

COMPLICATION AND RETENTION OF PERIPHERAL INSERTION CENTRAL CATHETER IN NEWBORN: CASE REPORTS

COMPLICAÇÃO E RETENÇÃO DE CATETER CENTRAL DE INSERÇÃO PERIFÉRICA EM RECÉM-NASCIDO: RELATOS DE CASOS

COMPLICACIÓN Y RETENCIÓN DE CATÉTER CENTRAL DE INSERCIÓN PERIFÉRICA EN RECIÉN NACIDO: INFORMES DE CASOS

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How to cite this article: Weissheimer G, Giacomozzi CM, Costa T, Carvalho LM, Sousa AC. Complication and retention of peripheral insertion central catheter in newborn: case reports. Rev baiana enferm. 2023;37:e52281.

Objective: to report cases of complications and retention of peripherally inserted central catheters in newborns. **Method:** Case report on two cases of coiling and retention of a peripherally inserted central catheter in a Neonatal Intensive Care Unit of a hospital in Southern Brazil, between May and October 2022. **Results:** In the first case there was difficulty in removing the catheter soon after its insertion, requiring surgical removal. In the second, the folding in the antecubital fossa of the neonatal upper limb was identified by radiography, without migration of the tip to the central region, despite showing blood reflux, being removed by manual traction. **Conclusion:** the formation of tangles or knots in peripherally inserted and retained central catheters are rare complications. Being aware of this event makes it possible to build evidence and strategies for prevention and appropriate management in professional practice.

Descriptors: Central Venous Catheters. Infant, Newborn. Intensive Care Units, Neonatal. Nursing. Case Reports.

Objetivo: relatar casos de complicação e retenção de cateter central de inserção periférica em recém-nascidos internados na Unidade de Terapia Intensiva Neonatal. *Método:* estudo descritivo, do tipo relato de caso, realizado entre maio e outubro de 2022, em um hospital no Sul do Brasil. *Resultados:* identificaram-se dois casos de

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enovelamento/formação de nó e retenção de cateter central de inserção periférica. No primeiro caso ocorreu dificuldade na remoção do cateter logo após sua inserção, com necessidade de remoção cirúrgica. No segundo caso, identificou-se pela radiografia o enovelamento na fossa antecubital do membro superior neonatal, sem migração da ponta para região central, apesar de apresentar refluxo sanguíneo, sendo removido por tração manual, sem resistência ou intercorrências. Conclusão: a formação de novelos ou nós em cateter central de inserção periférica e retenção tratam-se de complicações raras. Estar atento a esse acontecimento possibilita a construção de evidências e estratégias de prevenção e manejo adequado na prática profissional.

Descritores: Cateteres Venosos Centrais. Recém-Nascido. Unidades de Terapia Intensiva Neonatal. Enfermagem. Relatos de Casos.

Objetivo: reportar casos de complicación y retención de catéter central de inserción periférica en recién nacidos internados en la Unidad de Terapia Intensiva Neonatal. Método: estudio descriptivo, del tipo relato de caso, realizado entre mayo y octubre de 2022, en un hospital en el Sur de Brasil. Resultados: se han identificado dos casos de ennegrecimiento/formación de nudo y retención de catéter central de inserción periférica. En el primer caso ocurrió dificultad en la extracción del catéter inmediatamente después de su inserción, con necesidad de extracción quirúrgica. En el segundo caso, se identificó por la radiografía el ennegrecimiento en la fosa antecubital del miembro superior neonatal, sin migración de la punta hacia la región central, a pesar de presentar reflujo sanguíneo, siendo removido por tracción manual, sin resistencia e intercorrências. Conclusión: la formación de ovillos o nudos en catéter central de inserción periférica y retención se tratan de complicaciones raras. Estar atento a este acontecimiento possibilita la construcción de evidencias y estrategias de prevención y manejo adecuado en la práctica profesional.

Descriptores: Catéteres Venosos Centrales. Recién Nacido. Unidades de Cuidado Intensivo Neonatal. Enfermería. Informes de Casos.

Introduction

Premature newborns (PTNB) with respiratory distress, hypoglycemia, infection, perinatal asphyxia, among others, commonly require hospitalization in the Neonatal Intensive Care Unit (NICU) for treatment⁽¹⁾. Estimates show that 15 million PNI are born annually worldwide, indicating an overall rate of 11% of births⁽²⁾.

The treatment implemented for this age group often requires prolonged intravascular therapy (more than six days) with the use of vasoactive drugs, hypertonic solutions and parenteral nutrition incompatible with the administration in peripheral veins. The limitation in venipuncture due to the characteristic of the venous network of newborns hinders the continuity of treatments, making the use of central venous access necessary. Thus, the Peripherally Inserted Central Catheter (PICC) has been shown to be a safe device, frequently used by neonatal patients^(1,3). PICC presents a lower risk of infection when compared to other central venous accessions, can be inserted to the bedside with light sedation or without sedation, has a

lower cost than other central catheters, reduces patient exposure to multiple punctures, among others^(4,5). The management of PICC requires skills and competencies to maintain the safety of the NB during treatment and reduce the risks of adverse events. Thus, nurses play an important role in the care of newborns using PICC, and their actions should be effected through technical and scientific knowledge⁽⁶⁾.

The Resolution of the Collegiate Board (RCB) n. 45/2003 describes that the nurse must participate, together with the doctor, in the choice of central venous access for the instituted therapy, including PICC⁽⁷⁾. Because it is a complex procedure, it requires prior qualification and training for insertion, maintenance and removal, according to Resolution of the Federal Nursing Council (COFEN) n. 258/2001⁽⁸⁾ and Opinion COFEN n. 243/2017⁽⁹⁾. Furthermore, the Regional Nursing Council (COREN) of Paraná, in Opinion n. 02/2015, provides for the competence of nurses to carry out the implementation of PICC guided by ultrasound by specific qualification for

this technique⁽¹⁰⁾. This type of technology can assist in vascular visualization, guide insertion and evaluate the location of the catheter tip. This feature is recommended for clinical practice, however, it is not always available⁽³⁻⁴⁾.

Through the legal aspects of the profession, the nurse is the team professional with the function of taking over and planning the care of the patient. Thus, the importance of the role of nurses in neonatal intravenous therapy stands out, highlighting all stages of care, from the selection of devices to their removal, which involve neonatal clinical evaluation, including selection, insertion, maintenance and possible complications of the catheter, according to the resources available in the context that the professionals work.

Despite the benefits of PICC for the neonate and the qualification of the professionals who manage it, complications may occur during its use, such as positioning of the tip outside the central vascular system, catheter obstruction, infiltration, extravasation, tissue injury and infection⁽³⁾. Other rare and serious complications may occur, such as extravasation of solution infused into the catheter into the pleural, peritoneal⁽¹¹⁾, pericardial⁽¹²⁾ and catheter embolization by fracture⁽¹³⁾.

Even if these complications are uncommon, knowing them is essential for clinical practice in the NICU, as it can allow the adoption of strategies for their reduction. The management of the situations mentioned above, as well as the commitment of nurses to scientific advancement with the sharing of rare complications related to the insertion and use of PICC increase the expertise of professional performance in this area and, therefore, improve the situations by other professionals. Therefore, the objective of this study is to report cases of complication and retention of peripherally inserted central catheter in newborns admitted to the NICU.

Method

This was a descriptive study, the type of experience report on two rare complications occurred with newborns (NB) admitted to

a NICU of a university hospital in the state of Paraná, Brazil. The study site is a state reference for clinical and surgical treatment of PTNB, NB term and with malformations. This is a tertiary service consisting of 30 beds divided into 10 of NICU, 15 beds of Neonatal Intermediate Care Unit and 5 of Kangaroo Neonatal Intermediate Care Unit. In this NICU are inserted, on average, 20 PICC per month.

According to the availability of resources, the technique of direct puncture is used to insert the PICC, confirmation of the catheter tip by chest radiography.

The professionals who perform the procedure have an institutional protocol for insertion, management of complications, maintenance and removal of the PICC. Catheter selection includes the patient's clinical condition, characteristics and time of intravenous therapy. The selection of the vessel for puncture is based on the most calibrous, visible, palpable and rectilinear vein.

Analgesia is used according to the clinical profile of the patient and established by the care team and prescription by a qualified professional. Intravenous analgesia is used for patients under invasive mechanical ventilation during the procedure. For patients under spontaneous ventilation in ambient air or non-invasive ventilation, non-nutritive suction with 25% glucose or breast milk and non-pharmacological analgesia are included as facilitated restraint with diaper. The Neonatal Infant Pain Scale (NIPS) is used to assess neonatal pain and management.

A registration form is used to control the insertion of the venous device with the following data: NB identification, date of birth, sex, birth weight, length of hospitalization, Gestational Age (GA), Apgar Report and clinical indication of the catheter. Catheter: make, size, length, lot and expiration date. Insertion: insertion limb, expected length and length that the catheter migrated, if there was resistance to insertion, number of punctures and sites, pain control (sedation and/or pharmacological and non-pharmacological analgesia). Catheter tip position: location. Catheter removal: date, time, reason, length removed from catheter, catheter integrity,

if sent catheter tip for culture examination and blood culture.

The study was conducted between May and October 2022, involved the period of insertion of PICC, sending the project to the Research Ethics Committee and data collection. The study participants were NB hospitalized for clinical treatment submitted to the insertion of PICC by NICU nurses and who presented PICC folding and retention complication in May 2022.

The source of data collection was the patient's medical record, through information contained in the registration form for the control of insertion of the venous device that contemplates the control of complications. Similarly, images of the catheter, the procedure and radiography were used. Descriptive analysis of the information was used.

This research followed Resolution n. 466/12, of the National Health Council, and was approved by the Research Ethics Committee of the *Hospital de Clínicas* of the *Universidade Federal do Paraná* under Opinion n. 5.623.853, on September 4, 2022. The consent of those responsible for the inclusion of the RN in the report was obtained through the Informed Consent Form, which also included the authorization for the use of images.

Results

Case 1

NB born with GA of 35 weeks and 4 days, female, birth weight 2,685 grams, vaginal delivery. The birth occurred by premature labor. Apgar of NB was eight and nine in the first and fifth minute of life. The primary diagnosis of NB

was prematurity, admitted to the NICU in the first hour of life due to Acute Respiratory Distress Syndrome. During the first days of hospitalization required ventilatory support through continuous positive airway pressure.

On the third day of life presented abdominal distension, was in controlled assisted mechanical ventilation, inspiratory oxygen fraction (O₂Fi) 40%, peak inspiratory pressure (PIP) 16 and Positive pressure at the end of expiration (PEEP) 6 and indication of central venous access for infusion of milrinone, fentanyl and venous hydration.

Two nurses qualified for the procedure chose, according to the routine of the institution and evaluation of the infusional need of the RN, to insert a double-lumen PICC, with two caliber French, polyurethane, open tip (not valved). The catheter was cut with a scalpel blade in 18 centimeters (cm), according to previous anatomical measurement of the NB and routine of the institution. Universal paramentation was used (cap, goggles, sterile long sleeve apron, sterile glove), antisepsis of the skin, performed pain control with intravenous morphine. The procedure began, and in the second venipuncture in the cephalic vein of the left upper limb blood reflux was obtained in the introducer and the progression of the catheter in the blood vessel began. During the migration of the PICC, resistance was identified to introduce the last eight cm, being performed saline infusion 0.9% with swirling technique. However, it was not possible to advance the expected size of the catheter and it was decided to remove it. During the traction of the PICC, retention of the last four cm occurred, as shown in Figure 1.

Figure 1 – Image of the retraction of the PICC inserted in the NB in the NICU

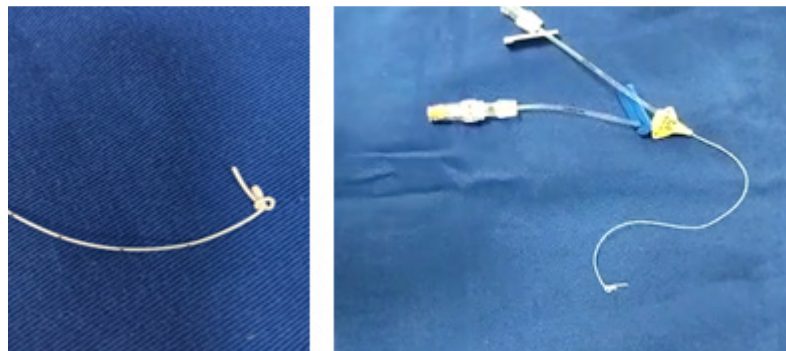


Source: created by the authors.

Faced with the retention of the PICC, the neonatal medical team was informed and the insertion site was covered with a transparent dressing to allow the application of a warm compress. The next attempt of removal was not enough for the removal of the catheter. Fixed the PICC with sterile dressing and made contact with

the medical team of the specialty of pediatric surgery to assess the case. The catheter was removed by the surgical team after performing a small incision with a scalpel blade on the skin of the NB at the insertion site. After the removal of the PICC, a ball (node) was identified in the catheter, as shown in Figure 2.

Figure 2 – Image of catheter containing a ball (node) after removal



Source: created by the authors.

Case 2

NB born with GA of 28 weeks and 2 days, male, birth weight 1,550 grams, vaginal delivery. There was premature labor, chorioamnionitis and premature aminorrexis. Apgar of the NB of five and seven in the first and fifth minute, respectively. The primary diagnosis was prematurity and the NB was admitted to

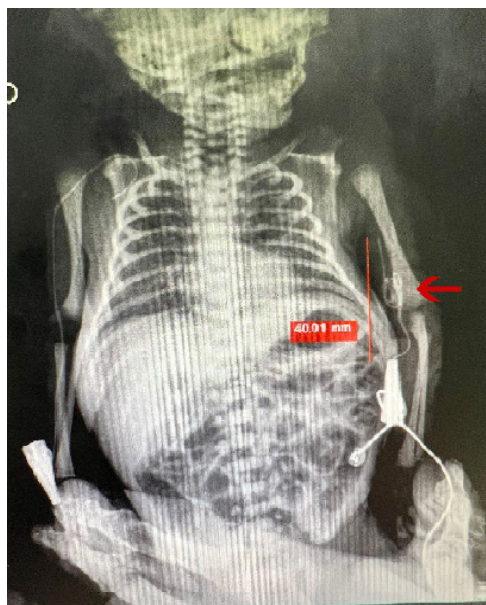
the NICU shortly after birth. During the first days of hospitalization required mechanical ventilation, received the insertion of umbilical venous catheter, following the institutional protocol of minimal handling for infusion of basic plan and administration of ampicillin and intravenous gentamicin. The umbilical catheter presented poor positioning of the tip and remained peripheral.

On the sixth day of life, PICC insertion was requested to end the treatment with infusion of antibiotics (ampicillin and gentamicin), parenteral nutrition and indication of central venous access for infusion of milrinone, fentanyl and venous hydration. The patient was in ventilatory support of Continuous Positive Airway Pressure (CPAP) with use of nasal cannula, O₂Fi 40% and PEEP 7.

Two qualified nurses, according to the evaluation of the venous network of the NB and protocol of the institution, selected a PICC with two caliber French, monolumen, polyurethane, open tip (not valved). Previous anatomical measurement of the NB was performed and the catheter was cut with a scalpel blade 11 cm long. After skin antisepsis and use of universal

precautions for the procedure, PTNB winding and glucose 25% by non-nutritive suction was used to prevent pain during the procedure. The puncture of the left basilica vein occurred in the second attempt, with adequate catheter migration, without resistance, FS 0.9% infusion was performed to verify permeability, and blood reflux was also observed. Performed dressing according to the routine of the institution and requested chest radiography to bedside. It was verified by the radiography image that the PICC made a ball (node) in the arm of the NB, that is, it did not migrate to the central vessel, as shown in Figure 3. The catheter was removed without complications. The incident was reported to the hospital's surveillance system.

Figure 3 – Radiographic image with a ball (node) of PICC on the left arm



Source: created by the authors.

The same NB had already undergone a PICC insertion procedure, which presented poor positioning of the catheter tip (in the right axillary region) and did not migrate to the central position even after repositioning maneuvers (saline infusion 0.9%), arm abduction and elbow flexion.

Discussion

PICC has become one of the most common technologies used in neonatal intravenous

therapy, as it enables long-term intravascular access and comfort, which contributes to increased survival and quality of life of newborns. Despite the advantages presented, there are some complications reported in the scientific literature, such as obstruction, infiltration/extravasation (12.4%)⁽³⁾, catheter breakage (17%), phlebitis (11%), accidental traction (9%)^(1,14), among others.

The scientific literature presents some cases about skein or nodes of PICC and guideline in adult, pediatric and neonatal patients; one case occurred with a child in Brazil and the others

occurred in other countries. This demonstrates that this is an uncommon complication and little reported in the literature.

A case of folding of a PICC guide wire in the state of São Paulo, Brazil, was identified in a one-year-old, hemophilic and neuropathic infant, who, after insertion of PICC with three French caliber in the forearm, had his guide wire retained, making it impossible to remove it. The radioscopy examination revealed the folding of the guide wire, requiring surgical removal⁽¹⁵⁾.

A published study from Italy reports a PICC inserted into the right basilica vein with three nodes in an 82-year-old patient admitted to the hospital to treat pneumonia. The catheter that presented complication was a PICC of four French, 38 cm, whose insertion was guided by ultrasound, the position of the tip was verified during the procedure with the electrocardiogram technique and it was found position in the superior vena cava, in the right cavo-atrial junction, confirmed by chest radiography. The radiography didn't show any nodes or folds in the catheter. During the hospitalization period, PICC was used by nurses to infuse antibiotics and collect blood samples⁽¹⁶⁾.

Catheter removal was elective after 11 days of hospitalization. According to the routine of that institution, the responsible nurse removed 24 cm from the device, when its output abruptly stopped. The nurse detected resistance in the removal and the patient felt pain at the insertion site, opting to suspend the removal of the final portion of the catheter. An radiography showed three nodes in the portion that was inserted in the patient. Attempts of flushing of 0.9% FS were performed, but without the possibility of infusion. Thus, a vascular surgeon surgically removed the PICC⁽¹⁶⁾.

In the United States, an 85-year-old woman was admitted for treatment of a liver abscess. Due to the need for parenteral nutrition, PICC insertion was considered the best choice. The PICC Arrow was used with four, mono lumen, guide wire with 80 cm. The right basilica vein was selected and punched with ultrasonic orientation and a guide wire was inserted into the vein by the modified Seldinger technique.

At approximately 10 cm, the guide found strong resistance and it was not possible to remove it from the patient's arm. Radiography indicated the formation of a node at the tip of the guide wire and required surgical removal⁽¹⁷⁾.

In another study in the United States, a PICC was inserted, the procedure was guided with ultrasound, advanced without resistance as the previous measurement and the tip was located at the level of the diaphragm, but it was not possible to infuse physiological solution. Thus, the team opted for catheter removal. Retraction was difficult and a node was observed at 0.5 cm from the distal end of the catheter⁽¹⁸⁾.

In Australia, a NB required the use of a PICC, cut with 25 cm and inserted into the saphenous vein at the height of the left calf. The initial chest and abdomen radiography showed that the tip of the catheter was at the T9 level without changes. Elective PICC removal was indicated 28 days after insertion. Some attempts by neonatal and surgical teams to remove the catheter proved useless. Radiography confirmed the formation of a node approximately 2.5 cm from the catheter tip⁽¹⁹⁾.

As verified in the studies, the mechanisms of bond formation and nodes in intravenous catheters are not fully understood, however, hypotheses suggest that there are factors that predispose to the formation of nodes, such as the soft and flexible nature of most especially the less calibrous, combined with the length of the intravascular path. Along the veins, there are venous junctions that form different blood flows. Moreover, it is important to consider venous valves that may contribute to PICC folding and predisposition to the formation of loops and nodes⁽¹⁹⁾.

Winding or node formation in a PICC should be suspected when undue resistance is felt during its insertion or removal, as well as for infusion of physiological solution soon after its insertion. In Case 1 presented in the results of this study, it is believed that the catheter migrated making loops inside the blood vessel and, at the time of retraction, these loops were tight, forming a ball (node) and preventing its removal.

Likewise, it is important to point out that catheters with visible curves and loops in radiography may present a greater tendency to this complication, however, they are not the only risk factor, as evidenced by the reports presented.

It is recommended, in cases of difficulty of removal or obstruction of venous lines, to consider the folding (node) or loop in the PICC. Radiography may be used to visualize the catheter extension and integrity⁽²⁰⁻²²⁾.

It is suggested that all clinical occurrences are reported and documented, so that an evaluation of the interventions can be made, in order to contribute to reflection and adoption of actions aimed at improving neonatal nursing care.

This report presents as limitations the procedure adopted in Case 1, because it was suspected that the PICC was attached to a venous valve and, therefore, a warm compress was applied. It is routine to apply warm compresses in PICC retentions, because they favor vasodilation and facilitate its removal. The catheter node was not suspected, so that radiography of the insertion limb was not requested, which could have facilitated the visualization of the node and the identification of the cause of retention of the PICC.

The insertion of the PICC in the institution of the study is performed by direct puncture of the vessel and confirmation of the tip of the catheter location by radiography, after its stabilization. The use of ultrasound could help in the identification that the catheter did not migrate to a central vein during the procedure of Case 2, which would allow earlier and more effective action of the complication. Another important aspect not made would be the expansion of the site of chest radiography capture, reaching as close as possible to the site of insertion of the catheter, for a view of its entire route.

Despite the limitations, it is emphasized that this study has contributions to professional practice, because the mechanism of node formation in central venous catheter is not fully understood. This case report contributes to raising awareness about this type of intercurrent. Early recognition of this rare but severe complication

may prevent catheter fracture and potential embolization by catheter fragments.

Conclusion

There were two rare complications in PICC, catheter folding/node formation and catheter retention. Early detection of complications is critical to prevent more serious damage. To reduce them, training and permanent education of the care team is necessary, in order to develop knowledge, dexterity and ability to handle the PICC, aiming at neonatal safety and quality of nursing care.

The performance of neonatal intravenous therapy requires nurses with technical competence, knowledge about intravenous therapy, about the neonatal public and technological advances that can contribute to the quality of neonatal care. It is important to use of technologies in neonatal care, such as bedside ultrasound, which is an ally in the early detection of complications presented in this study, enabling immediate intervention.

Collaborations:

1 – conception and planning of the project: Gisele Weissheimer, Clélia Mozara Giacomozzi and Taine Costa;

2 – analysis and interpretation of data: Gisele Weissheimer, Clélia Mozara Giacomozzi and Taine Costa;

3 – writing and/or critical review: Gisele Weissheimer, Clélia Mozara Giacomozzi, Taine Costa, Luciana Machado Carvalho and Adenilton Costa Sousa;

4 – approval of the final version: Gisele Weissheimer, Clélia Mozara Giacomozzi, Taine Costa, Luciana Machado Carvalho and Adenilton Costa Sousa.

Conflicts of interest

There are no conflicts of interests.

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Received: September 13, 2022

Approved: April 6, 2023

Published: October 3, 2023



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