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Original Article

Use of the central catheter for peripheral insertion in newborns: analysis of indication for removal

Utilização do cateter central de inserção periférica em neonatos: análise da indicação à remoção

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Objective: to analyze the use of the central catheter for peripheral insertion in newborns. **Methods:** retrospective, documentary study. For data collection, we used an instrument to record and follow the central catheter for peripheral insertion. Analysis performed using descriptive statistics to obtain absolute, relative, minimum and maximum values, standard and mean deviations, and chi-square test for K-proportions for qualitative variables. **Results:** we analyzed 383 records. The catheter was mainly indicated for administration of antibiotic therapy (46.5%). The most accessed vessel was the cephalic vein (23.5%). The most frequent complication was progression (6.8%), with prevalence of removal due to end of treatment/indication (25.3%). **Conclusion:** catheter used mainly for antibiotic therapy administration; cephalic vein mostly accessed, using fentanyl to mitigate pain and discomfort; progression, mostly incident complication; and higher removal rate due to end of treatment/indication.
Descriptors: Catheterization, Central Venous; Catheterization, Peripheral; Intensive Care Units; Nursing Care; Neonatal Nursing.

Objetivo: analisar a utilização do cateter central de inserção periférica em neonatos. **Métodos**: estudo retrospectivo, documental. Para coleta de dados, utilizou-se de instrumento para registro e acompanhamento de cateter central de inserção periférica. Análise realizada por meio de estatísticas descritivas para obtenção de frequências absolutas, relativas, valores mínimos e máximos, desvios-padrão e médias e teste de qui-quadrado para k-proporções para variáveis qualitativas. **Resultados:** foram analisados 383 registros. O cateter foi indicado, principalmente, para administração de antibioticoterapia (46,5%). O vaso mais acessado foi a veia cefálica (23,5%). A complicação mais incidente foi de progressão (6,8%), com prevalência de remoção por término de tratamento/indicação (25,3%). **Conclusão:** cateter utilizado, principalmente, para administração de antibioticoterapia; veia cefálica mais acessada, com uso de Fentanil para atenuar dor e desconforto; progressão, complicação mais incidente; e maior índice de remoção por término de tratamento/indicação.
Descritores: Cateterismo Venoso Central; Cateterismo Periférico; Unidades de Terapia Intensiva; Cuidados de Enfermagem; Enfermagem Neonatal.

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Introduction

Intravenous access in hospitalized newborns in intensive care units is based on clinical indication. Currently, there is a variety of options available, favored by technological breakthroughs[1]. Among these, the central catheter of peripheral insertion, with first reports of use in the decade of 1970, in the United States[2].

The central catheter of peripheral insertion is a vascular access device, inserted in one extremity, as a basilica or cephalic vein, and advanced until the tip is positioned in the middle third of the superior or inferior vena cava[2-4]. One of the indications is long-term intravenous therapy, over six days, used in neonatology and pediatrics[1,5].

The insertion and manipulation by nurses is supported by the Federal Council of Nursing[3-6], and the maintenance of venous access, particularly in clinically unstable newborns, challenges the professionals responsible for care[1].

The insertion, maintenance and control of the infection of the central catheter of peripheral insertion require care practices that promote the safety of the patient, with less exposure to pain, as well as reduction of risks and complications inherent to the procedure[4]. In this sense, understanding the processes involving the insertion of the central catheter of peripheral insertion and the evaluation of nursing maintenance practices in neonatal intensive care units can provide strategies for good practices and better results in the care of newborns using the catheter[7], a priori, avoiding intercurrences and early removal of the catheter.

Considering the above and that the insertion of the central catheter of peripheral insertion is performed in a neonatal intensive care unit, at a university hospital in the west of Paraná, Brazil, since 2008, using an instrument for recording and monitoring central catheter of peripheral insertion, without any evaluation of the nursing practice, we ask: what do the instruments for recording and monitoring central catheter of peripheral insertion point about the indication, catheter insertion and removal? Therefore, the objective was to analyze the use of the central catheter of peripheral insertion in newborns.

Methods

This was a retrospective study of documentary survey carried out at a University Hospital in the state of Paraná, Brazil, with a population of 1,052 newborns admitted to a neonatal intensive care unit, from July 2009 to July 2014. Of these, we chose for the sample the newborns who made use of a central catheter of peripheral insertion (inserted and removed in the study institution) and contained in the medical records the instrument for recording and monitoring central catheter of peripheral insertion, totaling a sample of 383 instruments of newborns analysis.

We carried out the collection from July 2015 to January 2016, by means of an instrument for recording and monitoring central catheter of peripheral insertion, elaborated by qualified nurses in the field of study for catheter insertion, present in printed records of newborns.

Analytical variables were: identification of the newborns (sex, age, weight, diagnosis); Indication data, insertion (date, product for degermation, duration of the procedure, number of puncture attempts, punctured vessel, measures to control pain, intercurrences, catheter tip position) and catheter removal (date, reason). The absence of variables of the instrument led to look at the data in printed and electronic medical records to locate missing information, with no losses of the instruments of the sample.

We analyze data through descriptive statistics of qualitative variables (absolute frequency, relative

frequency and lower and upper limits of confidence interval (CI) at 95%) and quantitative variables (mean, standard deviation, and lower and upper limits of CI at 95%). In addition, we performed Chi-square tests for K-proportions for qualitative variables. We carried out statistical tests with the help of the Statistical Software XLSTAT®, with the exception of confidence intervals, performed using the R statistical software.

The study was approved by the Research Ethics Committee of the State University of Western Paraná, according to Opinion nº 861,914/2014 and Certificate of Presentation for Ethical Appraisal nº 35908114,9,0000,0107.

Results

Of the 383 instruments for recording and monitoring peripheral insertion central catheter analyzed, 57 (14.9%) were fully filled and 326 (85.1%) had one or more variables unfilled.

The newborns of the sample, admitted to the neonatal intensive care unit, presented, on average, 14±28 days of age (CI: 11-17), with average weight of 1.836±1.035 grams (CI: 1,816-2,043) and with mean hospitalization time of 44±52 days (CI: 39-49).

We observed that the mean use of the catheter, from the insertion to the removal, was 16±13 days (CI: 14-17), and the duration of the procedure was 38±33 minutes (CI: 35-42). Regarding puncture attempts, the mean was 3±2 attempts (CI: 3-4). According to sex, 220 (57.0%) newborns were male and 163 (43.0%) female.

Regarding the medical diagnosis, most of the problems were related to prematurity, 147 (38.4%); and respiratory system, 90 (23.5%). Concerning the indication for catheter use, 178 (46.5%) were indications for antibiotic therapy and 90 (23.5%) for total parenteral nutrition (p<0.001) (Table 1).

Table 1 – Absolute and relative frequencies of medical diagnosis and indication of catheter use in newborns admitted in neonatal intensive therapy unit

Variables	n (%)	CI (95%)*	p-value†
Medical diagnosis			
Prematurity	147 (38.4)	35.4 – 41.4	
Respiratory system	90 (23.5)	20.9 – 26.1	
Digestive system	51 (13.3)	11.2 – 15.4	
Sepsis	36 (9.4)	7.6 – 11.2	
Nervous system	21 (5.5)	4.1 – 6.9	<0.001
Low weight	13 (3.4)	2.3 – 4.5	
Malformations	10 (2.6)	1.6 – 3.6	
Circulatory system	6 (1.6)	0.8 – 2.3	
Skeletal muscle system	3 (0.8)	0.2 – 1.3	
Urinary system	2 (0.5)	0.1 – 1	
No information	4 (1.0)	0.4 – 1.7	
Catheter indication			
Antibiotic therapy	178 (46.5)	43.4 – 49.6	
Total parental nutrition	90 (23.5)	20.9 – 26.1	<0.001
Prematurity	16 (4.2)	2.9 – 5.4	
Surgeries in general	4 (1.0)	0.4 – 1.7	
Other indications	67 (17.5)	15.1 – 19.8	
No Information	28 (7.3)	5.7 – 8.9	

Source: medical records of university hospital. *CI: confidence interval; †Chi-squared test for proportion

The most punctured blood vessels were the cephalic veins 90 (23.5%) and saphenous 54 (14.1%). Other vessels (left auricular, axillary, accessory, accessory cephalic, femoral, anterior jugular, posterior jugular, popliteal, radial, retro auricular, temporal, femoral vein) appear as prevalent, 97 (25.3%) (p<0.001) (Table 2). Intercurrences during insertion of the central catheter of peripheral insertion were uncommon, being the difficulty of progression the most incident, 26 (6.8%) (p<0.001). Regarding the reasons for catheter removal, the highest frequent was end of treatment/indication, 97 (25.3%) (p<0.001). However, the lack of removal reason appears in 128 (33.4%) medical records and instruments analyzed (Table 2).

Table 2 – Absolute and relative frequency of punctured vessels, intercurrences and reasons for catheter removal in newborns admitted in neonatal intensive therapy unit

Variables	n (%)	CI (95%)*	p-value†
Punctured vessel			
Cephalic vessel	90 (23.5)	20.9 – 26.1	
Saphenous vessel	54 (14.1)	11.9 – 16.3	
Basilica vessel	41 (10.7)	8.8 – 12.6	
Jugular vessel	21 (5.5)	4.1 – 6.9	<0.001
Axillary vessel	6 (1.6)	0.8 – 2.3	
Brachial vessel	5 (1.3)	0.6 – 2	
Others	97 (25.3)	22.6 – 28	
No information	69 (18.0)	15.6 – 20.4	
Intercurrences			
None	338 (88.3)	86.3 – 90.2	
Difficulty in progression	26 (6.8)	5.2 – 8.3	<0.001
Bleeding	10 (2.6)	1.6 – 3.6	
Access difficulty	7 (1.8)	1 – 2.7	
Ohers	2 (0.5)	0.1 – 1	
Removal reason			
End of treatment	97 (25.3)	22.6 – 28	
Discharged	51 (13.3)	11.2 – 15.4	
Obstruction	37 (9.7)	7.8 – 11.5	
Death	31 (8.1)	6.4 - 9,8	
Flogistic Signals	11 (2.9)	1.8 – 3.9	<0.001
Accidental removal	8 (2.1)	1.2 – 3	
Break	7 (1.8)	1 – 2.7	
Infiltration	3 (0.8)	0.2 – 1.3	
Others	10 (2.6)	1.6 – 3.6	
No information	128 (33.4)	30.5 – 36.3	

Source: medical records of a university hospital. *CI: Confidence interval; †Chi-squared test for proportion

From the total of the catheters analyzed, 235 (61.3%) of the patients had the catheters removed in the neonatal intensive care unit (p<0.001). Regarding the degermation of the skin for catheter insertion, 109 (28.4%) used alcoholic chlorhexidine 2.0%; and 105 (27.4%), alcoholic chlorhexidine 4.0% (p<0.001).

Referring to the request for culture of the catheter tip, there was a higher frequency of non-request 314 (82.0%) (p<0.001). From the requests for culture of the catheter tip, two (15.4%) cases presented positive results, one examination found bacteria and yeasts; and the other, only yeasts. There were eight (61.5%) with negative results to the request for culture of the catheter tip and three (23.1%) that did not have the analysis result filled (Table 3).

In the evaluation of intravenous medications to mitigate pain and discomfort, most received fentanyl 151 (39.4%), and non-pharmacological measures to mitigate pain and discomfort were not used in 347 (90.6%) cases (p<0.001) (Table 3).

Chest radiography to confirm the central position of the catheter was performed in 321 (83.8%) of the instruments and medical records analyzed (p<0.001). Regarding the position of the catheter tip after radiography, the central position was recorded in 284 (74.1%) cases (p<0.001) (Table 3).

Table 3 – Absolute and relative frequencies of catheter removal unit, skin degermation, catheter tip culture, measures to mitigate pain and discomfort, radiography and catheter tip position

Variables	n (%)	CI (95%)*	p-value†
Catheter removal unit			
Neonatal intensive therapy unit	235 (61.3)	58.3 – 64.4	
Intermediate care unit	34 (8.9)	7.1 – 10.6	<0.001
Other hospital	11 (2.9)	1.8 – 3.9	
Pediatric intensive therapy unit	4 (1.0)	0.4 – 1.7	
No information	99 (25.9)	23.1 – 86	
Skin degermation			
Alcoholic chlorhexidine 2%	109 (28.4)	25.7 – 31.3	
Alcoholic chlorhexidine 4%	105 (27.4)	24.7 – 30.2	
Chlorhexidine without concentration identification	96 (25.1)	22.4 – 27.8	<0.001
Alcoholic solution70%	57 (14.9)	12.7 – 17.1	
No information	16 (4.2)	2.9 – 5.4	
Catheter tip culture request			
No request	314 (82.0)	79.6 – 84.4	<0.001
Request	13 (3.4)	2.3 – 4.5	
No information	56 (14.6)	12.4 – 16.8	
Medicines			
Intravenous fentanyl	151 (39.4)	36.4 – 42.5	
Oral paracetamol	37 (9.7)	7.8 – 11.5	
Intravenous Dormonid	33 (8.6)	6.9 – 10.4	<0.001
Intravenous morphine	1 (0.3)	-0.1 – 0.6	
Others	15 (3.9)	2.7 – 5.1	
None	92 (24.0)	21.4 – 26.7	
No information	54 (14.1)	11.9 – 16.3	
Non pharmacologic measures			
None	347 (90.6)	88.8 – 92.4	
Oral Glycose 50,0%	22 (5.7)	4.3 – 7.2	<0.001
Breastfeeding	1 (0.3)	-0.1 – 0.6	
Others	7 (1.8)	1 – 2.7	
No information	6 (1.6)	0.8 – 2.3	
Radiography			
Yes	321 (83.8)	81.5 – 86.1	<0.001
Absent number	62 (16.2)	13.9 – 18.5	
Catheter tip position			
Central positioning	284 (74.1)	71.4 – 76.9	<0.001
Peripheral positioning	24 (6.3)	4.8 – 7.8	
No information	75 (19.6)	17.1 - 22	

Source: medical records of a university hospital. *CI: Confidence interval † Chi-squared test for proportion

Discussion

We considered a limitation of the study the amount of variables unfilled in the instruments and the absence of data in the analyzed medical records.

The results indicated the importance of using instruments/protocols to fill gaps between scientific evidence and nursing practice, since indication, insertion, maintenance and removal of the central catheter of peripheral insertion should be based on institutional protocols, developed from the systematization of Nursing care[5].

The data indicated a higher incidence of the use of the central catheter for peripheral insertion in male newborns and with weight below 2,000 grams. The complications of prematurity (syndrome of respiratory distress or disease of hyaline membrane, perinatal asphyxia, sepsis, among others)[8], whose risk factors are prematurity and low birth weight, may justify the proportions identified[9].

A weight below 2,500 grams, at the time of the catheter insertion, is a predictor of infection, by the use of the device, followed by the time of use in days and the realization of catheter repair[3,10-11]. However, the catheter removal, due to phlogistic signs, showed little incident in the investigated unit. However, the non-completion of the removal reason in the medical records is prevalent.

The insertion of the central catheter of peripheral insertion occurs mainly in newborns with ages from less than three to more than 61 days of life and commonly used in newborns admitted in intensive environment[3,12].

As for the diagnoses of newborns using central catheter of peripheral insertion, diagnoses of prematurity, affection of the respiratory and cardiac systems and fetal malformation are more incident, as in this study[3]. Diagnoses related to low weight, digestive system affections, shock or sepsis, identified in other findings[10-11], show little or no incidents in this study.

The central catheter of peripheral insertion is usually inserted to replace the umbilical venous catheter or due to the fragility of the venous network. This indication is defined by the health team and is usually suitable for long-term therapies[3], which may be from several weeks to six months for administration of parenteral nutrition, infusion of vesicant, irritant, vasoactive medications, hyperosmolar, chemotherapeutic, antimicrobial solutions, and repeated blood transfusion. In this study, the prevalence of prematurity diagnoses and problems related to the respiratory system justifies the indications of catheter, especially for antibiotic therapy and total parenteral nutrition, corroborating with scientific evidence[4].

Different studies indicate the basilica, cephalic and saphenous veins as preferentially punctured to insert the peripheral insertion central catheter[10-11], in addition to other vessels, such as the median cubital and jugular vein[2]. However, international guidelines recommend to puncture the basilica, cephalic, median cubital and brachial veins, being the first two indicated because they present less difficulty in catheter positioning, fewer valves and higher caliber, they have favorable anatomy and allow easy dressing exchange[13]. It is recommended to avoid areas of articulation and prioritize distal and superficial veins, except in emergency conditions, surgeries and local lesions[14].

The anatomical, physiological and cognitive characteristics inherent to the newborn age group may influence the success of the puncture, as well as prematurity, the existence of chronic disease, long surgical treatment, long peripheral intravenous therapy and use of vesicant medicines[15]. Therefore, it is crucial for the nurse to have knowledge about the anatomy, physiology of the skin and the venous system and ability to evaluate specific clinical and surgical conditions of each newborn.

The puncture attempts and the duration of the procedure may relate to the particularities of the insertion of the device in newborns and to the intercurrences during the procedure. The chances of infection increase, as the puncture attempts are higher, in addition to exposing the newborn to a higher pain condition[16].

During catheter insertion, intercurrences may occur, such as difficulty in catheter progression, bleeding, bruising, risk for thrombosis and phlebitis[15]. In this study, the main intercurrences were difficulty in accessing, catheter progression and bleeding.

As for the reasons for removal of the central catheter of peripheral insertion, we confirm the prevalence of elective removal, at the end of intravenous therapy and or discharged from the intensive Care Unit[12], besides removal due to complications such as infiltration, extravasation, thrombophlebitis, local infection[15], among others. The latter, little evident in the neonatal intensive care unit studied. However, the non-fulfillment of this information in the medical records was prevalent for the other reasons mentioned.

The time of catheter permanence corresponded to the average results of national and international researches, which showed that most catheters remained for a period exceeding five days, ranging from one to 38 days[12,16].

For skin degermation, we identified the use of alcoholic chlorhexidine 2.0% and alcohol 70.0%, respectively, as first and second choice, according to international recommendations and use in other realities[16-17]. However, there is a considerable lack of records regarding the type of chlorhexidine (alcoholic and or degerming) and its concentrations[18] for the degermation of newborns' skin.

The low incidence of catheter tip culture request is possibly related to catheter removal, only when there are signs of catheter-related infection[3]. Therefore, the low incidence of catheter removal by phlogistic signals is related to the low incidence of infection. Moreover, the two positive blood cultures of the catheters removed due to the suspicion of infection in the bloodstream related to the study catheter are compatible with results of low incidence of positive cultures in central catheter of peripheral insertion[16].

The adequate use of environmental, behavioral and pharmacological interventions can reduce pain in newborns during the installation of the central catheter of peripheral insertion. First choice non-pharmacological interventions are sucrose and non-nutritive sucking (pacifier) or human milk. In addition, the administration of glucose, individualized treatment with limitation of environmental stimuli, lateral positioning, eased reinforcement (hold arms and legs in a flexible position), music therapy, maternal or paternal skin to skin contact, reduction of light and noise and parental presence can also be used[19].

We confirmed the use of glucose, in addition to breast milk, contact measures and the use of glucose associated or not to breastmilk[16] as effective non-pharmacological measures to relieve pain during the procedure. However, it is prevalent the non-use of actions to prevent and control pain during catheter insertion through non-pharmacological strategies, even though evidences point to their efficacy[20]. The pharmacological strategies for analgesia and sedation are the most commonly used, intravenously, usually in bolus, with the use of Fentanyl[11], Midazolam[14], Dipyrone and Paracetamol[20].

We identified a high number of instruments and medical records without confirming the position of the catheter tip, which can be confirmed by chest radiography or ultrasonography. It is noteworthy that the use of ultrasonography by nurses, in clinical practice, to guide peripheral venous puncture in newborns, ensures greater safety in the execution of the procedure[2,19].

Conclusion

The catheter was mainly used to administer antibiotic therapy, and the cephalic vein was the most accessed, using fentanyl to mitigate pain and discomfort; the most incident complication was progression; and the highest removal rate, at the end of treatment/indication. However, we identified fragility in the completion of the instrument for recording and monitoring the central catheter for peripheral insertion, indication of catheter removal, which may compromise planning and evaluation of nursing care.

Collaborations

Baggio MA, Cheffer MH, Luz MAP and Sanches MM collaborated with the conception, design, analysis and interpretation of the data, writing the article and relevant critical review of the intellectual content and approval of the final version to be published. Berres R contributed writing the article, relevant critical review of the intellectual content and final approval of the version to be published.

References

1. Vera SO, Sousa GN, Araújo SNM. The work of nurses in the practice of inserting and maintaining the PICC: a literature integrative review. Reon Facema [Internet]. 2015 [cited May 7, 2019]; 1(1):47-53. Available from: http://www.facema.edu.br/ojs/index.php/ReOnFacema/article/download/9/12
2. Onofre PSC, Pedreira MLG, Barros DP, Peterlini MAS. Cateter intravenoso central de inserção periférica guiado por ultrassonografia: relato de experiência. Rev Soc Bras Enferm Ped [Internet]. 2016 [citado 2019 Jan 10]; 16(2):96-9. Disponível em: http://www.sobep.org.br/revista/images/stories/pdf-revista/vol16-n2/vol_16_n_2-relato_de_experiencia_4.pdf
3. Costa P, Paiva ED, Kimura AF, Castro TE. Risk factors for bloodstream infection associated with peripherally inserted central catheters in neonates. Acta Paul Enferm. 2016; 29(2):161-8. doi: http://dx.doi.org/10.1590/1982-0194201600023
4. Santo MKD, Takemoto D, Nascimento RG, Nascimento AM, Siqueira É, Duarte CT, et al. Peripherally inserted central venous catheters: alternative or first choice vascular access? J Vasc Bras. 2017; 16(2):104-12. doi: http://dx.doi.org/10.1590/1677-5449.011516
5. Oliveira CR, Neves ET, Rodrigues EC, Zamberlan KC, Silveira A. Peripherally inserted central catheter in pediatrics and neonatology: possibilities of systematization in a teaching hospital. Esc Anna Nery. 2014; 18(3):379-85. doi: http://dx.doi.org/10.5935/1414-8145.20140054
6. Conselho Federal de Enfermagem. Resolução n°258/2001 [Internet]. 2001 [citado 2019 ago. 15]. Disponível em: http://cofen.gov.br/resoluo-cofen-2582001_4296.html
7. Pedreira MLG. Obstruction of peripherally inserted central catheters in newborns: prevention is the best intervention [editorial]. Rev Paul Pediatr. 2015; 33(3):255-7. doi: dx.doi.org/10.1016/j.rpped.2015.05.003
8. Sousa DS, Sousa Júnior AS, Santos ADR, Melo EV, Lima SO, Almeida-Santos MA, et al. Morbidity in extreme low birth weight newborns hospitalized in a high risk public maternity. Rev Bras Saúde Matern Infant. 2017; 17(1):139-47. doi: http://dx.doi.org/10.1590/1806-93042017000100008
9. Gonzaga ICA, Santos SLD, Silva ARV, Campelo V. Prenatal care and risk factors associated with premature birth and low birth weight in the a capital in the Brazilian Northeast. Ciênc Saúde Coletiva. 2016; 21(6):1965-74. doi: http://dx.doi.org/10.1590/1413-81232015216.06162015
10. Rangel UV, Gomes Junior SCS, Costa AMAM, Moreira MEL. Variables associated with central peripheral insertion catheter infection in high risk newborns. Rev Latino-Am Enfermagem. 2014; 22(5):842-7. doi: dx.doi.org/10.1590/0104-1169.3481.2488
11. Lui AML, Zilly A, França AFO, Ferreira E, Toninato APC, Silva RMM. Care and limitations in the management of the peripherally inserted central catheter in neonatology. Rev Enferm Centr O Min. 2018; 8:e1918. doi: http://dx.doi.org/10.19175/recom.v7i0.1918
12. Jantsch LB, Neves ET, Arrué AM, Kegler JJ, Oliveira CR. Utilização do cateter central de inserção periférica em neonatologia. Rev Baiana Enferm [Internet]. 2014 [citado 2019 Fev 22]; 28(3):244-51. Disponível em: http://www.portalseer.ufba.br/index.php/enfermagem/article/view/10109/
13. Araújo FL, Manzo BF, Costa ACL, Corrêa AR, Marcatto JO, Simão DAS. Adherence to central venous catheter insertion bundle in neonatal and pediatric units. Rev Esc Enferm USP. 2017; 51:e03269. doi: dx.doi.org/10.1590/s1980-220x2017009603269
14. Phillips LD, Gorski LA. Manual of IV Therapeutics: evidence-based practice for infusion therapy [Internet]. 2014 [cited jun 13, 2019]. Available from: http://iranianfamilyphysicians.com/images/book/Lynn_D__Phillips_MSN__RN__CRNI,_.pdf

15. Danski MTR, Mingorance P, Johann DA, Vayego SA, Lind J. Incidence of local complications and risk factors associated with peripheral intravenous catheter in neonates. Rev Esc Enferm USP. 2016; 50(1):22-8. doi: http://dx.doi.org/10.1590/S0080-623420160000100003

16. Rangel RJM, Castro DS, Amorim MHC, Christoffel MM, Primo CC. Practice of insertion, maintenance and removal of peripheral inserted central catheter in neonates. J Res Fundam Care Online. 2019; 11(n.esp.):278-84. doi: http://dx.doi.org/10.9789/2175-5361.2019.v11i2.278-284

17. Organização Pan-Americana da Saúde. Centro Latino-Americano de Perinatologia, Saúde da Mulher e Reprodutiva. Prevenção de infecções relacionadas à assistência à saúde em neonatologia. Montevidéu: CLAP/SMR-OPS/OMS; 2016.

18. Curan GRF, Rossetto EG. Interventions to decrease catheter-associated bloodstream infections in newborns: an integrative review. Texto Contexto Enferm. 2017; 26(1):e5130015. doi: http://dx.doi.org/10.1590/0104-07072017005130015

19. Morais APS, Façanha SMA, Rabelo SN, Siebra e Silva AV, Queiroz MVO, Chaves EMC. Non-pharmacological measures in the pain management in newborns: nursing care. Rev Rene. 2016; 17(3):435-42. doi: http://dx.doi.org/10.15253/2175-6783.2016000300019

20. Kegler JJ, Paula CC, Neves ET, Jantsch LB. Pain management in the use of the peripherally inserted central catheter in newborns. Esc Anna Nery. 2016; 20(4):e20160099. doi: http://dx.doi.org/10.5935/1414-8145.20160099