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Original research article

Nurses' knowledge of central venous catheter care

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Abstract
Introduction: The central venous catheter (CVC) and its use represents a step forward in patient treatment, but involves numerous potential complications. Applying nursing standards to clinical practice achieves high-quality nursing care.
Design: Cross-sectional quantitative study using a questionnaire.
Methods: Quantitative research using questionnaire technique was conducted to examine nurses' knowledge of nursing care for central venous catheters and adherence to nursing standards. The research sample consisted of 256 nurses in selected regional hospitals in the Slovak Republic. The criterion for including nurses in the sample was the provision of CVC care in routine practice. The data were analysed using descriptive statistics and statistical testing methods.
Results: The research found that nurses have certain shortcomings in nursing care for central venous catheters. Nurses know how to work correctly according to aseptic procedures (81%), but they are unsure what barrier devices are needed for dressing and treatment (25%).
Conclusion: Based on the research results, it can be concluded that despite nurses' knowledge being adequate, it is necessary to provide regular training on the principles of CVC care to reduce infections associated with healthcare.

Keywords: Central venous catheter; Clinical practice; Knowledge; Nurse; Nursing

Introduction

Central line-associated bloodstream infections (CLABSI) are considered to be one of the most common nosocomial infections. The incidence of CLABSI is reported primarily in the intensive care environment, as the use of central venous access is more frequent for critically ill patients (Laurinc et al., 2023). It is estimated that approximately 60% of cases of nosocomial bacteremia are caused by intravascular devices. One of the most commonly used devices is the central venous catheter (CVC), which has been essential in the care of critically ill patients, especially in intensive care units, since the second half of the 20th century (Kalender and Tosun, 2015). CVCs provide intravascular access with the catheter tip placed in the area of the transition of the superior vena cava into the right atrium (or in the area of the lower third of the superior vena cava, or the upper third of the right atrium, i.e., the area of the cavoatrial junction). This position is considered to be an ideal place for administering solutions with any pH value and osmolarity (Nedomová, 2023).

CVCs are invaluable in a variety of clinical applications, including central venous pressure measurement, medicines administration, blood and blood product transfusion and parenteral nutrition, and for indications where a peripheral venous route is not appropriate (Kalender and Tosun, 2015). Although CVCs are essential for the effective treatment of critically ill patients, their use increases the risk of local and systemic infections, which may lead to prolonged hospitalisation, increased morbidity and mortality, and increased healthcare costs. Therefore, it is crucial to carefully monitor and evaluate the risk factors associated with their use (Ferreira et al., 2015; O'Grady et al., 2011; Roza-Diez et al., 2014). In this context, the nursing team plays a significant role, being the basis for providing continuous care for patients in hospital facilities. Nursing staff have a crucial role in preventing CVC-associated infections and in applying correct techniques, which significantly influence the outcomes associated with the use of these devices (Mendonca et al., 2011). For this reason, it is essential that hospital facilities support regular training of healthcare professionals. One effective strategy for preventing CLABSI is to continuously raise awareness among healthcare professionals of recommended measures through lifelong education. This includes regular review of CVC care protocols and evaluation of educational strategies, practices, and processes for professional performance (Jardim et al., 2013). Further, assessing the nursing team's knowledge of CVC care, in accordance with current recommendations, provides valuable information for improving the effectiveness of training and the identification of areas that require further strengthening in the future (Barbarosa et al., 2017).

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The aim of the research was to determine nurses' knowledge of nursing care for CVC in standard wards and in anesthesiology and intensive care units, and to identify nurses' knowledge focused on principles and procedures specific to nursing care for a patient using a CVC.

Materials and methods

The research was conducted using a quantitative method with a self-designed questionnaire, which assessed nurses' knowledge of nursing care for CVC and adherence to nursing standards. The design of the questionnaire was based on the current state of relevant sources, including national and international recommendations (Laurinc et al., 2023; O'Grady et al., 2011; Practice Guidelines for Central Venous Access 2020..., 2020). The questionnaire was anonymous, voluntary, and did not contain any controversial ethical questions. It contained a total of 27 questions. Research data were processed using descriptive statistics in the Statistical Package for the Social Sciences program. Data collection was conducted at two regional hospitals in the Slovak Republic from April to June 2024 with the consent of selected healthcare providers. The research results only apply to this research. The research sample consisted of 256 nurses with varying periods of professional experience. The criterion for including nurses in the sample was the provision of CVC care in routine practice.

Results

Based on the questionnaire survey, we found that the surveyed nurses engage in CVC care very often to often, with most nurses having a shorter period of professional experience (Table 1).

We also asked the nurses whether they had standards for providing CVC nursing care at their facilities and whether they followed them. We found that 75% of nurses have standards for CVC nursing care at their facilities, and 55% of nurses provide care according to the established standards (Table 2).

As for CVC insertion site checks, we concluded that nurses working in intensive care units and intensive medicine wards perform insertion site checks regularly every 12 hours (57%), and that they perform these checks more often than nurses in standard wards (39%). As many as 91% of nurses always treat the insertion site when applying a secondary covering.

Table 1. Frequency of CVC care by period of experience

Period of experience/ frequency	Very often	Often	Occasionally	*N*
1–5 years	45	55	21	121
6–10 years	23	11	1	35
11–20 years	15	20	3	38
21–30 years	12	14	2	28
Over 31 years	7	23	4	34
N	102	123	31	256

Table 2. CVC care according to standards

N = 256	*n*	%
Yes	141	55
No	77	30
Don't know	38	15

We then examined the types of disinfectants used when dressing CVC (Table 3), with as many as 31% of nurses reporting that they disinfect the skin with any disinfectant available at the facility.

We then asked the nurses about their adherence to aseptic procedures and the use of barrier devices for CVC treatment. The correct procedure for handling and administering medicines through CVC was chosen by 81% of nurses, where nurses must first hygienically wash their hands, then hygienically disinfect their hands, put on gloves, disinfect the CVC entrance, administer medicines, and finally hygienically disinfect their hands. Only 25% of nurses listed all CVC dressing supplies correctly, such as disposable gloves, sterile gloves, sterile gauze swabs/squares, sterile instruments, alcohol-based skin disinfectant solution, secondary covering, kidney tray, CVC dressing set, sterile closures/needleless ports, face mask, and gown. As many as 14% of nurses still use Betadine powder/ointment or antibiotic ointment when dressing CVC, which can cause fungal infection or resistance. Nurses achieved a low level of knowledge for barrier devices used in CVC care (Table 4). Barrier devices such as a face mask, sterile gown, sterile gloves, and non-sterile disposable gloves should be used during treatment.

Table 3. Disinfectants for skin disinfection before CVC insertion and during CVC dressing

Disinfectant	Frequency	Percent	Valid percent	Cumulative percent
2% chlorhexidine in 70% alcohol	64	25.0	25.0	25.0
2% chlorhexidine in 70% alcohol, povidone-iodine (Betadine)	51	19.9	19.9	44.9
2% chlorhexidine in 70% alcohol, any alcohol-based disinfectant designed for skin disinfection, as available at the ward	20	7.8	7.8	52.7
Povidone-iodine (Betadine)	25	9.8	9.8	62.5
Povidone-iodine (Betadine), any alcohol-based disinfectant designed for skin disinfection, as available at the ward	16	6.3	6.3	68.8
Any alcohol disinfectant designed for skin disinfection, as available at the ward	80	31.3	31.3	100.0
Total	256	100.0	100.0	

Table 4. Barrier devices in CVC treatment

Barrier devices	Frequency	Percent	Valid percent	Cumulative percent
Face mask, sterile gown, sterile gloves, non-sterile disposable gloves	69	27.0	27.0	27.0
Non-sterile disposable gloves, face mask, sterile gown	7	2.7	2.7	29.7
Non-sterile disposable gloves and face mask	78	30.5	30.5	60.2
Sterile gloves, face mask	91	35.5	35.5	95.7
Don't use any of the above options, it's not necessary	11	4.3	4.3	100.0
Total	256	100.0	100.0	

The last area surveyed was documentation of CVC care. Only 23% of nurses correctly identified the areas that the record should contain, namely: date and time of CVC dressing, assessment of CVC functionality, assessment of the area around the CVC insertion, date of next dressing, type of secondary covering used. A positive finding was that 64% of nurses record CVC treatment at regular intervals during each shift (Table 5).

Table 5. Frequency of CVC care records

N = 256	*n*	%
Yes	166	64
No	67	26
Don't know	23	9

Discussion

The most serious complication that can occur after CVC insertion is infection, which threatens the patient's life and leads to many undesirable consequences. The results of the study that examined nurses' knowledge of CVC care and the ways in which they provide this care were analysed and compared with existing literature.

Ensuring proper venous access care is essential in nursing practice, and nursing interventions can significantly reduce the risk of infections in patients (Jarding and Makic, 2021). CVC care is the exclusive responsibility of nurses. According to Decree of the Ministry of Health of the Slovak Republic No. 208/2024 Coll., a nurse with professional competence to perform professional work independently treats the sites of invasive access and checks and assesses their functionality and condition. Nurses must have sufficient knowledge of strategies for the prevention, treatment, and management of local and systemic complications, supported by evidence-based practice guidelines (Osti et al., 2019). Most of these interventions and preventive strategies are part of routine nursing practice (Arbaee and Ghazali, 2016; Jarding and Makic, 2021). According to the American Society of Anesthesiologists (Practice Guidelines for Central Venous Access 2020..., 2020), it is essential to implement preventive measures against infectious complications prior to the insertion of venous access and to maintain these measures throughout its entire duration of use. These interventions include aseptic insertion of venous access, selection of an appropriate antiseptic solution, catheters with antimicrobial agents, correct selection of the catheter insertion site, method of fixation, and selection of an appropriate covering.

The use of uniform standards and protocols helps guide clinical practice and care, ensuring continuity and effectiveness of interventions aimed at qualification, systematisation, standardisation, and guidance of care to avoid different practices in the same environment or for the same patient (Barbosa et al., 2017).

As part of the research, we used the questionnaire survey technique to examine nurses' knowledge of CVC care. The research results are worrying in some areas. However, it is important to note that we have identified clinically relevant areas for the introduction of training or further education of nurses regarding the issue.

CVC dressing is performed using aseptic technique, which means using sterile gloves, sterile gauze, and a disposable face mask. Non-sterile gloves should only be used to remove old and soiled dressings and should therefore not come into contact with the catheter insertion site. The use of aseptic technique during dressing changes has also been shown to be important in preventing CLABSI (Barbosa et al., 2017). Podrazilová and Hudáčková (2015) found several serious shortcomings in nurses' knowledge of the aseptic approach in nursing care for an inserted CVC. These include incorrectly stated procedure for disinfecting the insertion site, incomplete CVC dressing supplies, and very problematic dilution of the heparin lock. In our research, 81% of nurses chose the correct procedure for handling and administering medicines through CVC, but only 25% of nurses were able to list all CVC dressing supplies correctly.

As for the skin disinfection solution recommended for CVC dressing changes, our study showed poor knowledge on the part of nurses, with as many as 31% of nurses stating that they disinfect the skin with any disinfectant available at the facility. Only 25% of nurses indicated the correct answer, i.e., 2% chlorhexidine in 70% alcohol. Research results have linked the use of an alcohol-based chlorhexidine substance to lower rates of colonisation or CLABSI associated with CVC compared to other antiseptic agents (Barbosa et al., 2017; Ferreira et al., 2015; O'Grady et al., 2011).

The CVC insertion site should be checked daily and immediate replacement should be performed whenever the dressing is soiled, wet, or not intact. Although standards require a 24-hour period for gauze dressing changes, studies recommend that they be changed within 48 hours (Barbosa et al., 2017). In our sample, 55% of nurses believed that they provided CVC care according to applicable nursing standards. Other research has shown that nurses have adequate knowledge about the frequency of dressing changes in CVC care (Borges and Bedento, 2016; Brião et al., 2009).

Preserving venous access functionality and preventing infection is an important aspect of patient treatment. It depends mainly on the approach of healthcare professionals,

while following recommended procedures in the care of inserted venous access. An important aspect is the implementation of recommended procedures into clinical practice, regular training of healthcare professionals for venous access, and evaluation of the implementation of procedures in practice in order to have a quality system and ensure patient safety. An important factor for positive clinical outcomes for patients is a professionally trained nurse to match the standards of current clinical practice in the 21st century (Laurinc et al., 2023). However, the increasing demands placed on nurses are beginning to test the limits of standard nursing education (Tóthová et al., 2020). The importance of training and education was also confirmed by a study by Aydoğdu and Akgün (2020), which found that nurses' training is one of the fundamental factors influencing their level of knowledge of CVC. A positive effect of short training courses within lifelong learning was also shown in a study by Prokešová et al. (2009).

The quality of nursing care management for a patient with venous access largely depends on the material and technical equipment of the healthcare facility. It is also significantly influenced by sufficient staffing with nursing personnel who possess the required professional competence. Understaffing, especially in the nursing profession, increases the risk of complications due to the absence of continuous professional assessment of potential complications, whether local or general. It is essential to recognise that the care of a patient with a venous access does not end with the insertion and dressing of the venous access (Laurinc et al., 2023).

Conclusion

The study highlighted nurses' insufficient knowledge of the use of appropriate disinfectants in CVC care, as well as insufficient knowledge of barrier nursing techniques. Although CVC handling is a common and seemingly simple practice, it requires special care and strict adherence to recommended measures to improve patient safety and the quality of care provided. The results confirm the need to implement new strategies for education and distribution of CVC care recommendations to ensure their adoption. These strategies should focus on improving knowledge, especially in areas that showed a higher index of ignorance.

In conclusion, it can be stated that improving nurses' awareness and implementing regular educational programmes on the issue of CVC and infections associated with their use is essential for optimising care for critically ill patients and preventing serious complications such as blood infections.

Ethical aspects and conflict of interest

The authors declare that the study has no conflict of interest and that ethical aspects of research were observed in its preparation. All respondents were informed about the purpose of the study and agreed to be included in the sample.

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