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KNOWLEDGE AND PRACTICE ON THE TECHNIQUES FOR THE INSERTION OF PERIPHERALLY INSERTED CENTRAL CATHETER

Conhecimento e práticas sobre as técnicas de inserção do cateter central de inserção periférica

Conocimientos y prácticas sobre las técnicas de inserción del catéter central de inserción periférica

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RESUMO

Objetivo: avaliar o conhecimento e as práticas dos enfermeiros sobre as técnicas de inserção do cateter central de inserção periférica. **Método**: estudo descritivo quantitativo, do tipo levantamento (Survey), com 32 enfermeiros habilitados para inserção do cateter central de inserção periférica. A coleta de dados foi realizada pelo RedCap, incluindo variáveis como dados dos participantes, características do enfermeiro e da instituição, e avaliações pré e durante a inserção do cateter central de inserção periférica. **Resultado**: as práticas e o conhecimento dos enfermeiros na pré-inserção e inserção do cateter central de inserção periférica são variados, destacando-se que 57,1% utilizam ultrassom. **Conclusão**: o estudo evidenciou um conhecimento deficiente sobre as técnicas de inserção do cateter central de inserção periférica e mostrou que algumas práticas clínicas não estão em conformidade com os guidelines de terapia infusional reconhecidos mundialmente.

DESCRITORES: Cateterismo periférico; Enfermeiros; Conhecimento.

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ABSTRACT

Objective: to assess nurses' knowledge and practice on the techniques for the insertion of peripherally inserted central catheter. **Method:** this was a quantitative descriptive study, of the survey type, with 32 nurses who were qualified in the insertion of peripherally inserted central catheters. Data collection was conducted using RedCap including variables such as participant data, nurse and institution characteristics, and assessments before and during peripheral central catheter insertion. **Results:** nurses' practice and knowledge of pre-insertion and insertion of the peripherally inserted central catheter varied widely. In particular, 57.1% of nurses use ultrasound. **Conclusion:** insufficient knowledge regarding the insertion techniques of peripherally inserted central catheters was evident and it was demonstrated that some clinical practices do not comply with globally accepted infusion therapy guidelines.

DESCRIPTORS: Catheterization, peripheral; Nurses; Knowledge.

RESUMEN

Objetivo: evaluar el conocimiento y las prácticas de los enfermeros sobre las técnicas de inserción del catéter central de inserción periférica. **Método:** estudio descriptivo cuantitativo, tipo encuesta, con 32 enfermeros habilitados para la inserción del catéter central de inserción periférica. La recolección de datos se realizó a través de RedCap, incluyendo datos de los participantes, características del enfermero y de la institución, y evaluaciones pre-inserción y en el momento de la inserción del catéter central de inserción periférica. **Resultados:** las prácticas y el conocimiento de los enfermeros en la pre-inserción e inserción del PICC son variados, destacándose que el 57,1% utiliza ultrasonido. **Conclusión:** se evidenció un conocimiento deficiente respecto a las técnicas de inserción del catéter central de inserción periférica y se demostró que algunas prácticas clínicas no están en conformidad con las guías de terapia de infusión reconocidas mundialmente.

DESCRIPTORES: Cateterismo Periférico; Enfermeros; Conocimiento.

INTRODUCTION

Peripherally inserted central catheters (PICCs) are considered medium- to long-term, non-tunneled vascular access devices used for the administration of continuous or intermittent intravenous therapy.[1-2]

They are typically inserted into an upper extremity vein by percutaneous puncture of a superficial or deep peripheral vein until they reach the central position in the lower third of the superior vena cava or at the atrioventricular junction.[1,3]

The PICC offers many advantages over other central access devices, including lower cost, lower infection rates, lower risk of pneumothorax and hemothorax, less pain during insertion, greater patient comfort, can be inserted at the point-of-care or in the outpatient setting, and even makes it possible for the patient to be discharged with the catheter.[1,4]

The insertion and use of vascular access devices can cause complications such as phlebitis, infiltration, extravasation, nerve injury, occlusion, blood infection, air embolism, deep vein thrombosis, malposition, and skin breakdown[1]. Nurses must be aware of the signs of these complications, apply appropriate interventions, and perform insertion using a technique based on scientific evidence and practical protocols[1].

However, studies have shown that only a small proportion of institutions have PICC insertion protocols in place, and that nurses' knowledge of complications is inadequate.[5-6] A study assessing nurses' attitudes and knowledge about PICC maintenance showed an unsatisfactory level of knowledge for most items[7]. Brazilian studies describe nurses' lack of knowledge about measuring the size of the catheter and assessing the position of the catheter tip.[8-9]

PICC insertion requires technical competence and clinical judgment for safe decision-making. However, little is known in Brazil about the experience, practice, and knowledge of nurses who insert patients' vascular access devices. This knowledge gap is scientifically relevant because it directly affects patient safety and clinical outcomes. In light of the above, this study aimed to evaluate the knowledge and practices of nurses regarding PICC insertion techniques.

METHOD

This is a quantitative descriptive study, of survey type, carried out in a tertiary level university hospital, whose target population is highly complex patients, located in the interior of the State of São Paulo.

The study population consisted of 32 nurses qualified to insert the PICC, working in inpatient wards and adult and pediatric intensive care units (ICU). Nurses who had completed a qualification course in PICC insertion and who returned the data collection tool within the specified time were included. Those who had worked at

the institution for less than three months, who were on vacation, or who were on any type of leave were excluded.

A data collection form was developed with the following information: participant data, characteristics of the nurse inserting the PICC, characteristics of the institution, pre-insertion assessment of the PICC, and assessment at the time of insertion. The process of constructing and validating the form was described by Guimarães et al., 2022.[10]

The data collection form was developed on the virtual platform REDCap® (Research Electronic Data Capture) and can be consulted at the link https://redcap.link/j5r3ajz5 and was applied online from October to December 2022.

*By clicking on the link, the professional first had access to the virtual ICF with clarifications about the research, in addition to the request for authorization to use the data, at the end of which there were the options "I accept to participate in the research" and "I do not accept to participate in the research"; if accepted, the participant would be directed to the data collection form. If not accept, the participant would receive a thank you message that en*ded the process.

*At the end of the survey period, data were exported to the Statistical Package of Social Science (SPSS) software, version 28.0 for Windows. Descriptive analysis was performed using simple frequencies for categorical variables and central tendency (median) and dispersion (minimum and maximum values) for numer*ical variables.

*The project was approved by the Research Ethics Committee of the University of São Paulo, Ribeirão Preto School of Nursing (CEP-EERP-USP), with the consent of the co-participating institution. It was registered under approval opinio*n No. 5.694.859.

RESULTS

There was the participation of 14 nurses, 10 (71.4%) female and four (28.6%) males, aged between 24 and 59 years, with a median age of 43 years.

Table 1 shows the professional characteristics and profile of the participants using PICC.

Table 1 - Professional characteristics and profile of the participants who insert the PICC. Ribeirão Preto, 2023.

Variables	N (%)
Job Title	
Clinical Nurse	10 (71,4)
Nurse in charge	4 (28,6)
Education Level	
No additional training	5 (35,7)
Specialization	7 (50)
Master's degree	2 (14,3)
Workplace	
Intensive Care	7 (50)
Pediatrics	2 (14,3)
Medical Hospitalization	2 (14,3)
Other	3 (21,4)
Time working in the nursing field	
From 0 to 5 years	2 (14,3)
From 5 to 10 years	2 (14,3)
From 10 or more years	10 (71,4)
Workplace provides adequate catheter training	
No	12 (85,7)
Yes	2 (14,3)
Workplace provides free time for catheterization training	
No	11 (78,6)
Yes	3 (21,4)

Variables	N (%)
Performs PICC insertion in the institution	
Yes	11 (78,6)
No	3 (21,4)
Time inserting PICC	
From 0 to 5 years	6 (42,85)
From 5 to 10 years	2 (14,3)
From 10 to more years	6 (42,85)
Approximate number of PICCs you have inserted in the career	
From 0 to 5	4 (28,6)
From 5 to 10	3 (21,4)
From 10 to 20	1 (7,1)
From 20 to more	6 (42,9)
Completion of a refresher course on PICCs	
Not taken	12 (85,7)
Once every 6 months	2 (14,3)

Source: The Author.

Regarding the institution's characteristics related to the use of the PICC, 13 (92.9%) reported that the institution did not have a vascular access team. Regarding the presence of ultrasound to guide the insertion of the PICC, 10 (71.4%) said that the device was available in the institution, four (28.6%) participants responded that the institution did not have an electrocardiographic guide to verify the tip to insert the PICC. Finally, five (35.7%) responded that the institution did not have a protocol for PICC insertion.

Table 2 shows the characteristics of the PICC qualification course attended by the participants and Table 3 discusses the evaluation of the practice and knowledge before the insertion of the PICC, for the variable "criteria considered for the indication of the PICC" the participant could mark one item.

Table 2 - Characteristics of the PICC qualification course taken by the participants, Ribeirão Preto, 2023.

Variables	N (%)	Median
Type of course taken		
One to two days of classroom instruction and insertion on adult and pediatric manikins	11(78,6)	
One to two days of classroom instruction, adult and pediatric manikin insertion, and patient insertion under the supervision of an experienced professional	1 (7,1)	
One to two days of online classroom instruction, with in-person insertion training	2 (14,3)	
Minimum number of successful supervised course insertions required before autonomous insertion		
No minimum number of insertions required	6 (42,9)	
1 to 2 insertions	6 (42,9)	
3 insertions	2 (14,3)	

Variables	N (%)	Median
Course Workload		
Hours		20 hours
Did the course include ultrasound training		
Yes	7 (50)	
No	7 (50)	
Course included PICC placement and stabilization training		
Yes	14 (100)	
Course included training on how to perform the subcutaneous anesthetic button		
Yes	6 (42,9)	
No	8 (57,1)	
Course included training on PICC removal		
Yes	12 (85,7)	
No	2 (14,3)	

Source: The Author.

Table 3 - Evaluation of participants' practice and knowledge of PICC pre-insertion. Ribeirão Preto - 2023

Variables	N (%)
Pre-insertion assessment **Indication criteria considered for PICC indication**	
Intravenous therapy for more than 6 days	12 (85,7)
Prescription of inappropriate infusion therapy for peripheral venous network (electrolytes, vesicants and irritants, vasoactive drugs, parenteral nutrition)	10 (71,4)
Patients with impaired peripheral venous network (difficulty with venous access)	9 (64,3)
Chemotherapy	5 (35,7)
Clinical instability of the patient requiring multiple infusions	3 (21,4)
Patients in whom insertion of a catheter into the neck or chest increases the risk of complications, such as patients with respiratory problems on mechanical ventilation and/or tracheostomy	3 (21,4)
Patients with coagulopathies	2 (14,3)
Use in burn patients	1 (7,1)
Use of ultrasound to find a suitable vein prior to PICC insertion	
Yes	8 (57,1)
No	6 (42,9)
Patient history evaluation prior to insertion:	
Yes, I evaluate patient history and use ultrasound	9 (64,3)
I evaluate the patient's history and don't use ultrasound	4 (28,6)
I do not evaluate the patient's history and do not use ultrasound	1 (7,1)

Variables	N (%)
Use of ultrasound to evaluate the anatomy of the entire vessel and identify abnormalities:	
Yes	8 (57,1)
I never use ultrasound	6 (42,9)
Choice of PICC size:	
Less than 45% of vein diameter	7 (63,6)
Same vein diameter	2 (18,2)
Don't know the answer	2 (18,2)
After vein selection, what measurement is used to determine catheter size:	
Puncture site to the right clavicle-sternal junction and from there to the third intercostal space	11(76,6)
Puncture site to the left clavicle-sternal junction and from there to the third intercostal space	2(14,3)
Don't know the answer	1 (7,1)
First Choice Vase:	
Basilic vein	8 (57,1)
Cephalic vein	3 (21,4)
Brachial vein	3 (21,4)
Have you ever inserted a PICC into the jugular vein	
Only once	6 (42,9)
More than 5 times	3 (21,4)
Never	3 (21,4)
More than 20 times	2 (14,3)
Insertion site used for most procedures	
1/3 above the flexion region of the arm	11 (78,6)
1/3 below the flexion region of the arm	2 (14,3)
In the area of the flexion region of the arm	1(7,1)
A stable patient diagnosed with a urinary tract infection has been prescribed prolonged intravenous antibiotic therapy, which is your first choice regarding the number of lumens of the PICC:	
Single lumen	13(92,9)
Double lumen	1(7,1)
The most common number of lumens used in practice:	
Single lumen	10(71,4)
Double lumen	4(28,6)
When inserting the catheter into the upper limb, is it possible to avoid the side where the patient has a subclavian puncture, jugular vein or pacemaker:	
Yes	10(71,4)
No	2(14,3)

Variables	N (%)
I don't know how to answer	2(14,3)
Evaluation of the history of chronic kidney disease and the possibility of future hemodialysis:	
No	12(85,7)
Yes	2(14,3)
Have you ever inserted a PICC line in a patient on any form of dialysis:	
No	10(71,4)
Yes	4(28,6)
Have you discussed nephrology placement or approval prior to PICC insertion in dialysis patients:	
No	14(100)

Source: The Author.

Table 4 discusses the assessment of practice and knowledge of PICC insertion, for the variable "security device used to provide stability to the catheter" the participant could mark one item.

Table 4 - Evaluation of participants' practice and knowledge on PICC insertion. Ribeirão Preto, 2022

Variables	N (%)
Assessment at the time of insertion How the hygiene of the hands is performed before the procedure:	
Water and 2% chlorhexidine	12(85,7)
Surgical brushing of hands with a brush containing 2% chlorhexidine	2 (14,3)
Use of maximum precautionary barrier for PICC insertion (use of cap, mask, sterile glove, sterile apron, sterile drape):	
Yes	14 (100)
Use of protective goggles during procedure:	
Yes	9 (64,3)
No	5 (35,7)
Perform skin antisepsis at insertion site prior to applying surgical drapes:	
Chlorhexidine antiseptic at 2%, followed by alcoholic chlorhexidine at 0.5%	14 (100)
Documentation of ultrasound-guided catheter-to-vein relationship in PICC insertion note	
Does not perform documentation	6 (42,9)
Does not use ultrasound	7 (50)
Yes, but I don't use images for documentation	1 (7,1)

Variables	N (%)
Use of clear sterile cover to protect probe from ultrasound:	
Yes	9 (64,3)
Do not use ultrasound	5 (35,7)
Use sterile gel for ultrasound:	
Yes	9 (64,3)
Do not use ultrasound	5 (35,7)
Disinfect ultrasound device before procedure:	
Yes	7 (50)
No	2 (14,3)
Do not use ultrasound	5 (35,7)
Disinfect ultrasound device after procedure:	
Yes	9 (64,3)
Do not use ultrasound	5 (35,7)
Use of an electrocardiographic guide for PICC insertion:	
Does not use electrocardiographic guide for insertion	9 (64,3)
Don't know what an electrocardiographic guide is	3 (21,4)
Use of EKG or defibrillator with sterile wires	1 (7,1)
Yes, other high-end confirmatory system	1 (7,1)
Evaluate arrhythmia history if using an electrocardiographic guide for PICC insertion:	
Does not use electrocardiographic guide for insertion	10 (71,4)
Yes	3 (21,4)
No	1 (7,1)
Documentation of the patient's electrocardiographic tracing during the procedure, if an electrocardiographic guide is used for PICC insertion:	
Does not use electrocardiographic guide for insertion	11 (78,4)
Do not document	2 (14,3)
I don't use images for documentation	1 (7,1)
Technique used for insertion most of the time:	
Direct puncture (needle introducer that "peels/breaks" - peel-away technique)	11 (78,6)
Modified Seldinger technique (puncture the vessel with a long needle, insert a flexible guidewire, withdraw the needle and position the dilator where the catheter will be inserted)	3 (21,4)
Use of local anesthetic or anesthetic button during puncture:	
Yes	7 (50)
No	7 (50)
Institution has a protocol for the administration of the subcutaneous anesthetic button:	
No	11 (78,6)
Yes	3 (21,4)

Variables	N (%)
Ideal catheter tip location (catheters inserted in upper extremities):	
At the atrioventricular junction	9 (64,3)
In the right atrium	4 (28,6)
In the right ventricle	1 (7,1)
X-ray request is made by:	
A professional physician	13 (92,9)
The nurse who inserts the PICC	1 (7,1)
Verification of the position of the PICC tip on the x-ray is done by:	
The nurse who inserts the PICC and a professional physician	10 (71,4)
The nurse who inserts the PICC	1 (7,1)
A professional physician	3 (21,4)
Existence of a radiographic follow-up protocol for catheter tip evaluation:	
No	10 (71,4)
Yes	4(28,6)
If the catheter cannot be advanced to the superior vena cava, it is acceptable to leave it in the brachiocephalic or subclavian vein:	
Yes	10 (71,4)
No	4 (28,6)
Performing intravenous infusion at the PICC before confirming correct tip location:	
Never	12 (85,7)
Sometimes	1 (7,1)
Most of the times	1 (7,1)
Final sterile dressing is performed before confirmatory radiograph:	
Yes	11 (78,6)
No	3 (21,4)
Dressing material used after insertion: Dressing used to cover the PICC for the first 24 hours:	
Clear polyurethane dressing	6 (42,9)
Gauze and microporous tape	7 (50)
Gauze and clear polyurethane dressing	1 (7,1)
Safety device used to provide stability to the catheter:	
Suture	9 (64,3)
Adhesive fixation device integrated into dressing (fixation device that adheres to the skin integrated into the dressing)	5 (35,7)
Sterile Peripheral Catheter Fixation Device iv-fix™	5 (35,7)
Adhesive fixation device (fixation device that adheres to the skin and is separate from the dressing)	4 (28,6)

Source: The Author.

DISCUSSION

Members of the healthcare team work together to achieve the universal goal of safe, effective and appropriate infusion therapy. Specialized education and training must be promoted in healthcare settings, with a specific focus on vascular access devices.[1]

The lack of ongoing evidence-based education and skill development for nurses at all levels contributes to vascular device failure and high complication rates. Studies demonstrate the importance of ongoing assessment of competency in the insertion of these devices. Experienced nurses may not recognize the need to update their knowledge and skills to correct errors and improve techniques.[11-12]

The positive outcomes associated with specialized training for personnel who insert and manage PICCs have been reported in the literature.[13-14] The Centers for Disease Control and Prevention (CDC)[15] recommends that healthcare professionals be educated about the indications for use of vascular access devices, appropriate procedures for insertion, and maintenance of vascular access devices. They also recommend that only trained and competent personnel perform insertion and maintenance of vascular access devices.[16]

It can be observed that complications related to the PICC are frequently described in the literature, and the insertion techniques and the qualification of the professional performing the insertion of the PICC are mainly responsible for their occurrence, often resulting in the need for early removal of the device.[13-14]

Indications for the use of the PICC include: patients with clinical instability; complex intravenous infusions; invasive hemodynamic monitoring; continuous intravenous therapy inappropriate for peripheral infusion (vesicant medications, chemotherapy, antibiotics, parenteral nutrition, vasoactive drugs, electrolytes); frequent and prolonged intravenous therapy (more than 6 days), especially with limited veins; coagulopathies; respiratory problems with mechanical ventilation or tracheostomy; and burn patients.[1,17] This study shows that nurses consider these indications when using the PICC.

The use of ultrasound during vascular device insertion is recommended to improve success rates and reduce punctures and complications. Ultrasound can identify vascular anomalies, vessel diameter, depth, and trajectory; assess surrounding anatomy to avoid puncturing nerves and arteries; locate the best puncture site; and facilitate difficult venous access.[1,17]

When using vascular visualization technology, such as ultrasound, in the insertion of vascular access devices, it is important to evaluate and document the professional's competency in the use of this technology.[1,17]

The use of the ECG-guided PICC insertion technique is beneficial to the patient because it eliminates radiation exposure from radiography to confirm the location of the device. In this study, nine nurses use ultrasound to locate a suitable vein prior to PICC insertion and to evaluate the anatomy of the entire vessel and identify abnormalities.

It is recommended that the patient's medical history be reviewed to identify conditions affecting the peripheral vasculature that may require visualization technology to locate venous or arterial insertion sites. Factors that may make it difficult to locate veins include: medical conditions such as diabetes and hypertension; history of frequent venipuncture or prolonged infusion; skin variations (darker tones, hair excess); scars or tattoos; age (neonates and the elderly); obesity; and fluid volume deficit.[1,17]

Assessment of vascular anatomy with ultrasound prior to insertion is essential to identify vascular anomalies and estimate vessel diameter. The choice of vessel for cannulation should be based on size, shape, depth, flow and permeability, and avoidance of nearby structures such as nerves and arteries. It is also important to measure the catheter-to-vessel ratio and ensure that it is less than 45% before inserting the PICC into the upper extremity.[1,17-18]

When using ultrasound, it is recommended that the gel be sterile, preferably single-use, and that a transparent and sterile probe cover be used, in addition to disinfecting the device before and after each use to reduce the risk of ultrasound probe contamination and subsequent risk of infection.[1,17]

The right upper extremity basilic vein is recommended as the first option for PICC insertion due to the smaller number of valves and lower risk of complications. The practitioner should choose the palpable vein with the largest caliber and straightest path, where they feel safest. It starts with the longest vein and continues through the others according to the catheter. The arm circumference is measured and the length of the catheter is determined by an external measurement from the insertion site to the third intercostal space.[1,17] In the study, 57.1% of participants preferred the basilic vein as their first choice.

CONCLUSION

The results of this study demonstrate a lack of knowledge about PICC insertion techniques and show that some clinical practices are not in line with what is recommended by globally accepted infusion therapy guidelines. Improving insertion techniques is essential to reduce complications and ensure the safety and efficacy of this device in the therapies and treatments in which it can be used. Therefore, it is necessary to continually educate and update nurses on the procedure and technologies available for PICC insertion.

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