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Review Article

CUIDADOS E LIMITAÇÕES NO MANEJO DO CATETER CENTRAL DE INSERÇÃO PERIFÉRICA EM NEONATALOGIA

CARE AND LIMITATIONS IN THE MANAGEMENT OF THE PERIPHERALLY INSERTED CENTRAL CATHETER IN NEONATOLOGY

PRECAUCIONES Y LIMITACIONES EN LA GESTIÓN DEL CATÉTER CENTRAL DE INSERCIÓN PERIFÉRICA EN NEONATOLOGÍA

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RESUMO

Objetivo: Identificar evidências científicas que investiguem os cuidados e limitações no manejo do Cateter Central de Inserção Periférica em neonatologia. **Método**: Revisão integrativa da literatura, realizada na Biblioteca Virtual, em Saúde, considerando as publicações disponíveis no período 2007 a 2016, que retratassem a experiência brasileira. Foram selecionadas 24 publicações. **Resultados**: Dentre os cuidados para inserção do cateter, o conhecimento teórico-prático foi o de maior relevância, seguido por contenção da dor; orientação e consentimento familiar; escolha do sítio de inserção e mensuração do cateter; uso de barreira máxima e preparo do membro. Os cuidados para manutenção incluíram: educação permanente da equipe; técnicas assépticas para manuseio e realização de curativo; higienização das mãos e lavagem do cateter com solução salina 0,9%. As limitações que se destacaram: infecção, flebite bacteriana; obstrução; ruptura; perda acidental; extravasamento; não progressão; dificuldade de acesso vascular; posicionamento da ponta do cateter; tipo de cateter, flebite química ou mecânica. **Conclusão**: Aprimorar as ações de enfermagem por meio da educação permanente contribui para que a assistência torne-se efetiva, contínua e proativa. Ressalta-se também a necessidade de estudos com melhores níveis de evidência científica em relação ao manejo do Cateter Central de Inserção Periférica em neonatologia.
Descritores: Cateterismo venoso central; Cateterismo periférico; Enfermagem neonatal.

ABSTRACT

Objective: To identify scientific evidence that investigate care and limitations in management of Peripherally Inserted Central Catheter in neonatology. **Method**: Integrative literature review held in the Virtual Health Library, considering the publications available in the period from 2007 to 2016 that portrayed the Brazilian experience. Twenty-four publications were selected. **Results**: Among care for catheter insertion, the theoretical and practical knowledge was the most relevant, followed by: pain management; orientation and family consent; choice of insertion site and catheter measurement; use of maximum barrier and limb preparation. Maintenance care included continuing staff education; aseptic techniques for handling and dressing; hand hygiene and washing of the catheter with 0.9% saline solution. The limitations that stood out were infection; bacterial phlebitis; obstruction; rupture; accidental loss; extravasation; non-progression; difficult vascular access; positioning of the catheter tip; catheter type, chemical or mechanical phlebitis. **Conclusion**: Improving nursing actions through continuing education contributes to an effective, continuous and proactive assistance. Furthermore, there is need for studies with better levels of scientific evidence regarding the management of the Peripherally Inserted Central Catheter in neonatology.
Descriptors: Central venous catheterization; Peripheral catheterization; Neonatal nursing.

RESUMEN

Objetive: Identificar las evidencias científicas que investiguen los cuidados y limitaciones en el manejo del Catéter Central de Inserción Periférica en neonatología. **Método:** Revisión integrativa de la literatura, realizada en la Biblioteca Virtual en Salud, considerando las publicaciones disponibles en el período 2007 a 2016 que retractasen la experiencia brasileña. Si seleccionaron 24 publicaciones. **Resultados:** Considerandose los cuidados para la inserción del catéter, el conocimiento teórico y práctico fue más relevante, seguido de: manejo del dolor; la orientación y el consentimiento de la familia; elección del sitio de inserción y medición del catéter; utilización de barrera máxima y preparación del miembro. Las medidas adoptadas para manutención incluyeron educación permanente del equipo; técnicas asépticas para el manejo y ejecución del aderezo; higiene de las manos y el lavado del catéter con solución salina 0,9%. Las limitaciones que se destacaron fueron infección; flebitis bacteriana; obstrucción; ruptura; pérdida accidental; extravasación; no progresión; difícil acceso vascular; posicionamiento de la punta del catéter; tipo de catéter; flebitis química o mecánica. **Conclusión**: Mejorar las acciones de enfermería por medio de la educación permanente contribuye a la asistencia efectiva, continua y proactiva. Se resalta también la necesidad de estudios con mejores niveles de evidencia científica en relación al manejo del Catéter Central de Inserción Periférica en neonatología.
Descriptores: Cateterismo venoso central; Cateterismo periférico; Enfermería neonatal.

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INTRODUCTION

The Neonatal Intensive Care Unit (NICU) is a therapeutic environment for the treatment of high-risk newborns, which requires from the team a preparation that sustains the complexity of the activities developed there. There are, for each clinical outcome, different risk factors, since high-risk newborns, especially premature infants in intensive care, are exposed to various adverse events, whether clinical or circumstantial, reflecting the complexity of this therapeutic environment[1].

Many of these newborns require access for infusion of medicines, serums, Total Parenteral Nutrition (TPN), Partial Parenteral Nutrition (PPN), among others. To do so, various methods of venous catheterization are used, but the Peripherally Inserted Central Catheter (PICC) has been recognized as a first-choice technique, by its high rate of successful insertions and low rate of withdrawal by complications[2,3]. The main benefits of this catheter are: decreased number of punctures and, consequently, reduction in pain and stress caused by invasive procedures; reduced risk of infection when compared to other types of central venous catheters; and maintenance of treatment for long periods[2-4].

The POCC has been used in Brazil since 1990, but it has become frequent in neonatology since 2000[1], since then, has shown favorable results, once it promotes greater safety and comfort to the high-risk newborn, considered fragile and vulnerable to iatrogenic risks[2,4].

The Federal Nursing Council regulated its use, as described by Resolution 258/2001, first and second articles. In this way, the nurse is the professional legally supported to insert, manipulate, and remove the PICC, when it is indicated[3].

The PICC insertion in newborns is a high-complexity procedure, which requires specific knowledge about its insertion and maintenance[5]. Although its frequency of potential complications is lower than of other catheters, they require discussion at hospital and academic environments. Discussing the indications for insertion, maintenance and care with the PICC is essential to ensure the safety of the seriously ill newborn and, to this end, it is necessary to (re)formulate strategies and recommendations specific to the neonatal and pediatric segment[6].

The success for the PICC insertion increases through the knowledge about its properties, as well as with the training of the professional responsible for inserting and maintaining the device and the team that continuously operates the catheter. In this sense, it is essential to assess the practices that involve its insertion and management, the professional qualification and the need for protocols to prevent complications and ensure quality in assistance. Such precautions become important to reduce neonatal morbidity due to complications related to the use of intravenous devices[7,8].

The exposed allows inferring that the use of the PICC in the NICU has presented positive results for the survival of these patients, through the insertion and maintenance of the catheter by qualified professionals. Thus, this review aims to identify scientific evidence that investigate the care and limitations in the management of Peripherally Inserted Central Catheter in neonatology.

METHOD

This is an integrative review of the literature with the purpose to gather and synthesize, systematically and orderly, results of researches on certain theme or issue; contribute to the deepening of knowledge of the investigated theme; allow synthetizing multiple published studies; and enable general conclusions regarding a particular area of study[9].

In this way, firstly, the following guiding question was elaborated: “What are the care and limitations for PICC insertion and maintenance in neonates?”. To answer the question, a search in the Virtual Health Library (VHL) began in the following databases: Latin American and Caribbean Literature in Health Sciences (LILACS); Nursing Database (BDENF); and in the Medical Literature Analysis and Retrieval System Online (MEDLINE), selecting the original studies conducted in Brazil, published in the period from 2007 to 2016, in Portuguese, English or Spanish.

The temporal clipping is justified by the period when the PICC began to be used in neonatal environment in Brazil (from 2000), and the researches began to stand out some years later, thus, this study sought to present experiences of Brazilian health care professionals. The following descriptors and combinations for the search were used, “central venous catheterization *and* peripheral catheterization *and* neonatal nursing”; “central venous catheterization *and* peripheral catheterization”;

"central venous catheterization *and* neonatal nursing"; "peripheral catheterization *and* neonatal nursing".

The search occurred during March 2017. The titles and abstracts found were read, and then the articles that met the inclusion criteria were fully read. For the steps of search and selection of articles, two researchers acted independently, with the objective of minimizing possible errors.

After selecting the studies, to review and remove the necessary information, a semistructured data collection form was used, composed by the following variables: journal; title; year; objectives; thematic considerations; results and conclusions.

The studies were critically analyzed according to the information relevance, as well as its impact of scientific evidence. The used hierarchical classification system was level of evidence. This type of classification allows professionals from the health team to seek quality data, information and strategies to sustain the care decision[10].

This type of analysis is organized as follows: level I - evidence from systematic reviews or meta-analysis of randomized controlled, structured or clinical guidelines trials; level II - evidence from well-structured controlled randomized clinical trials; level III - evidence acquired through a well-structured non-randomized clinical trial; level IV - evidence from well-delineated case-control or cohort studies; level V - evidence from systematic review of qualitative and descriptive studies; level VI - evidences from original descriptive or qualitative studies; level VII - evidence built by opinions of authorities or specialized technical reports[10]. Regarding the degree of recommendation of scientific evidence, this classification classifies levels I and II as strong, III and IV as moderate and V to VII as weak[10].

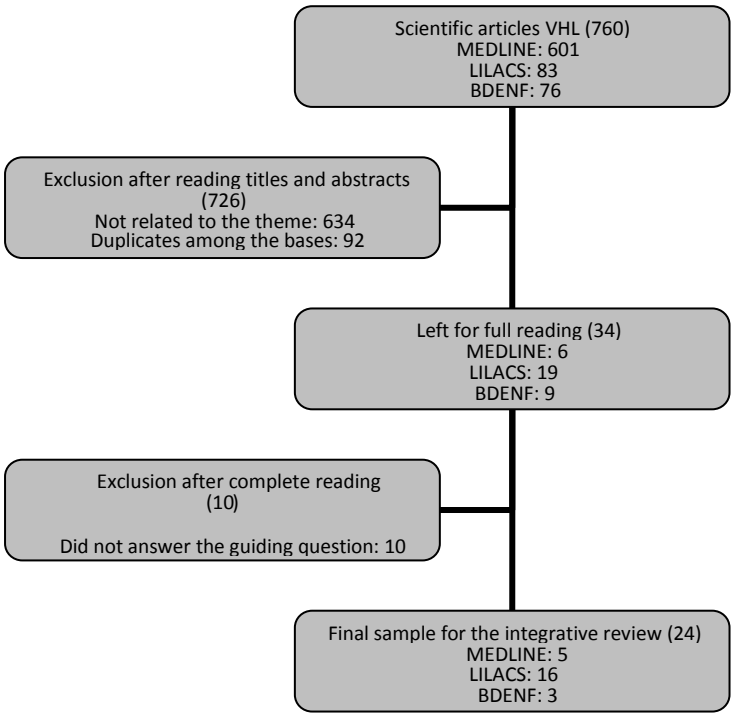
The synthesis of the studies was organized into tables to facilitate the detailed visualization of results obtained in each study. The analysis enabled the identification of recurring themes, which were grouped into the following thematic categories: "Care and limitations for the PICC insertion" and "Care and limitations for the PICC maintenance". Then, the categories were analyzed and discussed in order to respond the initial objective and, finally, to build the last step, the integrative review of literature, pointing out the possible knowledge gaps with respect to the care and limitations in the PICC management in neonates.

In relation to ethical issues, the study respected the precepts of authorship and, since it is a bibliographic research, there was no need for submission to the Research Ethics Committee (REC).

RESULTS AND DISCUSSION

The search returned 760 references about the subject, however, when analyzing according to the inclusion criteria, 24 studies remained to build the integrative review, divided as follows: 16 of LILACS, 5 of MEDLINE and 3 of BDENF, as shown in figure 1.

Figure 1 - Distribution of the found and analyzed scientific references according to databases LILACS, MEDLINE, BDENF, 2017.



Source: Author's data, 2017.

There was prevalence of studies performed by nurses in the Southeastern (19 studies) and South (five studies) regions, from intensive care units of public or private institutions. Figure 2 presents the studies selected for this review.

Figure 2. References included in the integrative review according to journal, year of publication, title and level of evidence, 2017.

Journal/Year	Title	Evidence
Rev. esc enferm USP (2008)	Initial peripherally inserted central catheter tip position in neonates	Level VI
Rev. Min. Enf. (2009)	The nurse in the practice of peripherally inserted central catheter in neonatal care[1]	Level VI
Rev. gaúcha enferm (2010)	Peripherally inserted central catheter: description of its utilization in Neonatal and Pediatric ICU[2]	Level VI
Rev. latino-am enferm (2010)	Nurses' knowledge on the insertion technique of the peripherally inserted central catheter in newborns[11]	Level VI
Acta paul. enferm (2010)	Measuring pain in neonates during placement of central line catheter via peripheral insertion[12]	Level VI
Online Braz. j. nurs. (*Online*) (2010)	Profile of newborns who used Peripherally Inserted Central Catheter (PICC) in a University Hospital: Cross-sectional study[13]	Level VI
Rev. Bras. enferm (2011)	Management practices of peripherally Inserted central Catheter at a neonatal unit[14]	Level VI
Rev. Enferm UERJ (2011)	Peripherally-inserted central catheter use in neonatal clients at a public state hospital: retrospective study[15]	Level VI
Rev. HU (2011)	Peripherally inserted central cetheter: the nursing's role in its use in neonatology[16]	Level VI

Rev. Bras Enfer (2012)	Neonatology nurses' knowledge about Peripherally Inserted Central Venous Catheter[17]	Level VI
Rev. gaúcha enferm. (2012)	Prevalence and reasons for non-elective removal of peripherally inserted central catheter in neonates [3]	Level VI
Rev. eletr enferm (2012)	Peripherally Inserted Central Venous Catheters: limits and possibilities[8]	Level VI
Rev. Esc Enferm USP (2013)	Analgesia and sedation during placement of peripherally inserted central catheters in neonates[18]	Level VI
Rev. Esc Enferm USP (2013)	Reasons for non-elective removal of epicutaneous catheters in neonates[19]	Level IV
Online braz. j. nurs. (*Online*) (2013)	Complications related to the type of peripheral catheter in cohort with neonates[20]	Level IV
Rev. Esc. Enferm. USP (2013)	Factors associated with infection from the use of peripherally inserted central catheters in a neonatal intensive care unit [21]	Level VI
Rev. eletr enferm (2013)	Nursing care in view of complications regarding the peripherally inserted catheter in newborns [15]	Level VI
Rev. Esc Enferm USP (2013)	Central venous catheterization in Pediatric and Neonatal Intensive Care Units[23]	Level VI
Escol Anna Nery (2014)	Peripherally inserted central catheter in pediatrics and neonatology: possibilities of systematization in a teaching hospital [24]	Level VI
Ciência Cuidado e Saúde (2014)	Complications of peripherally inserted central catheter (PICC) in neonates [25]	Level VI
Online braz. j. nurs. (*Online*) (2014)	Intravenous therapy and non-elective removal of epicutaneous catheters: a cohort study of neonates [26]	Level IV
Rev. paul ped (2015)	Heparin for clearance of peripherally inserted central venous catheter in newborns: an *in vitro* study[27]	Level II
Rev. latino-am enferm (2015)	Elaboration of a risk score for non-elective removal of the peripherally inserted central catheter in neonates[28]	Level IV
Acta paul enferm (2016)	Risk factors for bloodstream infection associated with peripherally inserted central catheters in neonates[29]	Level IV

Source: Author's data, 2017.

The studies found in this research, according to the hierarchical classification of scientific evidence[10], presented, in their majority, weak evidence, since they were inserted into level VI. Only six studies showed moderate scientific evidence (Level IV) and one presented strong evidence (Level II).

In this way, although each used research method is important, studies with better levels of recommendation are necessary, which could improve the basis of nurses' clinical practice, in particular in the care of the seriously ill newborn, since this remains as a focus of attention of health services for presenting the greatest incidence among infant deaths[2,8].

The studies' thematic considerations based on characterization, insertion and maintenance of the PICC in newborns; the theoretical-practical knowledge; used protocols; professional practice; and continuing education. For the analysis, the themes on care and limitations for PICC insertion and maintenance were highlighted, such as: nurses' knowledge; management of the catheter; care quality. Two tables evidenced the results: "Care and limitations for the PICC insertion" (Figure 3) and "Care and limitations for the PICC maintenance" (Figure 4).

Figure 3. Care and limitations for the PICC insertion in neonates hospitalized in the NICU, 2017**.**

PICC Insertion	
Care	**Limitations**
Theoretical-practical knowledge	Catheter tip positioning
Pain containment: sedation or analgesia	Catheter non-progression
Family guidance	Dificult venous access
Choice of the insertion site/Catheter measurement	Types of catheter
Use of maximum barrier and limb preparation	Chemical/mechanical phlebitis

Source: Author's data, 2017.

Regarding the care for the PICC insertion, most studies mention the professional's theoretical-practical knowledge for the success of the procedure[2,8,11,30], since the nurse is the main responsible for the PICC insertion, maintenance and withdrawal. Once the PICC use is considered a breakthrough for the nursing performance in intravenous therapy, it requires qualification in recognized courses, which provide full security for its use[4,11,22].

Patients that use PICC require continuous care assessment at all stages of the process. In addition, the Nursing Care Systematization (NCS) presents itself as an important management tool for planning, executing and controlling this care. Applying the NCS is fundamental for developing the process of intravenous therapy, because it bases on institutional protocols and scientific evidence, enabling the care organization and legal support for the nursing actions[24].

Added to the theoretical-practical knowledge and NCS, the catheter implantation should start with guidance and clarification of the family or guardian on the deployment procedure and aftercare[11], as well as obtaining the consent of the family for performing such procedure[11,16]. This practice can support health professionals in the catheter management, in addition to allowing the family's participation in care planning of newborns admitted to the NICU.

At the moment of catheter insertion, the newborn care must be large, the insertion process must count with: assessment of the type of intravenous therapy to be infused; catheter selection[14]; maximum barrier technique (use of cap, mask, sterile gown with long sleeve, sterile gloves and sterile expanded enviroment); preparation of the limb that will receive the catheter with alcoholic chlorhexidine solution 0.5%[19]; accurate selection of the blood vessel; catheter measurement; positioning of the neonate in dorsal decubitus; preferably, use of the right upper limb at an angle of 90° in relation to the thorax[17].

There must be cardiorespiratory monitoring, sedation and analgesia by using pharmacological and non pharmacological agents to provide pain containment and comfort throughout the procedure[12,17].

The focus for such care relates to the reduction of iatrogenesis such as the positioning of the catheter tip in inadequate place, i.e., a non-central vessel, catheter rupture, mechanical and bacterial phlebitis, family stress and pain. The presence of such iatrogeneses directs to clinical complications, as well as to the delay of the therapeutic treatment that the neonate needs[16,22].

Some literatures addressed issues about sedation, analgesia and pain containment as an important care to be established[11,12,18]. A study conducted in the Southeast region showed that the frequency of painful response evaluated by the scale of Prematury Infant Pain Profile (PIPP) had a score greater than or equal to seven in 71.4% of newborns evaluated during the PICC insertion[12].

However, although pain is considered the fifth vital sign, neonates in intensive therapy, when subjected to painful procedures, do not always receive analgesic or sedative interventions, making this practice not so common[22]. Few studies reported the use of Fentanyl[1,21] or other analgesics, and, in some cases, the analgesia for the PICC insertion was disregarded, being used, sometimes, just sedatives to contain the agitation[7,12].

Any therapeutic or routine procedures in a hospital environment may act as stressors to the neonate, thus, pharmacological and non-pharmacological maneuvers must be used to reduce pain and promote the neonate's recovery in the moment of the PICC insertion[3,32].

Non-pharmacological measures are effective methods to control pain, which may be associated with pharmacological therapy to provide better analgesic effect, highlighting the use of non-nutritive sucking associated with sucrose solutions. Other strategies may also be used, such as the inclusion of parents in the procedure, gentle manipulation of the neonate, and reduction of sound stimuli[18]. Reducing painful stimuli to the newborn provides the lowest physiological and behavioral change, which will certainly favor the response to the therapy used in its treatment[12].

The main insertion limitations mentioned in literature were difficult venous access[1,7,12]; atheter non-progression[1,7,12]; positioning of the catheter tip[1,13,16]; types of catheter[24,25]; mechanical phlebitis[7].

The limitations related to difficult venous access, catheter non-progression and positioning can relate to the newborn's anatomy and physiology and, indirectly, to the nurse's ability to perform the procedure. For both, the chosen puncture will usually be the easiest, but not

always, this will result in success in entering and progression to a blood vessel[7].

In most studies, the chosen vein for puncture was the basilica[1,2,13,14]. The basilic vein is recommended as the first access way due to its larger caliber, smaller valvular number and location that facilitates its handling in dressings[2]. Another recommendation is to chose the right upper limb due to greater ease of progression and centralization of the catheter[22].

Nevertheless, a study conducted in Columbia including the insertion of 689 PICC in newborns described that the venous access in the scalp region have also proved to be efficient, since the rates of complications were not higher when compared to punctures in upper and lower limbs[33].

The location of the catheter tip is essential due to clinical or traumatic complications with the newborn during insertion. Eventually, cardiac arrhythmia occurs by the catheter introduction in the right atrium, although rare, but possible transfixation in other organs; and also by positioning at the entrance of the superior vena cava, leading to risk of formation of thrombi and phlebitis[7]. The location of the catheter tip can be confirmed by chest radiography or ultrasound[2].

For the proper management of the PICC in neonatology, at the moment of insertion, the literature suggests not to perform repeated PICC insertions, not to keep catheters with a non-central tip position, and to prevent single-lumen PICC insertion for the infusion of numerous intravenous solutions, requiring new interventions with a view to facilitating success in the PICC insertion[29]. Radiological control is important to monitor the positioning of the catheter tip during the period of permanence of the CCIP[15].

Regarding the types of catheters, the PICC should consist of biocompatible and little thrombogenic materials as silicone or polyurethane, and can be single or double lumen[2-4]. The limitations related to the type of catheter occur due to the need for more evidence to indicate the one that adequately meets the needs of each patient, in view of the various types of devices available[26].

In a study that assessed the risk of non-scheduled removal, double-lumen catheters made of polyurethane presented a greater chance of complications than single-lumen silicone catheters. However, the evidence showing the best material is not yet conclusive[28].

In relation to mechanical phlebitis, it can occur by venous trauma during puncture and/or improper device attachment, while chemical phlebitis can occur by contact of the catheter with gloves containing dust. For this reason, gloves with talc are not recommended to handle the catheter[31].

Figure 4. Care and limitations related to PICC maintenance in neonates hospitalized in the NICU, 2017.

PICC Maintenance	
Care	**Limitations**
Permanent education of the team/Institutional protocols	Bacterial infection/phlebitis
Dressing	Catheter obstruction
Proper catheter attachment	Migration/Accidental loss
Hand Hygiene/Aseptic Techniques	Catheter rupture
Flushing with 0.9% saline solution	Extravasation of the infusion

Source: Author's data, 2017.

Among the care for the PICC maintenance, one highlights the permanent education of the nursing team, as well as the deployment of well-defined clinical protocols to direct the clinical practice, thus ensuring the success of the maintenance of the catheter until the end of the therapy[8,13,16,17,19,21,22,24-26,28,30]. All team members must have knowledge about recommendations for completion of dressing; adequate catheter attachment; hand hygiene; aseptic techniques for handling the device; flushing (catheter flush) with 0.9% Saline Solution

As to the limitations for the PICC maintenance, the most frequently mentioned complication in the studies was the presence of bacterial infection and/or phlebitis related to the catheter[2,3,13,16,19,20,21,28,29]; followed by catheter obstruction[2,3,13-16,23,25,26]; catheter rupture[3,13,14,16,19]; extravasation of the infusion[2,3,16,25]; accidental loss[2,3,13,14,19]; migration of the catheter[2,8,15,25].

The infection of the bloodstream involves potential risk factors such as: weight; gestational age; time of permanence of the catheter; clinical diagnosis; types of catheters and intravenous therapy[29]. Care to prevent the emergence of infectious foci is essential to avoid early catheter withdrawal and loss, as well as the commitment of treatment, which can cause several complications in the neonate[34].

The presence of bacterial phlebitis, observed by hyperthermia, secretion in the insertion site, edema and local hyperemia may be caused by inadequate skin antisepsis in the insertion or exchanges of dressings, and, mainly, by the lack of hand hygiene[16].

In this sense, hand washing and disinfection of connections is extremely important before manipulating the catheter. The hand hygiene should be performed with water and liquid soap in the presence of visible dirt or contact with bodily fluids, and, when not visibly dirty, it must performed with alcoholic solution at a concentration of 60 to 80%. The disinfection of connections and/or connectors of the catheter needs to be performed with antiseptic solution with alcoholic basis, with mechanical friction, from five to 15 seconds[31,35].

Protocols for dressings are also necessary. The literature recommends performing the first dressing exchange from 24 to 48 hours, during which there may be small local bleeding by the introducer caliber. The remaining dressings can be performed with an interval of seven days or in the presence of dirt, moisture or detachment[22,31]. The use of sterile, transparent and semipermeable film is also important for constant observation of the insertion site[19,29].

The dressing exchange should be performed with minimal handling to avoid accidental displacement of the catheter[31]. The stabilization of the catheter is an effective intervention that can reduce the risk of phlebitis, catheter migration, displacement or its accidental loss. To do so, the use of adequate devices or sterile adhesive is recommended[31,35].

In relation to obstruction, it requires the adoption of flushing with 0.9% saline solution before and after administering drugs and, at every six hours, to ensure the catheter permeability[23,31]. The recommendation is to use pulsatile flushing, since it generates a swirling flow and is more effective for removing solid deposits (fibrin, hasty drugs) than the continuous flushing is. Furthermore, the positive pressure technique should also be used to minimize the return of blood to the catheter lumen[31]. Such care are very well indicated in the PICC of neonates, considering their narrow caliber, which greatly increases the chance of obstruction.

In clinical practice, heparin is widely used for unblocking the PICC, although there is not enough scientific evidence about its dosage and concentration in neonatology. In a study carried out in catheters (2.0 Fr) occluded *in vitro*, using the negative pressure technique, heparin at a concentration of 50 IU/ml was more effective for unblocking that heparin at a concentration of 25 IU/ml[27]. They both require protocols and training of health care teams regarding routines for the care to maintain this device[2].

Using PICC for blood transfusion and blood collection should be little recommended, because there is the possibility of thrombus formation, leading to thrombosis or catheter obstruction, showing weaknesses for these purposes[22].

Another limitation refers to the infiltration of infused fluids, which relates, in many cases, to accidental traction or catheter rupture at the small-caliber vessel level[22]. The rupture occurs by inappropriate handling when washing the catheter, exercising excessive flush pressure or by chosing a syringe of improper size. There is a risk of catheter rupture if syringes with volumes smaller than 10ml are used, because the lower the syringe volume, the greater the pressure exerted on the catheter walls[27].

The silicone PICC is more flexible and biocompatible than polyurethane, but is more fragile and its handling must be careful[13]. In case of rupture, the catheter must be immediately removed and a clinical investigation should be performed in suspected cases of migration of fragments. Some signs and symptoms can be observed: respiratory distress, tachycardia, cyanosis of the extremities, hyposaturation (below 85%), others[2].

The correct PICC maintenance is necessary due to events and complications that lead to its removal. The daily activities developed in the NICU often hamper the investigation of causes of complications related to the PICC use. Therefore, some care must be periodically inserted in the daily activities of the health team[2].

FIANL THOUGHTS

Predicting successes for the PICC insertion and maintenance in newborns relates to the effectiveness of care provided by the nursing

team when inserting the catheter, as well as actions to minimize the limitations that compromise its permanence until the end of the therapeutic treatment.

The national experience described in this integrative review shows that the priority care to insert and maintain the PICC in newborns and that sustains the whole procedure refers to professional training and permanent education of the nursing team part of the NICU. Nonetheless, firstly, the family must receive guidance on the procedure to be carried out and consent for professional support. The other care pointed out were pain containment by pharmacological or non-pharmacological therapy; adequate choice of insertion site and catheter measurement, use of maximum barrier and preparation of limber for puncture.

The limitations were positioning of the catheter tip, non-progression, difficult access, types of catheters and chemical or mechanical phlebitis.

The care regarding maintenance focuses, primarily, on controlling nosocomial infection, especially by adopting aseptic techniques for handling the device, holding the curative and adequate hand washing. In addition to these precautions, the literature suggests the pulsatile flushing with 0.9% saline solution periodically. The most common difficulties encountered for maintaining the PICC in neonatology were the presence of infection, bacterial phlebitis, catheter obstruction by blood clots or medicines, rupture or accidental loss of the catheter and extravasation of the infusion.

The proper management of the CCIP in high-risk environments requires the constant incentive to professional qualification for an effective, continuous and proactive attention for the seriously ill newborn, supported by scientific evidence. However, unveiling ways is necessary to implement these practices and care without technicality overlapping human essence, once the act of reducing stress and discomfort of newborns due to repeated punctures through the PICC insertion can be understood as a technology to humanize nursing care.

Moreover, studies with better levels of evidence in relation to the PICC management in neonatology are also necessary, aiming at providing more accurate results, which, in certain way, was considered as a limitation of this study. In the same way, this research may subsidize upcoming researches by incorporating evidence, synthesis and quick access to results that support behaviors and decision-making, providing a reflexive knowledge.

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