Peripherally inserted central catheter care in neonates: an integrative literature review

CUIDADOS COM CATETER CENTRAL DE INSERÇÃO PERIFÉRICA NO NEONATO: REVISÃO INTEGRATIVA DA LITERATURA

CUIDADOS CON CATÉTER CENTRAL DE INSERCIÓN PERIFÉRICA EN EL NEONATO: REVISIÓN INTEGRATIVA DE LA LITERATURA

Derdried Athanasio Johann[1], Luciana Souza Marques De Lazzari[2], Edivane Pedrolo[3], Priscila Mingorance[4], Tatiana Queiroz Ribeiro de Almeida[5], Mitzy Tannia Reichembach Danski[6]

ABSTRACT

The peripherally inserted central catheter (PICC) is a common technology employed in the intravenous therapy of neonates. This integrative review was performed with the objective to investigate and analyze the evidence available in the literature regarding this technology. The databases searched included the Latin American and Caribbean Health Sciences Literature (LILACS) and the United States National Library of Medicine (PubMed). Results point at gaps in relation to their use in the neonatal population (n=1); various themes regarding the use of anticoagulants (n=6), comparison with other catheters (n=4), diagnostic imaging (n=2), pain (n=2), and catheter-relation infection and its prevention (n=7), among others. There is a need for staff education regarding their use; scientific evidence with easy access; and national publications regarding their use.

DESCRIPTORS

Catheterization, central venous
Infant, newborn
Nursing care
Technology.

RESUMO

O cateter central de inserção periférica (PICC) é tecnologia comum empregada na terapia intravenosa de neonatos. Trata-se de revisão integrativa, cujo objetivo foi investigar e analisar as evidências disponíveis na literatura acerca da temática. As bases de dados pesquisadas foram Literatura Latino-Americana e do Caribe em Ciências da Saúde (LILACS) e Biblioteca Nacional de Medicina dos Estados Unidos (PubMed). Resultados apontam lacunas no que tange à população neonatal; conhecimento insuficiente dos profissionais quanto indicações (n=1); e variados temas sobre uso de anticoagulantes (n=6), comparação com outros cateteres (n=4), diagnóstico por imagem (n=2), dor (n=2), infecção relacionada a cateter e sua prevenção (n=7), entre outros fatores. Conclui-se que há necessidade de atualização profissional, evidências científicas de fácil acesso e publicações nacionais.

DESCRITORES

Cateterismo venoso central
Recém-nascido
Cuidados de enfermagem
Tecnologia.

RESUMEN

El catéter central de inserción periférica (PICC) es una tecnología común empleada en terapia endovenosa de neonatos. Se trata de una revisión integrativa, cuyo objetivo fue investigar y analizar las evidencias disponibles en la literatura acerca de la temática. Se investigaron las bases de datos Literatura Latinoamericana y del Caribe en Ciencias de la Salud (LILACS) y la Biblioteca Nacional de Medicina de los Estados Unidos (PubMed). Los resultados expresan omisiones en lo referente a la población neonatal; conocimiento insuficiente de los profesionales al respecto de las indicaciones (n=1), diagnóstico por imagen (n=2), dolor (n=2), infección relacionada al catéter y su prevención (n=7), entre otras. Se necesita de actualización profesional; evidencias científicas de fácil acceso y publicaciones nacionales.

DESCRIPTORES

Cateterismo venoso central
Recién nacido
Atención de enfermaría
Tecnología

[1]RN. Master student of the Nursing Graduate Program at Federal University of Paraná. RN at the Paraná Federal Institute. Member of the Research Group Health Technology and Innovation: Foundations for Professional Practice. Curitiba, PR, Brazil. derdriedjohann@hotmail.com [2]Nursing undergraduate at Federal University of Paraná. Volunteer of the research apprenticeship program. Member of the Research Group Health Technology and Innovation: Foundations for Professional Practice. Curitiba, PR, Brazil. luciana.marques88@hotmail.com [3]RN. Master student of the Nursing Graduate Program at Federal University of Paraná. Professor of the Paraná Federal Institute. Member of the Research Group Health Technology and Innovation: Foundations for Professional Practice. Curitiba, PR, Brazil. edivanepedrolo@gmail.com [4]Nursing undergraduate at Federal University of Paraná. Fellow of the PIBIC/CNPq research apprenticeship program. Member of the Research Group Health Technology and Innovation: Foundations for Professional Practice. Curitiba, PR, Brazil. primingo@yahoo.com.br [5]Nursing undergraduate at Federal University of Paraná. Volunteer of the research apprenticeship program. Member of the Research Group Health Technology and Innovation: Foundations for Professional Practice. Curitiba, PR, Brazil. tatiqueirozalmeida@hotmail.com [6]RN. Ph.D. Professor of the Undergraduate Program of the Nursing Department and the Nursing Graduate Program at Federal University of Paraná. Vice-leader of the Research Group Health Technology and Innovation: Foundations for Professional Practice. Curitiba, PR, Brazil. profa.mitzy@ufpr.br

Received: 03/28/2012
Approved: 05/03/2012

INTRODUCTION

Nursing is dedicated to the care for the individual in all life stages. The importance of these professionals in providing care for neonatal patients in Intensive Care Units (ICU) stands in the limelight due to its high complexity and specific needs.

Vascular access ports are indispensable devices for intensive care due to the need for medication therapy, hemodynamics monitoring, parenteral nutrition, among other recommendations[1]. The most used vascular access ports in neonatal care are: Peripheral Venous Access (PVA), Peripherally Inserted Central Catheter (PICC) or Umbilical catheter[2].

PICC is an intravascular device inserted through a superficial vein from the extremity of the body which, with the help of an introducing needle, advances through the superior or inferior cava, with the characteristics of a central catheter[3].

PICC is highly used in neonatal ICU units due to its easy insertion, prolonged use, less traumatic insertion and reduced risk for complications[4-5]. However, PICC requires a trained professional for its insertion and daily care and maintenance, with a view to avoid complications[4-5].

The suitable referential for developing this present study was the Evidence Based Practice (EBP). EBP employs instruments to consolidate scientific knowledge about a specific subject, searches for ideal and efficient professional conduct towards a specific problem, by organizing coherent and relevant evidence, listed according to quality[6]. The main evidence corresponds to the results of the research[7].

Implementing EBP in nursing is consonant to scientific evidence incorporation in clinical practice, allowing for knowledge acquisition and validation. Hence, there is a need for returning studies results into practice and research themes are a result to the need for it in an objective and applicable way in its routine[8].

The objective of this review is to investigate and analyze the available evidence in literature regarding the care for the insertion and maintenance of peripherally inserted central catheter in neonates.

METHOD

An integrative literature review was conducted, which allows for a synthesis of multiple published studies thus providing a general conclusion regarding this particular area of study. A simultaneous inclusion of experimental and semi-experimental studies is enabled, thus providing a more comprehensive understanding of the theme of interest[9].

The integrative review was developed following six stages: formulation of the research question, literature search, study categorization, evaluation of the included studies, results discussion and interpretation and an evidenced knowledge synthesis[9-10].

The research question used was: what are the clinical practice publications regarding peripherally inserted central venous catheter in neonates?

The article search was performed on the Latin American and Caribbean Health Sciences Literature Database (LILACS) and United States National Medical Library (PubMed) databases. The articles were selected according to descriptors from DeCS - Health Sciences Descriptors for the BVS portal, and from MeSH - Medical Subject Heading from PubMed.

LILACS database was electronically accessed through the Virtual Health Library and the PubMed through the National Center for Biotechnology Information – NCBI. Searches were performed in May of 2010.

In LILACS, three fields were crossed, the first and the second were 'subject descriptors' and the third 'type of publication', following the Boolean logic, according to the description on Chart 1.

In PubMed, ten descriptors were crossed to eight types of publications, following the Boolean logic, as shown by Chart 2.

Chart 1 - Search strategy used in LILACS database - Curitiba, PR, 2011

Field	Search Terms	Operator Boolean
Subject Descriptor	["INFANT" "low weight INFANT" "very low weight INFANT" "premature INFANT"]	OR OR OR
		AND
Subject Descriptor	["CATHETER related infections" "Central venous CATHETER indwelling"]	OR
		AND
Type of publication	["Clinical trial" "CONTROLLED CLINICAL TRIAL" "RANDOMIZED CONTROLLED CLINICAL TRIAL" "COMPARATIVE STUDY" "MULTICENTER STUDY" "EVALUATION STUDIES" "VALIDATION STUDIES" "CLINICAL PRACTICE GUIDE" "META-ANALYSIS"].	OR OR OR OR OR OR OR OR

Chart 2 - Search strategy used in PubMed - Curitiba, PR, 2011

Search number	Search Terms	Operator Boolean
#1 -	"Catheterization, Central Venous"[Mesh]	OR
	("Catheter-Related Infections"[Mesh]	OR
	"Catheters, Indwelling"[Mesh]);	
#2 -	(("Infant, Very Low Birth Weight"[Mesh]	OR
	"Infant, Low Birth Weight"[Mesh]	OR
	"Infant, Extremely Low Birth Weight"[Mesh]	OR
	"Infant, Premature"[Mesh]	OR
	"Infant, Postmature"[Mesh]	OR
	"Infant, Newborn"[Mesh]))	OR
	"Infant, Small for Gestational Age"[Mesh];	
#3 -	(#1 AND #2);	
#4-	(((((("Evaluation Studies "[Publication Type]	OR
	"Validation Studies "[Publication Type]	OR
	"Randomized Controlled Trial "[Publication Type]))	OR
OR		
	"Meta-Analysis "[Publication Type])	OR
	"Comparative Study "[Publication Type])	OR
	"Multicenter Study "[Publication Type])	OR
	("Guideline "[Publication Type]	OR
	"Practice Guideline "[Publication Type]).	
#5-	(#3) AND #4	

The articles included in the review met the following criteria: published between January of 2000 and May of 2010; in national and international journals; available in Portuguese, English or Spanish; presented a clinical research design; addressed the PICC theme.

To select publications, first the title and the abstract were analyzed, in order to confirm if they contemplated the research question and if they met the inclusion criteria. Pre-selected articles were fully read with a view to avoid selection bias. LILACS database search resulted in 19 references; however, none met the inclusion criteria. In PubMed, 221 articles were selected and 28 were included in this present study.

For data extraction, a validated instrument was adjusted to compose the article identification, methodological precision, evidence level, intervention, results and conclusions[11]. Studies evaluations were performed by analyzing the research lineation according to the researchers' area concepts[12-13].

A synthesis of the extracted data is presented in a descriptive format, contemplating the fifth and sixth stages of the integrative review. The evidence level was determined according to Chart 3

Chart 3 – Evidence level classification – LILACS and PubMed, 2011

Levels	Types of Studies
1	Strong evidence from, at least, one systematic review of multiple, clearly outlined, randomized controlled studies.
2	Strong evidence from, at least, one randomized, clearly outlined, controlled clinical trial.
3	Evidence as from a clearly outlined clinical trial, without randomization, from studies regarding only one before and after group, cohort, temporal series, or control-case studies.
4	Evidence from non-experimental studies by more than one research center or group.
5	Opinions from acknowledged authorities based on clinical evidence, descriptive studies or expert committee reports.

RESULTS

Regarding the methodological design, from the 28 analyzed studies, the following was extracted: eleven randomized clinical trials (RCT), four cohort studies, four descriptive, three observational, three systematic reviews (two with two RCT each and one with five), two before and after, and one clinical guideline. The frequency of publications throughout the analyzed years was of three publications/year with a variation of one to four per year.

Regarding the study objects, the following was found: seventeen were on children, thirteen were specifically on neonatal subjects; six on catheters; one on diagnoses exams; one on neonatal ICU; and one on nurses. The evidence level in the studies covered the following: three studies on evidence 1, ten on evidence 2, twelve on evidence 3 and three on evidence 5.

Regarding population/sample, interventions, results and conclusion designs, in each study they are succinctly, orderly presented according to the emerging categories in data collection. The *general Complication and Infection* categories were composed of four studies each and the *Infection prevention* category of three studies; they are detailed in Chart 4.

Chart 4 – Complications regarding to PICC in LILACS and PubMed, 2011

Authors / evidence	Type of study / sample	Intervention	Results and conclusions
General complications			
Liossis et al. (2003)(15) / / Level 3	Controlled cohort / 88 neonatal subjects	Does not apply.	The average time of the treatment was prolonged throughout 28 + 13 days; axillary and basilic veins were the most used insertion ports; insertion success rate is 74%; two patients bled more than three milliliters in the insertion; TPN interruption and occlusion were the reason for removing the PICC. There was a significant reduction in infectious episodes in percutaneously inserted Central venous Catheters (CVC), and infections in these cases were caused by: S. epidermidis and Candida albicans. In infection cases in neonatal subjects with peripheral catheter: S. epidermidis, S. aureus, Candida albicans, Escherichia coli.
Male et al. (2005)(16) / Level 3	Multicenter prospective cohort / 186 children	List location, type, size and duration of the treatment with CVC and the incidence of Venous Thromboembolic Events (VTE).	Results point out 13% of VTE, with a tendency to achieve higher levels in younger children; no significant associations regarding gender, size, weight, base diseases and study center; 49% of children presented infection evidenced by fever, local infection and septicemia; there was a significant association to the CVC location with the incidence of VTE; size (lumen and diameter) had no influence in VTE; VTE is related to CVC stay of 0-5 days, with no statistics significance.
Hoang et al. (2008)(17) / Level 5	Comparative descriptive / 477 PICCs in 396 neonatal subjects.	Compare the events of complications related to the PICC insertion location.	PICCs inserted in upper limbs present higher occurrence of adverse events. Bacteremia by Staphilococcus coagulase negativa was significantly higher in PICCs inserted in upper extremities. Infiltration rates were similar in both groups. There was no statistics difference related to the following variables: serum creatinine, hospital stay period and survival.
Winkle, Whiffen and Liu (2008) (18) / Level 3	Retrospective descriptive / 86 PICCs	Evaluate the events of complications.	39 PICCs presented complications that led to the removal of the catheter. Reasons for the removal were: occlusion (5%), accidental traction (12.8%), bursting with leakage (10.3%), local reaction and hyperemia (5%). There were no events of phlebitis or sepsis.
Infection			
Garland et al. (2001)(19) / Level 2	Randomized clinical trial / 705 neonatal subjects	Insertion site asepsis with 70% alcohol associated to chlorhexidine dressing (study) was confronted to transparent polyurethane film with povidone-iodine asepsis (control)	Colonization at the tip of the catheter was significantly lower in the study group. However, there was no difference in the bacteremia rate. There were cases of contact dermatitis only for the study group.
Foo et al. (2001) (20) / Level 3	Comparative retrospective cohort / 97 tunneled catheters and 68 PICCs.	Verify the events of infectious and mechanical complications in tunneled catheters and PICCs.	Complications were similar in both groups and were free of infections for 15 days.
Garland, Henrickson and Maki (2002)(21) / Level 5	Clinical guideline.	Does not apply.	The use of 2% alcohol solution chlorhexidine for skin asepsis is recommended, however, the use of providone 10%, iodine alcohol tincture and 70% alcohol are also approved. Dressings impregnated with chlorhexidine are not recommended for neonatal subjects younger than seven days or with age inferior to 26 weeks. Antimicrobial covered catheters are not recommended due to a lack of evidence.
Nazemi et al. (2003)(22) / Level 3	Retrospective cohort / 53 catheters (PICC, CVC and umbilical)	Evaluate the group with catheter removal in up to two days of the bactericidal diagnosis by enterobacteria with the group with the removal after two days.	Delaying catheter removal in 24 to 48 hrs demonstrated to increase in one or two days the time of antibiotic therapy. A new haemoculture collection is recommended after 24 or 48 hours from the initial antibiotic administration and the removal of the catheter is needed in positive cases.
Infection prevention			
Aly et al. (2005) (23) / Level 3	Before and after / 536 children, with 169 before and 367 after.	The implementation of policies for preventing neonatal ICU PICC related infections.	A significant reduction in the infection rate after the intervention was observed.
Capretti et al. (2008)(24) / Level 3	Before and after / 165 neonatal subjects, with 85 before and 80 after.	The implementation of a standard protocol for hand hygiene was analyzed.	Results after the protocol implementation demonstrated a significant reduction in CVC colonization rates.
Schulman et al. (2009)(25) / Level 5	Descriptive / 218,096 day patients in 19 NICU	Analyze conducts regarding infection prevention in the blood stream related to catheters in the NICU and develop a care document based on the best scientific evidence (bundle).	Individual morbidity rates in perinatal regional centers are substantial and alter greatly. There was no center without any infection related to catheters.

Six sub-categories (Chart 5) were inserted in the general aspects related to PICC: Comparison between PICC and other catheters (n=4 studies); Image diagnosis (n=2); Pain (n=2); Perception from nurses (n=1); Filter (n=2); and Use of anticoagulant (n=6).

Chart 5 - General aspects related to PICC in LILACS and PubMed, 2011

Authors Evidence	Type of study / sample	Intervention	Results and conclusions
Comparison of PICC to other catheters			
Janes et al. (2000)(26) / Level 2	Randomized clinical trial / 63 neonatal subjects with extremely low weight at birth	Does not apply.	Results demonstrate there was no difference between the groups regarding intravenously therapy duration, of the total number of catheters used, from sepsis episodes, antibiotic therapy and infant weight. Mechanical complications that culminated in catheter removal occurred in 42.9% of PICC: infiltration, leakage, obstruction and kinking.
Schwengel et al. (2004)(27) / Level 2	Randomized clinical trial / 96 neonatal subjects and children	Confront complications related to PVA with PICC in the post-surgery period.	PVA patients received a higher number of punctures; complications were similar, however light complications are more frequent in PVA. When kept on for four to seven days, the PICC is more expensive than PVA, however it is more beneficial to the patient.
LeFlore and Engle (2007) (28)/ Level 3	Observational prospective study / 113 PICCs and 100 tunneled catheters.	Does not apply.	Described the average time of stay was higher for the second group, however, when elective causes to remove the catheter are excluded, there was a lower rate of asepsis for the patient with PICC.
Ainsworth, Clerihew and McGuire (2008) (29) / Level 1	Systematic review / 432 neonatal subjects, allocated into five RCT	Comparison of PICC to PVA regarding the nutritional intake, growth, development and complications in hospitalized neonatal subjects receiving TPN.	The use of PICC was associated to a lower deficit between the nutritional intake prescribed and the real nutrition during the period of RCT. Neonatal subjects with PICC needed a lower quantity of inserted catheters. Meta-analysis demonstrated no evidence of infection related to catheters.
Image diagnosis			
Ohki et al. (2000)(30) / Level 3	Prospective study / 57 catheters	Evaluate the ultrasonography method for confirming the catheter tips position.	There was a flaw in the identification of only six cases.
Webster et al.(2005)(31) / Level 3	Observational retrospective / 123 radiographies in 104 neonatal subjects.	Determine when the use of digital image file technology and communication systems (PACS) increased the visibility of the catheter tips location in radiographies.	Results demonstrate there were not enough benefits to indicate its use.
Pain			
Lemyre et al. (2006(32) / Level 2	Randomized clinical trial / 49 neonatal subjects	Evaluate the level of pain in the four first minutes after the puncture in neonatal subjects previously submitted to 4% gel tetracaine or placebo.	There was no significant reduction in pain related to the puncture, according to the Premature Infant Pain Profile – PIPP evaluation.
Taddio et al.(2006)(33) / Level 2	Randomized clinical trial / 132 neonatal subjects	Pain facies during the puncture was observed and skin preparation into four analgesia stages: group 1 – no analgesia; 2- 4% gel tetracaine in the insertion site;3- intravenously inserted 0.1mg/Kg morphine; and 4- associated morphine and tetracaine.	Results demonstrate: neonatal subjects from group 4 expressed fewer facial-expressions of pain when compared to group 1; facial-expressions of pain were significantly fewer in neonatal subjects in use of morphine compared to tetracaine; more effective analgesia in group 4 than in group 2; there was a slight difference between groups 3 and 4; cardiac neonatal frequency was lower in all treatment groups than in the non-treatment groups; there was no difference in the average blood pressure in the first hour after the infusion, hypotension and oxygen demand average; the average change in ventilation rates in the first 12 hours was higher in group 3 than in group 2; there is low evidence that extubation frequency or re-intubation or changes in ventilation parameters after 12 hours from the infusion were different between groups 2 and 3.
Nurses' perception			
Vendramim et al. (2007)(34) / Level 3	Descriptive / 410 nurses	Does not apply.	Non-use of PICC was perceived by 52% of nurses due to the lack of scientific--technical knowledge (83.5%); lack of catheters in the institutions (39.1%); and the lack of indication (34.8%). Only 19.9% used PICC as alternative to the venous access. The use of PICC was significantly higher in private services and in neonatal therapy. The institutions in this research demonstrated a predominance of insertion protocols use, PICC maintenance and removal. Regarding the register, 58.5% used specific instruments regarding the use of PICC. Most interviewees (94.2%) used no written informed consent. Interviewees mentioned mechanical complications in 83% and local complications in 62.1%.
Filter			
Van Lingen et al. (2004)(35) / Level 2	Randomized controlled clinical trial / 88 neonatal subjects	The use of EDL96 filter in PICC and umbilical catheters was compared to the use of non-filtered catheters.	Results demonstrate a reduction in complications as occlusions, sepsis or necrotizing enterocolitis, however, with no statistical significance. Costs regarding the control group (non-filtered) are approximately twice higher.
Hoogen et al. (2006(36) / Level 2	Randomized controlled clinical trial / 442 neonatal subjects	Filter effectiveness was verified in the distal portion of the EV administrated catheter.	There was no statistical difference regarding asepsis; no phlebitis; time consumed in the change of equipment by the nursing team was significantly higher in the control group.
Anticoagulant use			
Kamala et al. (2002(37) / Level 2	Randomized controlled clinical trial / 66 neonatal subjects	The effectiveness of the Total Parenteral Nutrition (TPN) infusion was associated to 1IUmL-1 heparin versus TPN without heparin via PICC was verified.	There was no significant difference in the occurrence of obstructions, sepsis, hypertriglyceridemia, hyperbilirubinaemia, coagulant therapy or brain intraventricular hemorrhage.
Massicotte et al. (2003)(38) / Level 2	Randomized clinical trial / 186 children	The employment of sodium reviparin as standard care for preventing thrombosis events associated to central catheters in children was compared.	The thrombosis rate was similar.
Garland et al. (2005(39) / Level 3	Randomized prospective, blind experiment comparative study / 85 neonatal subjects	Filling the catheter with 10UI/mL heparin associated to vancomycin (25ug/mL) twice a day was compared.	Results demonstrate the filling of the PICC with vancomycin-heparin by 20 or 60 minutes, twice a day, considerably reduces infections related to the catheter, when they are not associated to colonization or catheter infection by vancomycin-resistant microorganisms. There was a reduction of 41% in the infection rate and of 60% in the use of intravenous vancomycin after the adoption of this practice.
Shah et al. (2007)(40) / Level 2	Randomized controlled clinical trial / blind experiment / 201 neonatal subjects	Evaluate the 0.5U/Kg/h heparin infusion versus placebo in 201 neonatal subjects with PICCs.	Results indicated a significant increase in the permanence of the catheter in the group using heparin.
Shah and Shah (2008)(41) / Level 1	Systematic review / Two randomized clinical trials in a total of 267 neonatal subjects.	Heparin infusion or placebo during catheter insertion.	Literature was systematically reviewed to evaluate the effects of heparin infusion during catheter insertion. There was a lower incidence of catheter occlusion in the study group; however, there was no difference in the occurrence of thrombosis.
Shah and Shah (2010)(42) / Level 1	Systematic review / 287 neonatal subjects allocated into two randomized clinical trials.	The use of heparin-impregnated catheters versus non-impregnated catheters.	There was no difference in the duration of permeability in catheters, as well as to the risk of thrombosis related to the catheter. One of the RCT demonstrated a significant reduction in occlusion risks in the catheter, infection and colonization related to catheters in heparin-impregnated catheter use.

DISCUSSION

Promoting the education for professionals who insert and handle intravenous catheters is internationally recommended, since the proper level of knowledge is fundamental for working in the ICU[21]. Within this context the nurse plays the role of team educator. Moreover, knowledge regarding guidelines and competences to insert and handle catheters must be periodically evaluated, and this function can only be performed by competent professionals[43].

Regarding PICC punctures, it is indicated for patients who will stay in the hospital for periods longer than 4 days[27]. When compared to PVA in extremely low weight neonatal subjects, the PICC reduces painful procedures and extends intravenous therapy time, without the incidence of asepsis (Evidence 2)[26].

Results in studies comparing Total Parenteral Nutrition (TPN) administration through central venous and peripheral catheter, demonstrate the infusion through PICC as favorable to nutritional intake. Moreover, there is evidence relating the use of PICC to a lower number of catheters used to fulfill the therapy (Evidence 1)[29].

During the insertion, the professional must use maximum barrier precautions: mask, cap, sterilized gown, gloves and surgical drapes. For cutaneous anti-sepsis, chlorhexidin is indicated as first choice antiseptic, however, there is no evidence regarding the comparison between chlorhexidine, iodine tincture and 70% alcohol solution. The antiseptic must be thoroughly dry before the puncture. Hands hygiene must be strictly performed each time the catheter must be manipulated[43].

In neonatal subjects younger than two weeks there is no consensus regarding the first choice antiseptic, since chlorhexidine is not indicated for this population due to the cutaneous reactions it triggers (Evidence 2)[21,43].

Regarding the total catheter insertions, there is no consensus in the best site for the pediatric population (Evidence 2)[21,43]. There is evidence pointing the use of PICC on lower limbs, whenever technically viable, must be considered for the prolonged administration of TPN (Evidence 5)[17]. However, there is also evidence that central lines installed on the femoral or subclavian veins demonstrated higher incidence for thromboembolic venous events, therefore the jugular or brachial veins should be chosen (Evidence 3)[16].

When analgesia during the PICC insertion is mentioned, evidence point the topical use of 4% tetracaine within 30 minutes before the puncture demonstrated no reduction in the pain related to the procedure (Evidence 2)[32]. The associated use of morphine and tetracaine demonstrated higher performance in pain relief related to catheter progression; however, both medications were associated to complications (Evidence 2)[33].

Verifying the tip of the catheter after the insertion is recommended. Evidence that ultrasonography provides precise information about the position of the tip of the catheter regarding vascular structures and dislocation after postural changes was demonstrated, contributing for the safe positioning of the catheter (Evidence 3)[30]. The recommended positioning of the catheter tip, in order to be considered central, must be near the cardiac shape, prioritizing the cava vein[44]. The digital image files technology and communication system (PACS) present no advantages in the view of the PICC tip when compared to the standard x-ray with contrast (Evidence 3)[31].

Ostial catheter coverage requires both gauze and tape dressings and transparent polyurethane dressing; gauze is preferred in cases of exudates or excessive transpiration (Evidence 5)[21,43]. Transparent dressings change must occur every seven days, unless in pediatric patients where dislocation risks of the catheter are higher than the benefit of the dressing change (Evidence 2)[21,43]. For gauze and tape dressings, the change must be performed every two days[43].

This present study related the 70% alcohol disinfection associated to chlorhexidine impregnated dressings of weekly changes for the protection against central catheters colonization. The use of impregnated chlorhexidine dressings is recommended, however, it is recommended for adolescents and adults with CVC who will stay for longer than seven days (Evidence 2)[19]. As demonstrated by this present study the use of this technology is restricted to subjects older than two weeks, and other studies support these findings as they affirm there is no recommendation for the use in neonatal subjects younger than seven days or gestational age inferior to 26 weeks (Evidence 5)[21].

It is recommended that the device should be removed from the subjects as soon as it is no longer needed, and also the daily evaluation of the insertion site, in order to monitor phlogiston signals (Evidence 5)[21,43]. There is no recommendation of prophylactic systemic antibiotics before the insertion or even while the catheter stay[43]. Moreover, topical administration of antibiotic ointments is not indicated due to their micro biotic and fungi infection resistance potential (Evidence 5)[21,43]. A study recommends the use of vancomycin solution associated to heparin (25µ/mL) twice a day in order to fill the catheter (Evidence 3)[39].

Regarding the use of antiseptic impregnated catheters or covered by antibiotics, it is recommended only for adults in institutions where the infection rates have been reduced due to broadly employed preventive measures. In addition, its use is recommended for patients who are expected to stay with the catheter longer than five days. There is no recommendation for the pediatric population (Evidence 5)[21,43].

Regarding connections, they are not to be submersed; therefore, during the bath both the catheter and all its

connections must be protected. The non-needle system must be substituted within the same frequency as the equipment and occlusion agents must be substituted every 72 hours or according to the manufacturer's guidelines (Evidence 5)[21,43].

Equipment used for lipid emulsions, blood or blood components infusions must be substituted every 24 hours; in case of propofol administration, the equipment must be changed between 6 to 12 hours of use. Parenteral solutions must be prepared in pharmacies under a laminar flow. In parenteral solutions cases of continuous infusion, the equipment may be changed after 72 to 96 hours, when associated to anti-microbial catheters, after seven days of use. There is no recommendation for the change of equipment used for intermittent infusions[43].

A study related the use of an intravenous filter with the higher durability of equipment and the reduction of nursing time and costs, however, it presented no reduction in the infection rates (Evidence 2)[36].

Regarding CVC and PICC, on the opposite of peripheral catheters, the routine change is not advised in order to prevent infections. The catheter is advised to be changed when there is purulent exsudate in the ostial catheter exit, as well as hyperthermia in cases of suspecting infections related to the catheter (Evidence 5)[21,43].

In case of infections related to the catheter caused by enterobacteria, there is evidence of success (45%) when the catheter was kept, however there was no success in maintaining the catheter in patients with infections lasting more than two days. Infections caused by enterobacteria associated to severe thrombocytopenia are rarely solved, unless the catheter is removed (Evidence 3)[22].

Monitoring these infections is stated as crucial and must be constant, both by regular evaluations of the insertion sites and by the institutional control of infection rates related to catheters, which must be expressed as infection rates related to central venous catheter by one thousand days with the catheter (Evidence 5)[21]. A Study pointed out the team's motivation as being connected to the reduction in infection rates related to catheters (Evidence 3)[23].

Heparin infusion demonstrated to linger PICC permeability time, with no additional adverse events (Evidence 2)[40]. Adding this anticoagulant to the total parenteral nutrition, however, showed no reduction in PICC obstruction incidence (Evidence 2)[37]. A systematic review was not able to determine the effectiveness of the heparin impregnated catheter regarding durability, thrombosis, occlusion, sepsis and other adverse effects, due to the lack of studies (Evidence 1)[42]. The prophylactic use of heparin allowed for most neonatal subjects with PICC to complete their treatment, due to a reduction in occlusion rates. Evidence supports the use of heparin in PICC for neonatal subjects within a 0.5UI/Kg/hr dose (Evidence 1)[42].

Although the use of anticoagulants was verified as a reducing agent in thrombosis risks related to central venous catheters (CVC), the use of prophylactic anticoagulants represented no significant reduction in infection rates of the blood stream related to catheters, therefore it is not recommended for routine use in order to prevent infections[43].

CONCLUSION

The care to neonatal subjects must be supported on reliable evidence in order to reestablish their health condition in the shortest period possible. Hospital complications as blood stream infections related to catheters and many others related to intravenous devices must be minimized in a way to offer neonatal patients and their families a less traumatic hospital stay, free of malpractices.

In face of this evidence-based practice, professional updating is considered mandatory; however, ways to facilitate information to nurses and their teams must be created. Evidence must be available in clear and concise language in a way to optimize research time.

The evidence presented in this review is, mostly, from international sources, a fact that points out the need for developing national nursing clinical studies with a view to evaluate and create technologies related to the working process.

REFERENCES

1. Schell HM, Puntillo KA. Segredos em enfermagem na terapia intensiva: respostas necessárias ao dia-a-dia nas Unidades de Terapia Intensiva. Porto Alegre: Artmed; 2005.

2. Tamez RN, Silva MJP. Enfermagem na UTI neonatal: assistência ao recém-nascido de alto risco. 2ª ed. Rio de Janeiro: Guanabara-Koogan; 2002.

3. Jesus VC, Secoli SR. Complicações acerca do cateter venoso central de inserção periférica (PICC). Ciênc Cuidado Saúde. 2007;6(2):252-60.

4. Vasconcelos PCO, Silva GRG, Silva GEM. Acesso venoso em neonatologia: cateterismo epicutâneo. In: Silva GRG, Nogueira MFH, editores. Terapia intravenosa em recém-nascidos: orientações para o cuidado de enfermagem. Rio de Janeiro: Cultura Médica; 2004. p. 23-36.

5. Phillips LD. Manual de terapia intravenosa. 2ª ed. Porto Alegre: Artmed; 2001.

6. Bork AMT. Enfermagem baseada em evidências. Rio de Janeiro: Guanabara-Koogan; 2005.

7. Lacerda RA, Nunes BK, Batista AO, Egry EY, Graziano KU, Angelo M, et al. Evidence-based practices published in Brazil: identification and analysis of their types and methodological approaches. Rev Esc Enferm USP [Internet]. 2011 [cited 2011 July 25];45(3):777-86. Available from: http://www.scielo.br/pdf/reeusp/v45n3/en_v45n3a33.pdf

8. Pedrolo E, Danski MTR, Mingorance P, de Lazzari LSM, Meier MJ, Croseta K. A prática baseada em evidências como ferramenta para prática profissional do enfermeiro. Cogitare Enferm. 2009;14(4):760-3.

9. Mendes KDS, Silveira RCCP, Galvão CM. Revisão integrativa: método de pesquisa para a incorporação de evidências na saúde e na enfermagem. Texto Contexto Enferm. 2008;17(4):758-64.

10. Ganong LH. Integrative reviews of nursing research. Res Nurs Health. 1987;10(1):1-11.

11. Ursi ES. Prevenção de lesões de pele no perioperatório: revisão integrativa da literatura [dissertação]. Ribeirão Preto: Escola de Enfermagem de Ribeirão Preto, Universidade de São Paulo; 2005.

12. Hulley SB, Cummings SR, Browner WS, Grady DG, Newman TB. Delineando a pesquisa clínica: uma abordagem epidemiológica. 3ª ed. Porto Alegre: Artmed; 2008.

13. Cruz DALM, Pimenta CAM. Prática baseada em evidências, aplicada ao raciocínio diagnóstico. Rev Latino Am Enferm. 2005;13(3):415-22.

14. Bandolier. Evidence based thinking about health care. Assessment criteria [Internet]. Oxford; 2007 [cited 2008 May 1]. Available from: http://www.medicine.ox.ac.uk/bandolier/band6/b6-5.html

15. Liossis G, Bardin C, Papageorgiou A. Comparasion of risks from percutaneous central venous catheters and peripheral lines in infants of extremely low birth weight: a cohort controlled study of infants < 1000 g. J Matern Fetal Neonatal Med. 2003;13(3):171-4.

16. Male C, Julian JA, Massicotte P, Gent M, Mitchell L; PROTEKT Study Group. Significant association with location of central venous line placement and risk of venous thrombosis in children. Thromb Haemost. 2005;94(3):516-21.

17. Hoang V, Sills J, Chandler M, Busalani E, Clifton-Koeppel R, Modanlou HD. Percutaneously inserted central catheter for total parenteral nutrition in neonates: complications rates related to upper versus lower extremity insertion. Pediatrics. 2008;121(5):e1152-9.

18. Winkle PV, Whiffen T, Liu IA. Experience using peripherally inserted central venous catheters for outpatient parenteral antibiotic therapy in children at a community hospital. Pediatr Infect Disease J. 2008;27(12):1069-72.

19. Garland JS, Alex CP, Mueller CD, Otten D, Shivpuri C, Harris MC, et al. A randomized trial comparing povidone-iodine to a chlorhexidine gluconate-impregnated dressing for prevention of central venous catheter infections in neonates. Pediatrics. 2001;107(6):1431-6.

20. Foo R, Fujii A, Harris JA, Lamorte W, Moulton S. Complications in tunneled CVL versus PICC lines in very low birth weight infants. J Perinatol. 2001;21(8):525-30.

21. Garland JS, Henrickson K, Maki DG. The 2002 Hospital Infection Control Practices Advisory Committee Centers for Disease Control and Prevention guideline for prevention of intravascular device-related infection. Pediatrics. 2002;110(5):1009-13.

22. Nazemi KJ, Buescher S, Kelly RE, Karlowicz G. Central venous catheter removal versus in situ treatment in neonates with enterobacteriaceae bacteremia. Pediatrics. 2003;111(3):e269-74.

23. Aly H, Herson V, Duncan A, Herr J, Bender J, Patel K, et al. Is Bloodstream infection preventable among premature infants? A tale of two cities. Pediatrics. 2005;115(6): 1513-8.

24. Capretti MG, Sandri F, Tridapalli E, Galletti S, Petracci E, Faldella G. Impact of a standardiezed hand hygiene program on the incidence of nosocomial infection in very low birth weight infants. Am J Infect Control. 2008;36(6):430-5.

25. Schulman J, Stricof RL, Stevens TP, Holzman IR, Shields EP, Angert RM, et al. Development of a statewide collaborative to decrease NICU central line-associated bloodstream infections. J Perinatol. 2009;29(9):591-9.

26. Janes M, Kalyn A, Pinelli J, Paes B. A randomized trial comparing peripherally inserted central venous catheters and peripheral intravenous catheters in infants with very low birth weigth. J Ped Surg. 2000;35(7):1040-44.

27. Schwengel DA, McGready J, Berenholtz SM, Koslowski LJ, Nichols DG, Yaster M. Peripherally inserted central catheters: a randomized, controlled, prospective trial in pediatric surgical patients. Anesth Analg. 2004;99(4):1038-43.

28. LeFlore JL, Engle WD. Comparison of nonelective removal of percutaneously versus surgically placed central venous catheters in high-risk neonates. J Am Acad Nurse Pract. 2007;19(3):111-5.

29. Ainsworth S, Clerihew L, McGuire W. Percutaneous central venous catheters versus peripheral cannulae for delivery of parenteral nutrition in neonates. Cochrane Database Syst Rev. 2007;(3):CD004219

30. Ohki Y, Tabata M, Kuwashima M, Takeuchi H, Nako Y, Morikawa A. Ultrasonographic detection of very thin percutaneous central venous catheter in neonates. Acta Paediatr. 2000;89(11):1381-4.

31. Webster NJ, Page B, Kuschel CA, Battin MR. Digital imaging does not improve localization of percutaneously inserted central line in neonates. J Paediatr Child Health. 2005;41(5-6):256-9.

32. Lemyre B, Sherlock R, Hogan D, Gaboury I, Blanchard C, Moher D. How effective is tetracaine 4% gel, before a peripherally inserted central catheter, in reducing procedural pain in infants: a randomized double-bind placebo controlled trial. BMC Med. 2006;4:11.

33. Taddio A, Lee C, Yip A, Parvez B, McNamara PJ, Shah V. Intravenous morphine and topical tetracaine for treatment of pain in preterm neonates undergoing central line placement. JAMA. 2006;295(7):793-800.

34. Vendramim P, Pereira MLG, Peterlini MAS. Cateteres centrais de inserção periférica em crianças de hospitais do município de São Paulo. Rev Gaucha Enferm. 2007;28(3):331-9.

35. Van Lingen RA, Baerts W, Marquering ACM, Ruijs GJHM. The use of in-line intravenous filters in sick newborn infants. Acta Paediatr. 2004;93(5):658-62.

36. Van den Hoogen A, Krediet TG, Uiterwall CSPM, Bolenius JFGA, Gerards LJ, Fleer A. In-line filters in central venous catheters in a neonatal intensive care unit. J Perinat Med. 2006;34(1):71-4.

37. Kamala F, Boo NY, Cheah FC, Birinder K. Randomized controlled trial of heparin for prevention of blockage of peripherally inserted central catheters in neonates. Acta Paediatr. 2002;91(12):1350-6.

38. Massicotte P, Julian JA, Gent M, Shields K, Marzinotto V, Szechtman B, et al. An open-label randomized controlled trial of low molecular weight heparin for the prevention of central venous line-related thrombotic complications in children: the PROTEKT trial. Thromb Res. 2003;109(2-3):101-8.

39. Garland JS, Alex CP, Henrickson KJ, Mcauliffe TL, Maki DG. A vancomycin-heparin lock solution for prevention of nosocomial bloodstream infection in critically ill neonates with peripherally inserted central venous catheters: a prospective, randomized trial. Pediatrics. 2005;116(2):198-205.

40. Shah OS, Kalyn A, Satodia P, Dunn MS, Parvez B, Daneman A, et al. A randomized controlled trial of heparin versus placebo infusion to prolong the usability of peripherally placed percutaneous central venous catheters (PCVCs) in neonates: the HIP (Heparin Infusion for PCVC) Study. Pediatrics. 2007;119(1):e284-91.

41. Shah PS, Shah VS. Continuous heparin infusion to prevent thrombosis and catheter occlusion in neonates with peripherally placed percutaneus central venous catheters. Cochrane Database Syst Rev. 2008;(2):CD002772.

42. Shah PS, Shah N. Heparin-bonded catheters for prolonging the patency of central venous catheters in children. Cochrane Database Syst Rev. 2007;(4):CD005983.

43. O'Grady NP, Alexander M, Burns LA, Dellinger P, Garland J, Heard SO, et al.; Center of Disease Control and Prevention (CDC). 2011 Guidelines for the Prevention of Intravascular Catheter Related Infections: related infections [Internet]. Atlanta; 2011 [cited 2011 Apr 14]. Available from: http://www.cdc.gov/hicpac/pdf/guidelines/bsi-guidelines-2011.pdf

44. Camargo PP, Kimura AF, Toma E, Tsunechiro MA. Initial placement of the peripherally inserted central catheter's tip in neonates. Rev Esc Enferm USP [Internet]. 2008 [cited 2011 Apr 14];42(4):723-8. Available from: http://www.scielo.br/pdf/reeusp/v42n4/en_v42n4a14.pdf

Correspondence addressed to: Derdried Athanasio Johann
Av. Lothário Meissner, 632 – Jardim Botânico
CEP 80210-170 – Curitiba, PR, Brazil