any aspect of the work submitted (including but not limited to grants and funding, participation in advisory boards, study design, manuscript preparation, statistical analysis, etc.).

Indexers

The Journal of Contemporary Nursing is indexed by [DOAJ](#) and [EBSCO](#).



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