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RESEARCH

Nursing care in the maintenance of the central venous catheter in pediatric intensive therapy

Cuidado de enfermería en el mantenimiento del catéter venoso central en la terapia intensiva pediátrica

Cuidados de enfermagem na manutenção do cateter venoso central em terapia intensiva pediátrica

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Abstract

Introduction: Central venous catheter maintenance in pediatric intensive therapy patients, is a critical procedure to prevent infections and associated complications. The nurse provides the care and oversees its management. However, the implementation of nursing care in its maintenance can be disrupted by obstacles that are present in the working day such as lack of knowledge or excessive workload. **Objective:** To evaluate nursing care in central venous catheter maintenance in pediatric intensive therapy patients in a third-level hospital. **Methodology:** The methodology used in this study was a quantitative, descriptive, observational and cross-sectional design in a sample of 20 critical care nurses who provided care to patients in pediatric intensive therapy. Incomplete surveys were excluded. Participants agreed to take part in the study and signed an informed consent form. A central venous catheter maintenance checklist was used. Central tendency measures, frequencies and percentages were calculated in the statistical analysis. **Results:** All participants performed hand hygiene, 95% correctly identified the patient and disinfected ports and connections before handling, 85 % verified the permeability of the venous catheter, and 80% changed solutions and equipment according to proper standards. Overall compliance was 94%. **Conclusions**: Nursing personnel provided appropriate care; however, areas of opportunity to improve central venous catheter care were identified such as hand washing and regulatory training.

Key words: Intensive care; Nursing; Catheter (DeCS).

Resumen

Introducción: El mantenimiento del catéter venoso central en pacientes de terapia intensiva pediátrica, es una práctica crítica para prevenir infecciones y complicaciones asociadas. La enfermera proporciona el cuidado y supervisa el manejo de este. Sin embargo, la implementación del cuidado de enfermería en su mantenimiento puede verse alterado por barreras presentes en la jornada laboral como la falta de conocimiento o la carga de trabajo. **Objetivo:** Evaluar el cuidado de enfermería en el mantenimiento del catéter venoso central en pacientes de la terapia intensiva pediátrica en un hospital de tercer nivel. **Metodología:** Diseño cuantitativo, descriptivo, observacional y transversal, en una muestra de 20 profesionales de enfermería especialistas en cuidados críticos que brindaban cuidados a pacientes en la terapia intensiva pediátrica, se excluyeron encuestas incompletas. Los participantes aceptaron participar y firmaron consentimiento informado, se aplicó una lista de verificación de mantenimiento del catéter venoso central. En el análisis estadístico se calcularon medidas de tendencia central, frecuencias y porcentajes. **Resultados:** Todos los participantes llevaron a cabo el lavado de manos, 95 % identificó correctamente al paciente y desinfectó puertos y conexiones antes de manipularlos, un 85 % verificó la permeabilidad del catéter venoso, y el 80 % cambio soluciones y equipos de acuerdo con la normatividad. Hubo un cumplimiento total del 94 %. **Conclusiones:** El personal de enfermería implementó adecuadamente los cuidados, no obstante, se observaron áreas de oportunidad que pueden mejorar el mantenimiento del catéter venoso central como son lavado de manos y capacitación sobre la normatividad.

Palabras clave: Cuidados intensivos; Enfermería; Catéter (DeCS).

Abstrato

Introdução: A manutenção do cateter venoso central em pacientes pediátricos em terapia intensiva é uma prática crítica para prevenir infecções e complicações associadas. O enfermeiro fornece os cuidados e

supervisiona seu gerenciamento. No entanto, a implementação da assistência de enfermagem em sua manutenção pode ser prejudicada por obstáculos presentes no dia a dia de trabalho, como falta de conhecimento ou carga de trabalho excessiva. **Objetivo:** Avaliar os cuidados de enfermagem na manutenção do cateter venoso central em pacientes pediátricos de terapia intensiva de um hospital terciário. **Metodologia:** Delineamento quantitativo, descritivo, observacional e transversal, em uma amostra de 20 profissionais de enfermagem especialistas em cuidados intensivos que prestavam assistência a pacientes em terapia intensiva pediátrica, foram excluídos inquéritos incompletos. Os participantes concordaram em participar e assinaram o consentimento informado, foi utilizada uma lista de verificação de manutenção do cateter venoso central. Na análise estatística foram calculadas medidas de tendência central, frequências e percentuais. **Resultados:** Todos os participantes realizaram lavagem das mãos, 95% identificaram corretamente o paciente e desinfetaram portas e conexões antes do manuseio, 85% verificaram a permeabilidade do cateter venoso e 80% trocaram soluções e equipamentos conforme normatividade. Houve adesão total de 94%. **Conclusões:** A equipe de enfermagem implementou adequadamente os cuidados, porém foram observadas áreas de oportunidade que poderiam melhorar a manutenção do cateter venoso central, como; lavagem das mãos e treinamento sobre regulamentos.

Palavras-chave: Cuidados intensivos; Enfermagem; Cateter (DeCS).

Introduction

The central venous catheter (CVC) is a device that provides central access to the bloodstream for the administration of drugs, fluid therapy, and total parenteral nutrition for hemodynamic monitoring or hemodialysis in critically ill patients [(1)]. The use of peripheral intravascular devices in hospitalized patients is nearly 70 %, with more than 10 % of these devices being central venous access devices [(1,2)]. In the United States, approximately 5 million CVCs are placed annually, with common complications, mainly mechanical and infectious, occurring in 5-19 % of patients. In Mexico, the rate of CVC-associated infections increased to 20 % in 2022 compared to 2021 [(3,4)].

There are intravascular catheters that are a fundamental part of the treatment of patients who are in a critical state of health, or in patients whose peripheral venous access is compromised; on the other hand, the CVC in pediatric intensive therapy (PIT) has the function of contributing to patient treatment, and its maintenance is essential because good management and maintenance of the CVC reduces the risk of infection, and benefits patient care [(4,5)]. However, it has been observed in the PIT area that hand hygiene technique is inadequate and there are deficiencies in the identification of lumens by the nursing personnel, in addition to

deficiencies in the use of safety barriers and protection during patient care, although the catheter clinic has quality indicators, therefore infection is a risk associated with the care of the CVC that could cause serious complications for both the patient and the nursing personnel, as they are the professionals responsible for maintaining the vascular access [5-7].

The above-mentioned is the most common occurrence of CVC-related infections in PIT, mainly due to the large number of catheters placed in this department. Several factors predispose to the development of infections secondary to intravascular therapy, including contamination of the CVC during insertion due to inadequate aseptic technique, contamination of the CVC lumen by external sources introduced through the lumen, administration of contaminated infusions, migration of microorganisms from the skin to the external surface of the CVC, hematogenous spread of infection from other sites, and the material properties of the catheter device [4,6-8].

The correct functioning of the CVC is essential for the diagnosis and treatment of curative or palliative pathologies, as it allows the administration of intravenous fluids, acidic or alkaline drugs, total parenteral nutrition, blood products and the monitoring of the patient's hemodynamic status. Therefore, the care of patients with intravascular devices, such as central, peripheral and long-term catheters, is a fundamental role for nurses in the hospital setting. As these devices are used on a daily basis, adequate professional preparation is required to ensure that CVC insertion, maintenance and removal are performed correctly [5,6-8].

Intravenous infusion therapy, on the other hand, involves nursing procedures that focus on establishing and maintaining pathways to infuse fluids, medications, blood or other components into the body through the insertion of a catheter into a vein. These procedures may have preventive, diagnostic, or therapeutic goals, and require skilled nursing care [4-9].

The effective implementation of nursing care in the maintenance of CVCs in PIT patients can therefore have a significant impact on the health and well-being of patients, as well as on the efficiency and quality of health

care services. Thus, proper implementation of nursing care in CVC maintenance can prevent complications and improve clinical outcomes in PIT patients [5,6-10]. The following research question was therefore asked: What is the nursing care provided in the maintenance of central venous catheters? The aim was to evaluate nursing care in the maintenance of CVCs in patients in the PIT of a third-level hospital in the State of Mexico, with the aim of informing clinical practice, improving patient care, contributing to the development of evidence-based practices and promoting patient safety in PIT.

Methodology

This study had a quantitative methodological design, with a descriptive, observational and cross-sectional approach, applied to a nursing personnel assigned to a third-level hospital in the State of Mexico. A non-probabilistic convenience sampling was used to obtain a sample of 20 nurses. The selection criteria included critical care nurses who provided care in the PIT and who agreed to participate by signing the informed consent form; those nurses who did not provide care to patients in the PIT, those who did not agree to participate, and those who did not complete the survey were excluded.

Data collection took place at the end of the nurses' working day. They were approached in the control area, invited to participate and, if they agreed, asked to sign the informed consent form. A CVC maintenance checklist, developed by the Standing Nursing Commission and the Mexican Ministry of Health as part of the Standardized Protocol for the Management of Patients with CVC and Peripherals, was then applied. This checklist consists of a general data section, such as sex and shift, and 12 closed-ended yes/no questions. It is scored according to the degree of compliance; each 'yes' is worth 1 point, so the maximum score is 12 points. It is categorized as follows: 100 % compliance (12 points), 90 % compliance (10 points) and 70 % compliance (<9 points) [7]. It should be noted that using Cronbach's alpha the reliability of the instrument in this study was 0.89.

This research was authorized by the head of teaching at the institution, with minimal risk to the participants. The signed informed consent was based on the Declaration of Helsinki and the General Health Law on research on human subjects in its articles 17 and 100 [8, 9].

For data analysis, a database was created in Statistical Package for the Social Sciences (SPSS) version 25, and central tendency measures, frequencies and percentages were obtained.

Results

Eighty percent of the nurses in the study were female, while 20 percent were male. The mean age was 30.9 years (SD ± 10.1). Sixty-five percent were from the evening shift and 35 % were from the morning shift, (Table 1).

Table 1. Nursing personnel identification data, 2023 (n=20)

Variable	f	%
Sex		
Female	16	80
Male	4	20
Shift		
Evening	7	35
Morning	13	65

Source: Self-developed

With regard to the checklist, 100 % compliance was found for hand hygiene before handling the catheter and recording the information on the forms provided. There was 95 % compliance with correct patient identification, and 90 % compliance with cleaning the insertion site according to protocol, keeping the insertion site visible and protected, and correctly identifying and selecting lumens and flushing them after use. Also, 85 % compliance was found in the checking of catheter patency and assessment of venous access conditions, while 80 % compliance was found in the changing of solutions and equipment according to the proper standards.

Only 75 % of nursing personnel complied with the requirement to remove the catheter on medical indication, using sterile technique, and to check its integrity; there was 70 % compliance with the requirement to replace the needle every 7 days in the case of a fully implanted reservoir catheter; and only 65 % of personnel

complied with the requirement to apply a sterile absorbent non-adherent pad at the insertion site and after removal, and to send the tip for culture in the case of suspected catheter-related infection or bacteremia. Overall compliance was 94 % for all aspects checked, (Table 2).

Table 2. Percentage of compliance with checklist items assessed by nursing personnel in a third-level hospital, 2023 (n=20)

Things to check	% Compliance
Identifies the patient correctly.	95
Performs hand hygiene prior to catheter manipulation.	100
Verifies catheter patency and assesses venous access conditions.	85
Performs cleaning of the insertion site according to protocol.	90
Keeps the insertion site visible and protected.	90
Replaces the needle every 7 days in case of fully implanted reservoir catheter.	70
Changes solutions and/or equipment in accordance to the standards.	80
Disinfects ports and connections before handling according to protocol.	95
Correctly identifies and selects lumens and flushes them after use.	90
Records the information in the corresponding forms.	100
Removes the catheter upon medical indication, using sterile technique and checks its integrity.	75
Covers the insertion site with a sterile non-adherent absorbent pad and after removal, sends the tip for culture in case of suspected catheter-related infection or bacteremia.	65
Overall compliance	94%

Source: Self-developed

Discussion

With the aim of evaluating nursing care in CVC maintenance of patients in PIT, compliance with nursing care in key practices was evaluated, obtaining a little over 90 % overall compliance in aspects such as hand hygiene and disinfection of the insertion site, which are essential aspects of CVC maintenance; and this is supported by other studies and clinical practice guidelines. It should be noted that these practices are fundamental in the prevention of CVC-related infections and improving quality of care and patient safety [(11-14)].

In addition to identifying areas for improvement, adherence to certain practices is a common aspect of quality of care in any healthcare setting. Previous researches [(10-16)] has shown that continuous monitoring, feedback and appropriate training can help to improve adherence to best practices and therefore improve patient outcomes. Moreover, ongoing supervision and monitoring are critical to ensure proper implementation of

CVC care and maintenance [11], requiring a culture of safety and quality within the healthcare institution, where feedback is valued, and action is taken to address areas for improvement [17,18].

It is essential that the team responsible for catheter placement, maintenance and removal, led by the nursing personnel, follow standardized guidelines based on standards (NOM-022 and the protocol for the standardized management of patients with peripheral, central and indwelling catheters and the classification of nursing interventions) to prevent adverse events and ensure patient safety [19,20].

The connection between proper implementation of CVC care and quality of care is well documented, with some studies [21,22] confirming that proper CVC care can reduce complications, minimize CVC-associated infections and improve patient outcomes. To this end, continuing education and professional development are essential to maintain and improve the quality of nursing care. The previous authors have emphasized the importance of continuing education for nurses and how this translates into safer and more effective care for patients [11,13-23].

This research highlights the importance of continuing education and clinical training for nurses in the management and care of CVCs. The findings emphasize the need to keep nurses up to date with best practices and clinical protocols. Investment in continuing education is essential to ensure a safe and effective delivery of high-quality clinical care. From a clinical perspective, a comprehensive analysis of the implementation of CVC maintenance in the PIT setting has been carried out, but a major limitation was the sample size, which should be increased for future research to obtain more accurate results [24,25].

The detailed assessment of nurse compliance in this study has shown a level of adequacy in several activities related to CVC care, with essential aspects such as adherence to hand hygiene measures, performance of appropriate disinfection at the insertion site and accurate lumen identification and selection being adequately implemented by a significant proportion of participants [25,26]. However, clinical areas for improvement have been identified, including the steps following catheter removal, accurate lumen identification and flushing,

and the correct application of sterile absorbent pads. In this context, there is a need to focus educational resources and awareness efforts on these specific areas to optimize the delivery of clinically effective and safe care.

Conclusions

In most of the practices related to CVC care, the nursing personnel showed a good level of compliance, since most practices such as hand hygiene, insertion site disinfection and lumen identification were adequately implemented by the majority of respondents. In addition, we were able to identify areas of improvement where there is an opportunity to enhance adherence to recommended practices. These areas include management after CVC removal, lumen identification and flushing, and covering the site with a sterile, absorbent, non-adherent pad. Thus, it is important to focus training and awareness efforts on these areas to ensure safe and high-quality care.

The results highlight the importance of focusing on proper aseptic practices to prevent CVC related infections, as well as to ensure that protocols for disinfection, solution change and lumen flushing are rigorously followed to prevent complications and improve patient outcomes. Similarly, this research shows that compliance with certain practices may vary among nurses. Therefore, it is essential to implement a system of continuous monitoring and evaluation to ensure that protocols are consistently followed up and that recommended practices are performed in all cases to promote the quality and safety of patient care.

Improving adherence to recommended practices will result in safer care, fewer complications and better outcomes for patients in PIT. Although most practices were found to have a high level of adherence, some areas were identified where adherence need some improvement. These areas include management after catheter removal, lumen identification and flushing, and site coverage with sterile absorbent pad, for which it is required to improve training and awareness in these specific areas to contribute to more consistent implementation of optimal care. The findings highlight the importance of preserve continuous monitoring

over the implementation of care in the management of CVCs; as well as periodic evaluation and feedback are essential to maintain compliance and ensure that practices are performed in accordance with established standards.

Consequently, compliance with nursing care practices has a direct impact on the quality of care provided to patients in PIT, improving the implementation of CVC care can contribute to reducing complications, improving clinical outcomes, and increasing patient safety and satisfaction. Furthermore, improved implementation of CVC care can help reduce complications, improve clinical outcomes, and increase patient safety and satisfaction. In addition, keeping personnel up to date on best practices and updated protocols is essential to ensure high quality care and patient safety, and implementation of ongoing assessment of nursing personnel on this topic could lead to better maintenance of CVC care.

Conflict of interest

The authors stated that they have no conflicts of interest.

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Artificial intelligence

The authors declare that they have not used any type of artificial intelligence resources in any of the sections of this manuscript (in preparation, design, writing, structuring and proposals of figures, tables or graphs).

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