

NURSING CARE IN PERIPHERAL INTRAVENOUS CATHETERIZATION IN HOSPITALIZED CHILDREN: INTEGRATIVE REVIEW

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ABSTRACT

Objective: to describe nursing care in peripheral intravenous catheterization in hospitalized children.

Method: integrative review carried out in November 2020 in LILACS, CINAHL, MEDLINE, SciELO, BDNF and COCHRANE databases. The analysis was constructed from the processes of this review.

Results: 19 articles were analyzed, classified according to the level of evidence: level II (5%), level IV (21%), level V (5%), level VI (63%) and level VII (5%). Analytical category “Care for hospitalized child requiring peripheral intravenous catheter”. Ultrasound was considered a useful technology. The most used and recommended catheter is the 24 Gauge caliber and the ideal dressing is to use sterile transparent film. Venipuncture in children is more difficult than adults and is often associated with adverse events. Elective catheter replacement is not recommended in children, but there are still doubts. The Difficult Intravenous Access score determines the probability of catheterization failure. Specialized and trained nursing professionals make a difference in this procedure. One should be concerned with pain, using pharmacological and non-pharmacological devices to minimize it.

Conclusion: this review contributes to good practices in the care of peripheral intravenous catheterization in children and was based on data on the main technologies used, forms of prevention of adverse events, as well as nursing actions that ensure the safest and least stressful process for children and their families.

DESCRIPTORS: Peripheral catheterization. Pediatric nursing. Neonatal nursing. Patient safety. Nursing care.

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CUIDADOS DE ENFERMAGEM NA CATETERIZAÇÃO INTRAVENOSA PERIFÉRICA EM CRIANÇAS HOSPITALIZADAS: REVISÃO INTEGRATIVA

RESUMO

Objetivo: descrever os cuidados de enfermagem na cateterização intravenosa periférica em crianças hospitalizadas.

Método: revisão integrativa realizada em novembro de 2020 nas bases de dados LILACS, CINAHL, MEDLINE, SciELO, BDNF e COCHRANE. A análise foi construída a partir dos processos desta revisão.

Resultados: foram analisados 19 artigos, classificados quanto ao nível de evidência: nível II (5%), nível IV (21%), nível V (5%), nível VI (63%) e nível VII (5%). Categoria analítica “Assistência à criança hospitalizada que necessita de cateter intravenoso periférico”. A ultrassonografia foi considerada uma tecnologia que pode ser útil. O cateter mais utilizado e recomendando é o de calibre 24 Gauge e o ideal da fixação é utilizar filme transparente estéril. A punção em crianças é mais difícil do que adultos e está frequentemente associada a evento adverso. Não se recomenda a troca eletiva do cateter em crianças, mas ainda existem dúvidas. O escore de Acesso Intravenoso Difícil determina probabilidade de insucesso da cateterização. Profissionais de enfermagem especializados e treinados fazem a diferença nesse procedimento. Deve-se ter preocupação com a dor, utilizando artifícios farmacológicos e não farmacológicos para minimizá-la.

Conclusão: esta revisão contribui para as boas práticas na assistência à cateterização intravenosa periférica em crianças e baseou-se em dados sobre as principais tecnologias utilizadas, formas de prevenção de eventos adversos, bem como ações de enfermagem que garantem o processo mais seguro e menos estressante para as crianças e seus familiares.

DESCRITORES: Cateterismo periférico. Enfermagem pediátrica. Enfermagem neonatal. Segurança do paciente. Cuidados de enfermagem.

CUIDADOS DE ENFERMERÍA EN CATETERIZACIÓN INTRAVENOSA PERIFÉRICA EN NIÑOS HOSPITALIZADOS: REVISIÓN INTEGRATIVA

RESUMEN

Objetivo: describir los cuidados de enfermería en el cateterismo intravenoso periférico en niños hospitalizados.

Método: revisión integradora realizada en noviembre de 2020 en las bases de datos LILACS, CINAHL, MEDLINE, SciELO, BDNF y COCHRANE. El análisis se construyó a partir de los procesos de esta revisión.

Resultados: se analizaron 19 artículos, clasificados según el nivel de evidencia: nivel II (5%), nivel IV (21%), nivel V (5%), nivel VI (63%) y nivel VII (5%). Categoría analítica “Asistencia a niños hospitalizados que necesitan catéter intravenoso periférico”. La ecografía se consideró una tecnología que podría ser útil. El catéter más utilizado y recomendado es el catéter de calibre 24 Gauge y lo ideal para la fijación es utilizar una película transparente estéril. La punción en los niños es más difícil que en los adultos y, a menudo, se asocia con un evento adverso. No se recomienda el intercambio electivo de catéter en niños, pero aún existen dudas. La puntuación de acceso intravenoso difícil determina la probabilidad de falla del catéter. Profesionales de enfermería especializados y capacitados marcan la diferencia en este procedimiento. Uno debe preocuparse por el dolor, utilizando dispositivos farmacológicos y no farmacológicos para minimizarlo.

Conclusión: esta revisión contribuye a las buenas prácticas en la asistencia al cateterismo intravenoso periférico en niños y se basó en datos sobre las principales tecnologías utilizadas, las formas de prevenir eventos adversos, así como las acciones de enfermería que garantizan un proceso más seguro y menos estresante para los niños y su familia.

DESCRIPTORES: Cateterismo periférico. Enfermería pediátrica. Enfermería neonatal. Seguridad del paciente. Cuidados de enfermería.

INTRODUCTION

Peripheral intravenous catheterization (PIC) is an invasive procedure widely used in pediatrics for the administration of medications or fluids. PIC allows the connection between the skin surface and the inside of a peripheral vein. The catheters used for this purpose are equipped with a thin tube consisting of biocompatible material¹. This procedure is part of the daily activities of nursing professionals, however, factors related to the physical and clinical characteristics of the child, in addition to the type and quality of the materials, can hinder the venipuncture, increasing the time of the procedure and interfering in the treatment².

The nursing team is responsible for the PIC process, from the verification of the devices, from the puncture site to the verification of the corresponding infusion pump³. It is an extremely painful procedure, and a stressful experience for newborns, children and family members. In the context of care, the maintenance of PIC should follow protocols that promote the safety of neonatal and pediatric patients, as well as the durability of venous access for as long as possible⁴⁻⁶.

The definition of child by the Children's Statute is from zero to 12 years of age⁷. Considering this clientele, specific actions can ensure safety during PIC, such as selecting the appropriate vein of the hand, forearm and arm, avoiding the antecubital area, and for children under three years of age, to evaluate the veins of the head, and then consider the veins of the feet. In the case of difficult venous access and/or after unsuccessful puncture attempts, visualization technology should be used. Furthermore, it is not recommended to routinely change venous access in pediatric and neonatal patients, unlike the adult patient⁸.

As stated, there is specific knowledge and PIC technique in neonatology and pediatrics, however problems are perceived in practice, especially in the case of difficult venous access and the permanence of the catheter for the appropriate time without the occurrence of adverse events⁴⁻⁶. It can be inferred that the need for the procedure adds to the weight of responsibility of the nursing team, which must be successful even in unfavorable conditions. Therefore, it is imperative that professionals update themselves on the appropriate technique and conducts that avoid complications in this clientele.

Considering the importance of nursing in the PIC process and the difficulties related to puncture and maintenance of peripheral venous access in children, the need for theoretical deepening in the theme with a view to directing the practice was verified, basing it on scientific knowledge to support nursing care and adequacy of the care provided, as proposed by evidence-based practice⁹.

Maintaining this perspective under the specificity of PIC in pediatrics, the objective of the study is nursing care regarding the puncture and maintenance of the peripheral venous catheter in hospitalized children. The objective proposed for this research is to describe PIC nursing care in hospitalized children.

METHOD

An integrative review of the literature was developed, which contributes to the summary of the results of relevant and recognized research worldwide, facilitating the incorporation of evidence for use in practice¹⁰⁻¹¹. The structure of this study was based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA), building the review based on this checklist, from the title, to the conclusion and explanation of the research funding, in addition to the flowchart contemplating the identification, selection, eligibility and inclusion of the articles found¹²⁻¹³.

As it is an integrative review of the literature, the stages of research of problem identification, bibliographic research, evaluation of included studies, data presentation and analysis were followed¹⁴. The PICOT format was adopted for the formulation of the research question; (P: target population; I: intervention or area of interest; C: compare types of intervention or groups; O: results or effects

achieved with the intervention and T: time required to obtain the result), resulting in the question: Which nursing care for puncture and maintenance of the peripheral intravenous catheter(O) do hospitalized children (P) in need of PIC (I) receive during the stay in the hospital environment (T)? As this is not an interventional clinical research, topic C (comparison) is not mandatory⁹.

The search was conducted in November 2020. The databases used were Latin American and Caribbean Literature on Health Sciences (LILACS), Cumulative Index to Nursing and Allied Health Literature (CINAHL), Medical Literature Analysis and Retrieval System Online (MEDLINE), Scientific Electronic Library Online (SciELO), Nursing Database (BDENF) and Cochrane Database of Systematic Reviews (Cochrane).

The inclusion criteria were scientific articles that presented a full text, published in the time frame from October 2017 to October 2020, in order to analyze the most recent articles on the subject, generating current evidence; in the Portuguese, English or Spanish languages; whose participants or object of study were children, health professionals or guardians of hospitalized children. Exclusion criteria were duplicate scientific articles; articles that did not specifically contemplate care in neonatology and/or pediatrics; and that did not deal with PIC.

The English descriptors extracted from the vocabulary of Medical Subject Headings (MeSH) were: Catheterization, Peripheral; Nursing Care; Child, Infant, Newborn. The combination with the Boolean operators AND and OR was evaluated in each database. Search 1 was: (Catheterization, Peripheral AND Nursing Care AND Infant, Newborn); search 2: (Catheterization, Peripheral AND Nursing Care AND Child); search 3: (Catheterization, Peripheral AND Nursing Care); and search 4: (Catheterization, Peripheral). Searches 1, 2 and 3 were prioritized. If the result was considered to have a low quantity of articles, it would expand to search 4 in order to cover articles within the criteria that were not well categorized.

The databases consulted were LILACS and BDENF, through the Virtual Health Library (VHL), in advanced search with the following filters: full text; (LILACS or BDENF); English, Portuguese and Spanish; and the 2017-2020 publication year. MEDLINE and CINAHL were accessed by *EBSCOhost* in advanced search; Boolean/Phrase search mode; Apply equivalent subjects; full text; human being; publication date from October 2017 to October 2020. Regarding age: marked all from Infant, Newborn to Child. SciELO was accessed by *scielo.org* in advanced search; English, Portuguese and Spanish languages; year of publication: 2017, 2018, 2019 and 2020. Access to COCHRANE was by the Cochrane Library in advanced research; type: Cochrane reviews; date: October 2017 to October 2020. In this database, only revisions were considered, since they are the main type of research available on the platform.

The articles were selected by two reviewers separately. After selection and full reading of the material, the result was compared between the two researchers, and the articles were excluded or maintained after joint analysis of the divergences with a third researcher. A form was created for data collection, adapted for integrative review, for better observation and analysis of each article¹⁵. The items in this form were: title, year of publication, journal name, publication language, authors educational qualifications, authors' country of origin/study, objectives, type of study, level of evidence, age group of children/quantity, professional participant - what/quantity, responsible participant/quantity, number of articles analyzed, devices used, main results, conclusions and biases or limitations of these studies.

The analysis was organized based on the integrative review processes, including plausibility, comparisons, search for patterns, abstract, data in general and the construction of a logical chain of evidence that would allow a basic numerical visualization of the distribution of the studies. The results were analyzed and represent the main data of all the material that enabled the formulation of categories¹⁴.

RESULTS

A total of 221 articles were found. In BDEF and LILACS, searches 1, 2 and 3 were used. In the other bases, searches 1,2, 3 and 4 were performed. Duplicate articles were excluded and those that did not meet the previous criteria, as shown in Figure 1. The difference between the reviewers resulted in the exclusion of an article by the second reviewer, confirmed by the third, because the article did not specify child care.

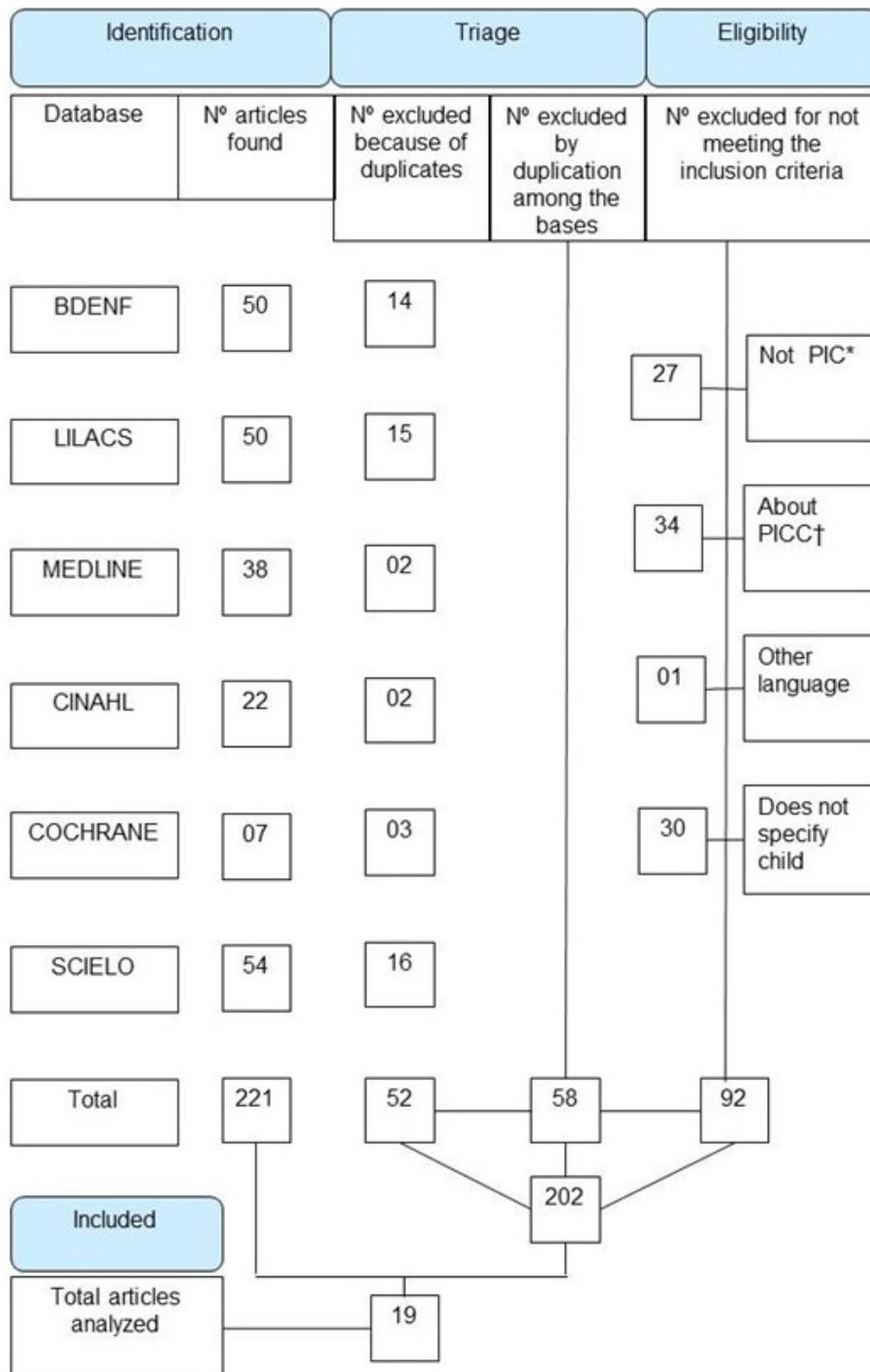


Figure 1 - Search flow and exclusion of articles by database - August (2017 to 2020). Rio de Janeiro, RJ, Brazil, 2020. Legend: *Peripheral intravenous catheterization; †Central Peripheral Insertion Catheter. Adapted from Moher et al¹³.

The total sample of the articles analyzed was 19, 42% in Portuguese, 58% in English and none in Spanish. As for the year of publication and the number of studies, 2017, 2019 and 2020 had four articles each; and 2018 had seven articles.

The identification of the articles according to the level of evidence was based on the Model of Evidence-Based Practice, which classifies the research according to the methodological approach, in a hierarchical manner, ranging from 1 to 7. No articles classified as level I (systematic review or meta-analysis of multiple randomized controlled clinical studies) or level III (almost experimental studies – without randomization) were found. Most articles were level VI (descriptive or qualitative research) 63%^{1-2,5,16-24}; followed by 21% of level IV articles (case-control and cohort studies)²⁵⁻²⁸, and levels II (individual studies with controlled and randomized experimental design)⁴, V (systematic reviews of descriptive (non-experimental) or qualitative studies)²⁹ and VII (expert opinions)³⁰ with 5% each⁹. Continuing the analyses of each article, Chart 1 was prepared for better visualization of participants and objectives related to the CIP.

Chart 1 - Identification of the sample of articles between 2017-2020 on care related to peripheral intravenous catheterization in neonatology and pediatrics by number of participants and age group of children. Rio de Janeiro, RJ, Brazil, 2020. (n=19).

Code	Article reference	Purpose of the article	Number of participants	Children's age group
1	Silva et al. ²⁴	Validate the content and appearance of didactic and instructional technology entitled "Peripheral venous puncture for family" with the accompanying family members of children.	Mothers:09. Grandmother:01.	Pediatrics: does not specify age limit.
2	Shaukat et al ²³	Evaluate the ability of pediatric emergency professionals to PIC § in patients with DIVA 4 or higher. Evaluate the association of the experience of professionals with the first attempt success rates. To evaluate the impact of experience on the ability of professionals to perform PIC insertion in patients with high DIVA score .	Doctors and nurses: 29.	Age under 18 years - N*: 181.
3	Santos et al ²⁹	To verify the influence of vascular† US, infrared light emission and transdermal illumination on the success of PIC; number of attempts, time to perform the <i>procedure, permanence of the catheter in situ and occurrence of complications in children, when compared to the traditional method.</i>	Articles: 25.	Age from zero to 18 years.

Chart 1 – Cont.

Code	Article reference	Purpose of the article	Number of participants	Children's age group
4	Otani et al ²⁸	Investigate the usefulness of US † for PIC §, comparing success rates with or without US† in children with difficult intravenous access.	First attempt: 734 children. Second attempt: 100 children with US† and 99 children with common technique.	Age under 16 years.
5	Gomes et al ²⁷	Describe the behavioral and physiological responses of newborns submitted to venous puncture, with and without the use of non-pharmacological measures for pain relief.	Newborn:84.	Zero to 28 days of life.
6	Goel et al ⁵	Describe and document venous changes that can be visualized with ultrasound in pediatric patients.	Children: 35.	Three to 15 years.
7	Freire et al ²²	Present cross-cultural adaptation and content and semantic validation of diva for current use in Brazil.	Doctors: 7. Nurses: 2. Nursing technician: 3. Nursing assistant: 8. Total: 20.	From 1 to 3 years.
8	Floriano et al ²	To verify characteristics related to critical child, catheter and professional that can influence the time to puncture success.	Children: 89.	Pediatrics: 0 to over 7 years (did not delimit maximum age).
9	Diener et al ²⁶	Evaluate the effectiveness of the intervention of specialists in children's lives to minimize the suffering of children undergoing intravenous placement procedures.	Children: 95.	Pediatrics: 2 years or more (did not delimit maximum age).
10	Cooke et al ²⁵	Understand the experience of peripheral access users; establish aspects of insertion and care relevant to them; and compare adult experiences to adult caregivers of a child.	Adults: 570. Companions of minors under 18 years: 142. Total: 712.	Adults over 18 years and companions of children under 18 years of age.
11	Chin et al ⁴	Determine whether the extravasation rate is reduced with elective replacement of peripheral venous access in newborns.	Newborn: 113	Newborns 32 weeks of GI‡ or more.

Chart 1 – Cont.

Code	Article reference	Purpose of the article	Number of participants	Children's age group
12	Carey ³⁰	Publicize the pediatric venous access service of <i>St. George's</i> , which is led by nurses through conference.	No.	Pediatrics: does not specify age limit.
13	Bolcato et al ¹	Report a case of mutilation after use of peripheral venous access for more than six days.	Child: 1.	Newborns from 23 weeks and 5 days of GI‡ to 2 years of age.
14	Bitencourt et al. ²⁰	To evaluate the prevalence of phlebitis related to the use of peripheral intravenous devices in children in a university hospital.	Children: 871.	29 days to 14 years.
15	Ben Abdelaziz et al. ¹⁹	Identify the types and incidences of PIC § complications in children and predisposing factors in a developing country.	Children:98	Average 4 years old.
16	Atay et al. ¹⁷	Identify the incidence and factors related to infiltration and extravasation in newborns with peripheral venous catheter.	Newborns: 152.	Extreme preterm to full-term newborns.
17	Sena et al ¹⁶	Identify patient safety measures in nursing care before, during and after peripheral puncture of premature newborns.	Nursing assistants: 11. Nursing techniques: 25. Nurse: 6. Total: 42.	Premature newborns.
18	Bezerra et al. ²¹	To identify the practice and level of knowledge of nursing technicians regarding peripheral venous catheterization in pediatrics.	Nursing technicians: 154.	Pediatrics: does not specify age limit.
19	Bai et al. ¹⁸	Develop a parental care response scoring system based on Swanson's Theory of Care and test the psychometric properties of this system in children with cancer.	Responsible at the first moment: 29. In the second moment: 43.	Children from 3 to 12 years.

†Ultrasound; ‡ Gestational age; § Peripheral Intravenous Catheterization; || *Difficult Intravenous Access Score*.

It is noticed that the age of the children was not specified in seven of the studies. However, these studies focused on pediatrics or neonatology, so the limitation of the age group can be understood as from newborn up to 18 years of age. As for the research participants, 21% of the articles included health professionals; and 16%, the children's companions as participants. Regarding the methodology, 5% (only one) used review methodology, with other articles as the object of study, and 48% made the observation of the child himself for the research.

Analytical category: Care for hospitalized children requiring peripheral intravenous catheter

The main themes found in the articles were organized giving rise to the analytical category: Care to hospitalized children who need peripheral intravenous catheter. In this category, the different forms of care observed were analyzed, because all studies highlighted some care related to the care of children who needed PIC. For better visualization of the context of the analysis, the category was subdivided into three subcategories: Hard technology assisting children with PIC; Adverse events and PIC in children; Nursing that promotes care in children with PIC.

Hard technology assisting children with PIC

Hard technology is a classification of technologies involved in health work, characterized by involving technological equipment such as machines, in addition to organizational norms and structures³¹. Studies were found that evaluated whether this type of technology could be beneficial or not in the care of children with PIC. A systematic review of PIC care related technologies in children in the pediatric emergency identified, among the technologies studied, that fiber optic light transillumination equipment increases the overall success rate of PIC compared to the traditional method (visualization and palpation)²⁹.

The technologies that most increased the success rate in the first attempt of PIC were infrared light and ultrasound (US). The US was the one that most reduced the time spent in the procedure, generating faster interventions, which improves care and mitigates the stress of the child and family members²⁹. The study also revealed that nurses trained to use US in PIC in pediatrics have high success rates in the procedure³⁰.

However, another study with children submitted to PIC insertion in pediatric emergency found that, after the first failed attempt of PIC by the traditional method, the second attempt, using US, was less efficient (only 68% success) than the traditional puncture method (84% success). Therefore, they did not recommend US to assist PIC insertion in the pediatric population in general, because the agitation of the child makes it difficult to use the device, making the procedure more time consuming and contributing to more movements and crying, which can lead to venoconstriction. They added that the catheter used is usually as short as the 24 Gauge (G) catheter, which led them to believe that US assistance during PIC insertion is inefficient²⁸.

The data indicated that the catheter caliber most used for PIC in pediatrics is 24G^{2,5,21,30}, but the catheter outside the needle made from Vialon[®] with anti-slip flaps, flexible transparent extensor tube and device for recapping the 22G caliber needle demonstrated better grip for the professional, increasing the success of the puncture and reducing the time of the procedure compared to the 24G caliber and other materials². In addition to the finding, the protocol of a children's hospital in Washington, Usa, suggests that the catheter used for PIC is 24G for children under three years of age and 22G for older children⁵.

The adequate material for PIC is important for success and longer access time. The use of sterile transparent film for catheter fixation is recommended, especially in pediatric patients, since adhesive and microporous tape do not allow a good visualization of the ostium for catheter insertion, making it difficult to identify signs of inflammation and good fixation²¹.

The experience with PIC can be painful, stressful and frustrating for patients. It is important to include pain relief measures as standard practice^{16,18,25,27,32}. J-Tip is a pharmacological technology for pain control caused by venous puncture, used by professionals specialized in PIC in pediatrics, it includes the application of pressure lidocaine without a subcutaneous needle, which provides local anesthesia within two to three minutes²⁶.

Adverse events and PIC in children

It is widely known that pediatric patients have greater difficulty in obtaining PIC insertion due to the smaller caliber and quantity of vessels appropriate for puncture. In addition, they are clients who generally do not cooperate during the procedure, making it even more difficult to perform the technique²¹. Moreover, it is observed that the failure rates in the first attempt at PIC insertion are higher in children compared to adults²⁵. In view of this, it is considered necessary to study the reasons for the low durability of the peripheral catheter in this clientele, which requires interventions and new PICs in shorter time intervals⁴.

Among the risk factors related to pediatric patients, which can cause multiple attempts and longer time in the puncture process, are: the age group less than three years; low weight or obesity; history of prematurity; skin color; psychomotor agitation; anxiety or fear; vascular diseases; or acute involvements that interfere in the blood circulation, such as dehydration or shock of varied etiology, causing greater vascular fragility, interference in the visualization and palpation of the vessel².

Nevertheless, PIC is one of the most common invasive procedures performed in neonates and pediatric patients and is often associated with adverse events^{1,4,17,19–20,25}. For example, venous alterations were found through US images in 73% of the most used veins for PIC placement in pediatric patients aged three to 15 years with a mean catheter use time every three days. The most significant changes were lumen narrowing (47%), wall thickening (33%), presence of thrombus (20%) and absence of blood flow around the catheter tip (40%). It is noteworthy that these alterations were not always seen on physical examination, i.e., they did not show signs of phlebitis, which hinders the evaluation of permeability of venous access and contributes to the high rates of PIC losses in children⁵.

Taking into account multiple PICs and their possible adverse events, the deadline for elective catheter replacement was highlighted among the studies. A randomized study with neonates showed no impact of elective replacement of the peripheral intravenous catheter every 72 to 96 hours in relation to the risk of extravasation injury. On the other hand, an increased risk of extravasation was observed around the puncture site in infants who had the PIC replaced electively⁴. It should be noted that the risk of extravasation or infiltration in PIC is proportional to prematurity, low birth weight, multiple antibiotic use and the use of parenteral nutrition¹⁷.

However, a case study reported that, although no clear signs or symptoms of phlebitis appeared at the insertion site of peripheral venous access of a premature neonate who, for six days, received antibiotic therapy, venous hydration and blood components through the catheter, after removing it, there was a thrombolytic process secondary to phlebitis, causing severe damage to the child, such as the amputation of distal phalanx of the hand where intravenous access was located¹. The data on phlebitis in children were relevant and evidenced the prevalence in 26% of the children analyzed, affecting mainly those under two years of age²⁰. The research indicated that 70.3% of the 111 nursing technicians who deal with pediatric clients believe that it is correct to perform catheter replacement after 96 hours of insertion, even if it is unblocked and without signs of infection²¹.

The number of risk factors for adverse events in PIC include the small caliber of the most commonly used catheter (24G); intravenous infusion by infusion pump with volume control; long-term intravenous therapy; medical diagnosis of respiratory disease or infection; use of antibiotics, including vancomycin and cefotaxime; use of proton pump inhibitors; 10% glucose solution instead of 5%; and physiological solution¹⁹. However, it is considered that many of the risk factors that lead to phlebitis are preventable^{19–20}. Among the practices that can be implemented at no additional cost are the rationalization of the use of this device, reduction of the duration of intravenous therapy, removal of unnecessary venous catheters, greater adherence to the use of medications and the appropriate forms of administration¹⁹.

The working conditions of nursing professionals may also be a disadvantage to safe practice in the promotion of PIC in pediatrics^{2,16}. It was verified that the longest time for the success of the puncture occurs among professionals who work 60 hours per week, who perform activities that precede the procedure such as the preparation and administration of medications and who are performing the procedure on the child in the third period of the night shift². Factors that can prevent complications related to PIC are the increase in the number of nurses per patient and the acquisition of sufficient infusion pumps¹⁹. Thus, seeking measures to reduce adverse events is essential to ensure quality care, reduce the need for multiple punctures, patient pain, family anguish, length of stay and hospital costs²⁰.

Nursing promoting care in children with PIC

Nursing plays a central role in the care of intravenous therapy, and PIC insertion is a commonly performed procedure used for the administration of fluids, medications and to aspirate blood in pediatric patients admitted to hospitals and health units^{5,20,22}. Unfortunately, peripheral venous accesses do not remain functioning during all the necessary time, which results in a new puncture intervention by nursing⁵. It is understood that the practice of PIC in pediatrics is a simple procedure, but there is care that should be known by the professional performing it, aiming at the patient's well-being²¹.

In view of nursing as the main promoter of PIC, the score Difficult Intravenous Access (DIVA) was developed in English, translated to Portuguese as a Score of Difficult Intravenous Access (DIVA score) in pediatrics. This score analyzes the visibility of the vein after the tourniquet as: visible (zero points) and not visible (2 points); palpability of the vein after tourniquet as palpable (zero points) and non-palpable (2 points); age of the child: greater than or equal to 36 months of age (zero points), 12 to 35 months (1 point) and less than 12 months (3 points); prematurity: history of term birth (zero points) and premature - gestational age less than 38 weeks at birth (3 points); skin tone: light (zero points) and dark (1 point)²²⁻²³.

Children who are identified with the DIVA score greater than or equal to 4 will be 50% more likely to be unsuccessful in the first attempt at PIC insertion²²⁻²³. For this reason, it is necessary to develop strategies to increase success in the first attempt of PIC insertion, especially for children²⁵. The DIVA score also indicates that the time for access in these children is longer than in children with lower scores²³.

Regarding nursing professionals, the study demonstrated that professionals with five years or more of experience in pediatric emergency had significantly more success and were faster in the first attempt at PIC insertion²³. However, in a similar pediatric emergency scenario, patients raised variables that influence the time to puncture success, and the mean time to puncture them was longer than recommended by the literature due to the need for more than one attempt at venous puncture, hypothermia of the child to be punctured and the age group of infants².

One study indicates that PIC specialists in pediatrics are important in the hospital environment because they are trained to evaluate and support children and their families, and generally employ evidence-based non-pharmacological care for pain control, including distraction²⁶. Given the discomfort produced by the PIC, light-hard technologies such as the booklet "Peripheral venous puncture for the family" are used by pediatric nurses in order to prepare family members for PIC insertion in children, in order to introduce them to care, promote the comfort of the child and to alleviate the stress and suffering as a result of the PIC²⁴.

Among the strategies that family members can adopt to reduce stress during PIC insertion, and that should be encouraged by nursing, are the request for information from professionals and the practice of actions of affection, such as calming, hugging, kissing or holding the patient's hand^{16,24}.

Listening to family members and children and making decisions to minimize pain, complications and repeated PIC insertion attempts is a good first step to ensure the participation of these patients in the procedure and the commitment of the professional in care^{18,25}.

Considering the knowledge regarding PIC in nursing, among the choices related to the anatomical site of puncture, the veins of the back of the hand are commonly chosen since it is an easy place to visualize alterations such as phlebitis and that does not cause major changes in the mobility of the child^{1,17,21}. The acquisition of technical and scientific knowledge about safety measures in PICs and the intensification of educational activities for the constant updating of nursing professionals favor the prevention and reduction of the incidence of adverse events related to neonatal and pediatric care^{16,21}. It is still recognized that there is a deficit in knowledge and practice regarding the intravenous products and the type of adequate dressing for PICs²¹.

Another relevant point for nursing concerns the pain caused by the PIC process^{16,27,32}. The neonatal population presents behavioral and physiological responses such as contracted face, grumbling, contracted arms and legs, shorthand and hypo saturation when submitted to PIC without the use of pain relief measures. In neonatology, some instruments for pain assessment can be used, such as the Neonatal Facial Coding System – Revised (NFCS–R) and the Children and Infant’s Postoperative Pain Scale (CHIPPS), with which professionals can differentiate the pain characteristics of a stressful procedure³². The most used non-pharmacological measures for pain relief in newborns includes the 25% glucose solution associated with non-nutritive sucking, followed by facilitated restraint and being held¹⁶.

DISCUSSION

The analytical category showed how complex PIC can be in children. Therefore, professionals use some technologies to assist in this procedure. There are contradictions between the studies analyzed, especially when it comes to US. Two studies related US with reduced procedure time and high success rates^{29–30}. However, US was also less efficient than the traditional PIC technique²⁸. With regard to positive findings, there are many advantages to using US in PICs, namely: greater diversity of locations for access, possibility of determining vessel size and depth, and predetermining proximal curvature or obstruction, which saves time and reduces the stress of children and their parents. US also performs better than other technologies such as transillumination (which is only beneficial for non-visible veins of young children) and near-infrared³³.

Some factors that may lead to adverse events related to PIC in children were highlighted: lower caliber and lower number of appropriate vessels²¹, low durability of PIC^{4–5}, physical alterations in catheterized veins, perceptible only in the observation of signs of phlebitis^{1,5}, lack of patient cooperation^{2,21,25}, and the need, in most cases, for a small catheter caliber (24G)^{2,5,21,30}. Predisposing factors that cause the failure of PICs or delay in the procedure are, above all, children who have compromised venous network, which makes it difficult to visualize, palpation and vessel caliber². These factors are listed in the DIVA score, which scores venous visualization, venous palpability, age, history of prematurity and skin color, highlighting the difficulty of PIC insertion in pediatrics^{22–23}.

It is worth adding that the National Health Surveillance Agency recommends, regardless of the patient’s age group, that attempts should be limited to two per professional, a total of four, since multiple punctures cause pain, postpone the start of treatment, compromise the vein and cause higher costs and risks of complications. Patients with difficult access need a thorough multidisciplinary evaluation to discuss the appropriate options⁸. The influence of the medical team on nursing practices is also emphasized, because in some situations, when nurses contraindicate PIC use, the medical team insists on the permanence of this catheter. This fact leads nurses to successive attempts at venous puncture without success, causing suffering to the patient³³.

Despite the need for a multiprofessional evaluation in difficult cases, nursing stands out as a promoter of PIC. The studies reveal the importance of professional experience and the training of pediatric PIC specialists to better serve this clientele^{16,23,26}. Professional training helps in the prevention and reduction of adverse events, improving the choice of the place to be punctured and the knowledge about intravenous products and types of PIC dressings^{1,16,17,21}. The studies are in accordance with the Code of Nursing Ethics, which determines that it is a professional's duty to improve technical-scientific knowledge and stimulate the qualification of nursing professionals under their supervision and coordination³⁵. The greater the knowledge of evidence-based nursing, the greater the autonomy in the decision on the PIC or the need for another access route such as the Peripheral Inserted Central Catheters (PICC), inserted by qualified nurses³³.

Studies indicate that it is necessary to look at the discomfort caused by this procedure in children and family members, and care should be promoted to mitigate stress, such as developing explanatory materials, stimulating the practice of affection during PIC and non-nutritive sucking for neonates, using pharmacological and non-pharmacological devices, listening to children and family members in their decisions, in addition to knowing how to identify pain in the pediatric and neonatal population through pain assessment instruments^{16,18,24-26,32}. Little is still discussed about the pharmacological performance of nurses in pain control in pediatrics. In Portugal, nurses routinely use the mixture of 50% nitrogen protoxide with 50% oxygen (MEOPA), commonly called "laughing gas", achieving results such as decreased anxiety and pain in procedures such as PIC insertion in children³⁷.

Working with neonatal and pediatric clients is challenging. PIC insertion in children requires an understanding of legal, ethical and moral complexities of care delivery. It requires knowledge of pediatric anatomy and physiology, family-centered care, as well as how to play and distract the child³⁰. One instrument that can be used to understand the difficulty of venous access in pediatrics is the DIVA score, mentioned in two studies, which can serve as a basis for the search for solutions to the problem in question²²⁻²³.

There were differences regarding the length of stay of the PIC in children. Some studies have pointed out that the elective exchange every 72 to 96 hours did not decrease the risk of extravasation⁴, which is in accordance with the recommendations of the National Health Surveillance Agency to not routinely exchange peripheral venous access of pediatric patients and neonates⁸. However, despite the recommendations and venous alterations visualized by US in children with up to three days of PIC insertion⁵, most nursing technicians responded in a study, that they replace the catheter after 96h of PIC even without phlogistic signs, which contradicts the recommendations²¹.

As for venous changes caused by PIC, it is considered that many of the risk factors that cause phlebitis are preventable¹⁹⁻²⁰. Among the practices that can be implemented at no additional cost are the rationalization of the use of PIC, reducing the duration of intravenous therapy; the removal of unnecessary venous catheters; and better adherence to the use of medications and appropriate forms of administration¹⁹, as well as nursing interventions that prevent and early detect the extravasation of venous infusions early in order to avoid the aggravation of lesions⁶. In this sense, the implementation of institutional protocols aimed at preventing phlebitis is essential for safe care²⁰ and are in a position to according to theories that reinforce the importance of soft-hard technologies in care models. Thus, knowledge will be built through structured knowledge, but with a degree of freedom that will provide professionals with possibilities for action, thus improving nursing care³⁷.

CONCLUSION

PIC use in neonatology and pediatrics is a procedure that requires specific nursing care to this clientele. It is believed that the objective of the study was achieved by describing the nursing care of PICs in hospitalized children. It was identified that the difficulty of PICs in children goes beyond

empirical deduction, because it covers physical, emotional and behavioral factors, the experience, qualification and working conditions of professionals, and the adequacy of materials. By understanding the role of nursing in PIC care, the DIVA score can be used to justify this difficulty and be the basis for multidisciplinary discussion regarding the possible route of administration for the child.

PIC-related adverse events in children are generally preventable. The qualification of nursing human resources and the importance of material resources to reduce the risks associated with this procedure were highlighted, which includes the choice of the appropriate catheter, infusion pumps and dressings, as well as knowledge about intravenous infusions and the use of imaging technologies such as US, despite the divergences found.

This research contributes to good practices in nursing care aimed at these children and was based on evidence on the main technologies used in PIC in pediatrics and neonatology, the forms of prevention of adverse events and nursing actions that ensure the safest and least stressful process for patients and their families. The methodology itself was a limitation of the study, which is characterized as a review of what has already been researched on the subject, generating controversial data. The age of the children surveyed in the articles can be considered a bias, since some did not delimit the age group; however, they were included because they referred to pediatrics. Another important data is none of the articles found contemplated the initial age of interest of the research, that is, from zero to 12 years of age.

Therefore, the need for more randomized studies to determine the best care with CIP in pediatrics and neonatology is reinforced, as well as qualitative studies to understand and problematize the universe of professionals, family members and children intertwined in this procedure.

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NOTES

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