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REVIEW

Complications and Prevention in the Use of Central Venous Catheter: A Nursing Approach

Complicaciones y Prevención en el Uso del Catéter Venoso Central: Un Enfoque desde la Enfermería

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ABSTRACT

Introduction: Hospital acquired infections represent a serious problem for healthcare systems, increasing morbidity, mortality and healthcare costs. According to the World Health Organization, up to 15% of patients in low- and middle-income countries contract infections during hospitalization, highlighting the need for preventive measures. Central Venous Catheters (CVC), although indispensable in the management of critically ill patients, are associated with infectious complications that constitute 14% of nosocomial infections, mainly bacteremia and sepsis.
Development: CVCs are medical devices designed to administer substances directly into the bloodstream, being essential in treatments such as transfusions, parenteral nutrition and administration of irritant drugs. However, their use can generate mechanical, infectious and thrombotic complications. These complications are often associated with the lack of standardized protocols, inadequate biosafety practices and insufficient training of healthcare personnel. The review highlighted that infections are preventable through aseptic techniques, such as hand washing, use of sterile barriers, and proper cleaning of the insertion site and catheter connections.
Conclusions: Successful prevention of complications associated with CVCs requires a multidisciplinary approach that includes ongoing staff training, implementation of evidence-based protocols, and use of monitoring tools such as checklists. These strategies not only ensure patient safety, but also reduce costs and improve clinical outcomes. The adoption of these practices is essential to optimize the quality of care in critically ill patients.

Keywords: Central Venous Catheter; hospital-acquired infections; nosocomial complications; prevention; nursing care.

RESUMEN

Introducción: Las infecciones intrahospitalarias representan un grave problema para los sistemas de salud, incrementando la morbilidad, mortalidad y costos sanitarios. Según la Organización Mundial de la Salud, hasta el 15% de los pacientes en países de ingresos bajos y medios contraen infecciones durante su hospitalización, lo que resalta la necesidad de medidas preventivas. Los Catéteres Venosos Centrales (CVC), aunque indispensables en el manejo de pacientes críticos, están relacionados con complicaciones infecciosas que constituyen el 14% de las infecciones nosocomiales, principalmente bacteriemias y sepsis.
Desarrollo: Los CVC son dispositivos médicos diseñados para administrar sustancias directamente al torrente sanguíneo, siendo fundamentales en tratamientos como transfusiones, nutrición parenteral y administración de medicamentos irritantes. Sin embargo, su uso puede generar complicaciones mecánicas, infecciosas y trombóticas. Estas complicaciones suelen estar asociadas a la falta de protocolos estandarizados, prácticas inadecuadas de bioseguridad y una capacitación insuficiente del personal de salud. La revisión destacó que las infecciones son prevenibles mediante técnicas asépticas, como el lavado de manos, el uso de barreras estériles y la limpieza adecuada del sitio de inserción y las conexiones del catéter.
Conclusiones: El éxito en la prevención de complicaciones asociadas a los CVC requiere un enfoque multidisciplinario que incluya la capacitación continua del personal, la implementación de protocolos basados en evidencia y el uso de herramientas de monitoreo como listas de verificación. Estas estrategias no solo garantizan la seguridad del paciente, sino que también reducen costos y mejoran los resultados clínicos. La adopción de estas prácticas es esencial para optimizar la calidad del cuidado en pacientes críticos.

Palabras clave: Catéter Venoso Central; infecciones intrahospitalarias; complicaciones nosocomiales; prevención; cuidados de enfermería.

INTRODUCTION

Hospital-acquired infections are those contracted by hospitalized patients. They constitute a problem that prolongs their stay and threatens their health due to an increase in the morbidity and mortality rate (Ferreyra García, 2021).

The first global report on infection prevention and control published by the World Health Organization (WHO, 2022) reveals that 7 out of every 100 people admitted to a hospital in high-income countries will contract at least one infection during their stay. Meanwhile, in low- and middle-income countries, the figure rises to 15 out of every 100 users, and it is estimated that 1 in every 10 patients will die due to a nosocomial infection. For its part, the Pan American Health Organization (PAHO, 2021) estimates that hospital-acquired infections cause the death of 700,000 people per year worldwide, with an impact of 10 million people by 2050, and urges the implementation of immediate measures to reverse this situation.

Hospital or nosocomial infections can be caused by different pathogens such as fungi, viruses, and bacteria and are classified, according to the route of infection, as endogenous (or self-infection), exogenous (when it comes from another person), or endemic cross infection (where the agent is found in a specific area of the institution). The most frequent are those of the urinary tract, associated with catheterization of these tracts; intra- or post-operative surgical infections; respiratory tract infections, where the most frequent are associated with patients on mechanical ventilation; and those of the

bloodstream in correlation with the use of peripheral and central venous catheters (Cabrera Manosalva & Ramírez de Llico, 2022).

DEVELOPMENT

Intravenous therapy can be defined as the direct administration of substances into the bloodstream by inserting a needle or catheter into specific access points. Hipólito Gragera (2021) conceptualizes a short peripheral intravenous catheter (PIVC) that is less than 7.5 cm long and channels peripheral veins in the hand, forearm, or antecubital fossa region. A fundamental element in intravenous therapy is the intravascular catheter, a device categorized as a medical supply made in different calibers and types of synthetic materials so that they can be adapted to specific therapeutic needs. The insertion of these catheters is the most commonly performed invasive procedure in hospitals and directly involves the role of Nursing.

For Guerra de Campos & Aragón de Melara (2017), intravenous therapy is important because immediate access to the bloodstream becomes a route of administration of substances that allows the desired plasma concentration to be reached quickly and precisely. Moreover, it is the only suitable route for blood transfusions, treatment of critically ill patients, and cancer therapies. The aforementioned uses, in addition to the more common ones, such as pharmacotherapy, hydration, and parenteral nutrition, influence the prescription of the type of venous access. The plasma concentration gives another consideration the substance must reach, which will determine whether the administration will be continuous, intermittent, or in boluses (rapid administration of fluid volumes less than 50 ml).

Just as there are short peripheral catheters, there are also Central Venous Catheters (CVC), which are thin, flexible tubes made of silicone or polyurethane (biocompatible materials) that are inserted into a more prominent vein and advanced into the venous system (Figure 1). These CVCs, also known as central venous cannulae and central venous lines, can be left in place for weeks or months to avoid the need for multiple transcutaneous instruments. In addition to the advantage of their useful life, they allow access to more significant blood flows, which is very useful when irritant substances must be administered. In other words, using CVCs is closely associated with their ability to hemodilute the instilled substance. When catheters are inserted to be used for a long time, they can be tunneled; that is, they are covered with a fold of the patient's skin along the path between the insertion site and the external orifice of the tunnel through which the catheter emerges to the outside. In this way, the CVC is more securely fixed, and the puncture site is better protected. A special type is the CVC with a subcutaneous port, which is access connected to a surgically implanted device under the skin in the arm, leg, abdomen, or chest (the preferred position). The device is connected to a central line and requires low maintenance, improving the patient's quality of life (Hipólito Gragera, 2021).

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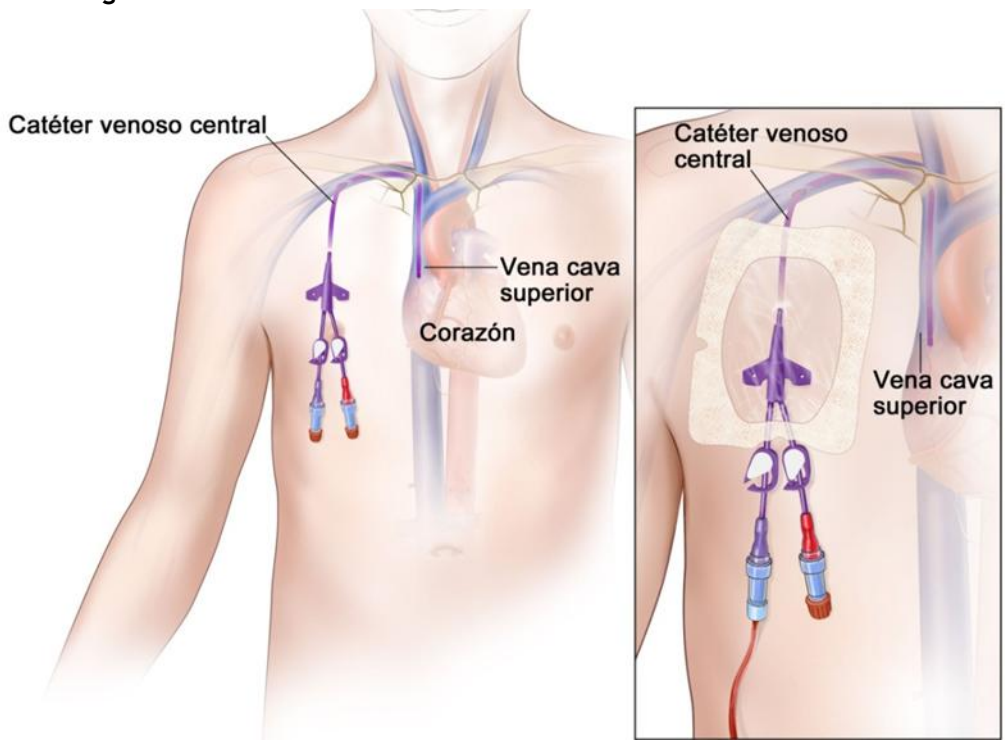
Figure 1. Central venous catheter access via the subclavian vein.



Source: Reproduced from Central Venous Catheter, National Cancer Institute NIH, 2023, (https://nci-media.cancer.gov/pdq/media/images/774006.jpg).

CVCs began to be used around 1950 and are inserted percutaneously using a medical procedure. Like any invasive procedure, there is a risk of complications due to injury to the operated tissue or nearby anatomical structures, and they can also promote the generation of infectious processes. The insertion point of the device is usually defined as between the internal jugular vein, the subclavian vein or the femoral vein. In the case of the jugular or subclavian veins, the tip of the catheter advances to the right atrium at the point where the superior vena cava begins or in the lower third of the vein; in the case of the femoral vein, the tip of the catheter advances to the inferior vena cava (Figure 2). The location reached by the ends is confirmed using radiographic procedures (Souto Ríos, 2022).

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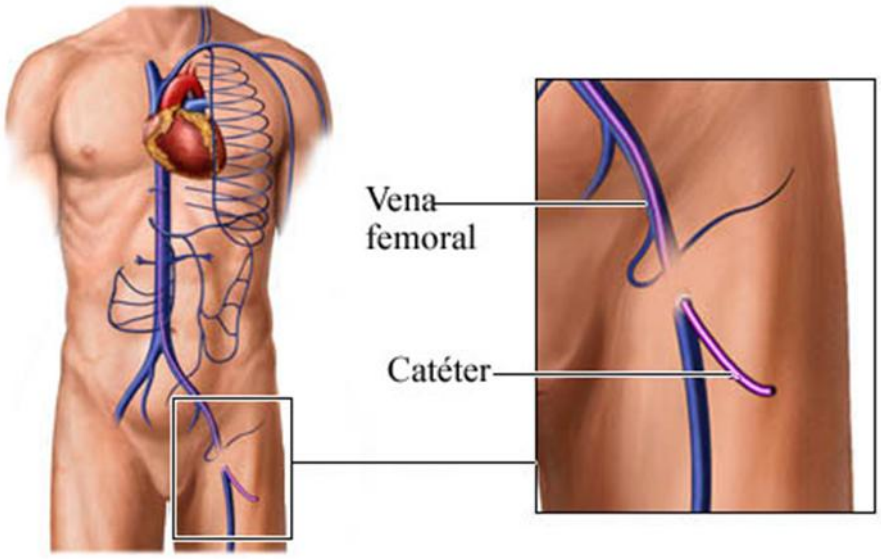
Figure 2. Femoral access for the central venous catheter.



Source: Reproduced from Inserting a catheter into the femoral vein, by Cigna Health Care, 2023, (https://content.healthwise.net/resources/13.7/es-us/media/medical/hw/s_n5551133.jpg)

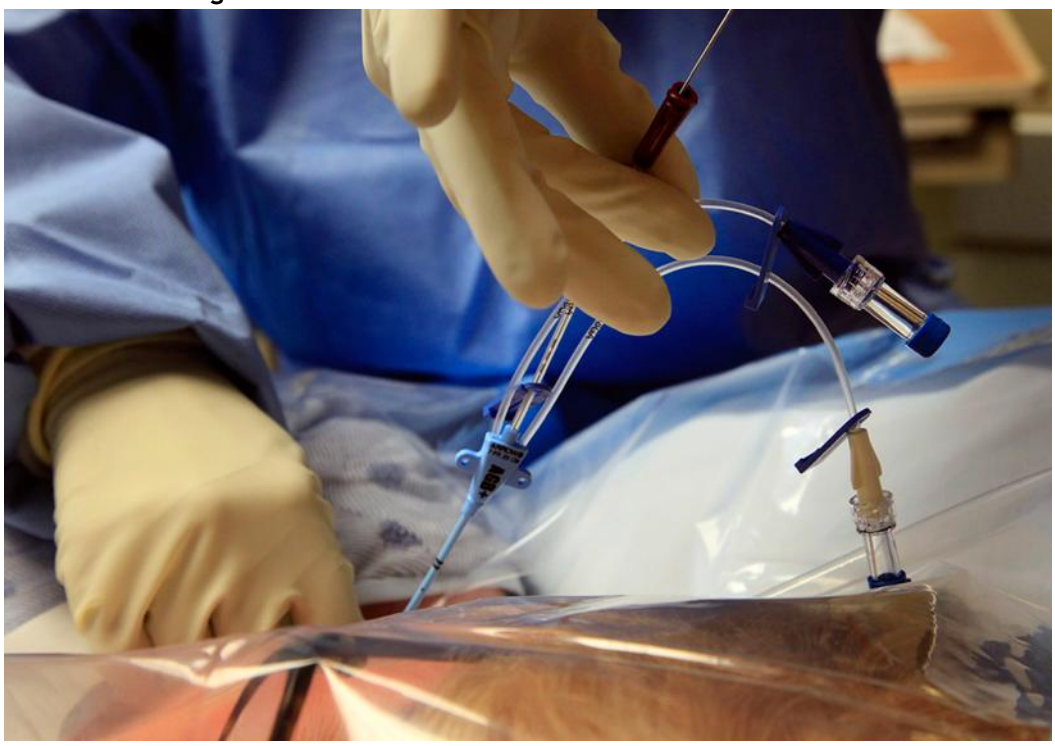
To identify catheters as a device, Apaza et al. (2016) explain that they can be categorized according to the type of treatment that requires them, the length of time they need to be in place, the selected insertion site, the path from the skin to the blood vessel, the size, and even by some particularity linked to the catheter.

Torres Muñoz et al. (2918) state that CVCs are the first choice when:

- Simultaneously perfusing drugs through different lumens; as well as vasoactive drugs, parenteral nutrition, hypertonic or highly irritating solutions.
- Measuring different pressures such as central venous, pulmonary capillary or pulmonary arterial.
- Implanting endocardial pacemakers.
- Applying renal purification techniques such as haemodialysis, haemofiltration, among others.

Outside the patient's body, the CVC is divided into smaller tubes called lumens. Each lumen has a clamp, a needleless connector (also known as a key) and a disinfectant cap at the end.

Figure 3. Central venous catheter as a medical device.



Source: Reproduced from central venous catheters, Intramet, 2023, (https://www.intramed.net/contenidover.asp?contenidoid=82177)

A classification of CVC by Carrero Caballero (2008) proposes:

1. By the anatomical location of the insertion.

a. Thoracic and internal jugular implantation (preferably in critical care).

b. Inguinal implantation.

c. Abdominal implantation, not the most common as it is used when other means of access have been exhausted.

d. Peripheral access implantation in cephalic veins of the upper limbs, basilic veins, saphenous veins of the lower limbs, angular head veins and external jugular veins in neonates.

2. By duration and closely related to the material from which the CVC is made.

a. Short-lasting, made of Teflon and polyurethane.

b. Medium-lasting, made of polyurethane and silicone-coated polyurethane.

c. Long-lasting, made with silicones.

3. By the number of lumens in the catheter. In those with more than two lumens, as well as having a clamping forceps, each one can be identified by color or be labeled (proximal, medial or distal).

a. A single lumen, called Unilumen.

b. Two lumens, Bilumen.

c. Three lumens, Trilumen.

d. Four lumens, Cuatrilumen.

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Risks and complications

In general terms, Vera Odar (2020) estimates that 1 in 5 patients who have a CVC may experience infectious, mechanical or thrombotic complications. In more detail, Guerra de Campos & Aragón de Melara (2017) list complications in six categories:

1. Mechanical complications: generally associated with the material used in the manufacture of the catheter, where materials that facilitate insertion and advancement due to their rigidity (such as PVC and polyethylene) can also cause vascular lesions and inflammatory reactions (phlebitis) with excessive fibrin deposits. These can produce thrombotic or embolic events.
2. Complications related to catheter insertion:

a. Extravasation occurs when the catheter moves and the fluid perfuses the subcutaneous tissue instead of the vascular bed, causing an accumulation of fluid with a change in the volume and temperature of the perfused subcutaneous area.

b. Bleeding occurs due to injury to the vessel or surrounding tissue, or in patients with coagulation disorders.

c. Embolism is a complication that occurs when air is aspirated during catheter insertion, causing serious problems when the aspirated volume reaches 50-100ml.

d. The risk of rupture arises from excessive or imprecise handling during the catheter insertion and maintenance procedure.

3. Complications related to the CVC insertion site:

a. The internal and external jugular veins are the most frequently chosen insertion points because they are clearly visible and palpable and have no vital structures in their vicinity. Of the two, the internal jugular vein has the highest flow rate and therefore represents a lower risk of thrombosis.

b. The subclavian vein presents a series of risks of complications in relation to the surrounding structures, pneumothorax is the complication of accidental puncture of the pleura or lung and hemothorax is the complication of accidental puncture of the subclavian artery.

c. The femoral vein is the usual insertion site when the CVC is intended for renal replacement therapy, plasmapheresis and for the administration of large volumes of blood.

4. Infectious complications: CVC-associated infection is defined as a localized or systemic infection secondary to using a device that was not present or incubating when the device was inserted. This way, local vein infections can be distinguished from generalized or systemic processes (sepsis). Sepsis is related to CVC contamination, allowing bacteria to access the bloodstream (bacteremia) and spread to other target organs. The most common route of infection is the migration of microorganisms from the skin at the point of insertion of the CVC towards the intravascular tip of the catheter, which is why it is essential to maintain optimal isolation of the catheter insertion site (Figure 4) and to periodically clean and disinfect it. Another route is direct contamination caused by contact with contaminated hands or objects, such as the tubing connected to the catheter. Less common is intravascular contamination by microorganisms from another infectious focus inside the body, and even less frequent is contamination from the solution being administered. Infectious complications can be referred to as late complications due to the latency period required for symptoms to appear.

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Figure 4. Isolation of the insertion site.

Source: Reproduced from isolation of the insertion site, PHC Nursing, 2023, (https://www.enfermeriaaps.com/portal/taurolidina-un-antiseptico-para-la-prevencion-de-infecciones-asociadas-a-cateter-venoso-central-rev-chilena-infectol-2019)

Guerra de Campos & Aragón de Melara (2017) conceptualize that Healthcare-Associated Infections (HAIs) occur 48 hours after admission or 72 hours after discharge, where the time frames considered as the window are related to the incubation periods. HAIs are a concern because they influence morbidity and mortality rates and the increase in hospital costs. In the use of devices such as CVCs, HAIs have multifactorial causes, but there is a known relationship between increased risks and healing and care practices. According to the authors, inadequate procedures would favor an extraluminal mechanism of eventual colonization of the catheter tip with the migration of microorganisms from the skin at the insertion site, producing bacteremia in the first days of implantation. An extraluminal mechanism is more frequent and originates from the inadequate cleaning of the connections during the connection and disconnection maneuvers of the systems, especially in catheters with several lumens and multiple channels.

Therefore, Apaza et al. (2016) state that these types of infections are preventable and, worryingly, they represent the third leading cause of hospital-acquired infection with an estimated 14% of all nosocomial infections and Algieri et al. (2013) place it at 10% depending on the host, catheter and handling factors.

It is advisable to incorporate the considerations made in a joint document of the Committee on Health Care-Associated Infections and Patient Safety (IACS-SP) of the Argentine Society of Infectious Diseases (SADI) and the Critical Infectious Diseases Committee (CIC) of the Argentine Society of Intensive Therapy (SATI), on the approach to and control of infections in adult Intensive Care Units (ICUs) (Farina et al., 2019). This document specifies that Catheter-Related Infections (CRIs) include Catheter-Related Bacteremia (CRB), insertion site infection, tunnel infection in tunneled catheters, and pocket infection in totally implantable catheters. CAB is the most common cause of patient morbidity and mortality. Therefore, a distinction is made in the operational concept that differentiates the term CAB from the epidemiological and clinical approaches. For epidemiology, a bloodstream infection (BSI) refers to an infection of the bloodstream that develops within 48 hours of the implantation of a CVC without localized infection and the need for a catheter tip culture. The clinical definition of BAC requires at least one positive peripheral blood culture in a patient who presents signs and symptoms of infection such as fever, chills, and/or hypotension and has a positive culture with the same germ and antibiogram.

In 2021, the Ministry of Health of Argentina (MSA) issued the document "Actions for Patient Safety in the Field of Health Care" within the Argentine Health System paradigm framework. The MSA raises the

need to achieve the potential of "qualified, responsible, timely, fair, ethical health care that is under permanent evaluation and improvement" with an ethical and economic argument that placed the issue of patient safety on institutional agendas (MSA, 2021).

The following year, it published the "Tool for the Evaluation and Improvement of Patient Safety" (MSA, 2022), which defines patient safety as the discipline that aims to prevent and reduce preventable harm associated with medical care and that includes structural elements, processes, instruments and methodologies to minimize risk or mitigate its consequences. This document sets out nine lines of action as patient safety tools and includes Safe Practices for the Prevention and Control of Healthcare-Associated Infections (HAIs). Regarding this final project, the MSA is based on the WHO's request to install strict institutional hand washing. It proposes implementing HAI control plans and monitoring in the context of training for the professionals involved. Point 3.6 of the line of action is dedicated to the package of measures to control infections associated with using CVC, one of the unique concerns along with ventilator-associated pneumonia and BSIs from bladder catheterization.

Figure 5. Tool for the Evaluation and Improvement of Patient Safety

3. PRÁCTICAS SEGURAS PARA PREVENIR Y CONTROLAR LAS INFECCIONES ASOCIADAS AL CUIDADO DE LA SALUD (IACS)
3.1. Existe un programa institucional de vigilancia, prevención y control de IACS[4]
3.2. Desarrolla un proceso de recolección de datos, análisis y procesamiento estadístico con el propósito de evaluar y establecer estrategias para el control de infecciones[5]
3.3. Promueve la capacitación y participación de todo el personal en la prevención de IACS
3.4. Fomenta y mantiene el desarrollo de un programa de higiene de manos
3.5. Cuenta con solución de base alcohólica y un área de lavado de manos, (pileta, agua, jabón y toallas descartables), lo más próximo posible al contacto con el paciente
3.6. Implementa un paquete de medidas para prevenir las infecciones asociadas a catéteres venosos centrales
3.7. Implementa un paquete de medidas para prevenir la neumonía asociada a la ventilación mecánica
3.8. Implementa un paquete de medidas para prevenir las infecciones asociadas a catéteres urinarios

Source: Adapted Third line of action of the “Tools for the evaluation and improvement of patient safety”, (p. 9), Ministry of Health of Argentina, 2020.

5. Complications due to CVC occlusion refer to the clogging of the interior due to the formation of a thrombus in the path of the catheter or at the end of the intravenous line as a consequence of negative pressure in the system that allows the blood column to recede, enter the lumen of the catheter and form a clot that obstructs it.

6. Complications during the catheter removal process include the risks of embolism, CVC rupture and laceration or heart valve rupture if the catheter is in an endocardial position.

Nursing care for central venous catheter maintenance

Nurses working in hospitals have regular tasks such as implanting peripheral venous catheters in basilic, cephalic, brachial, or metacarpal veins (oncolysis) and caring for patients with CVC. The role of nursing in intravenous therapy, as described by Souto Ríos (2022), consists of administering solutions or drugs according to medical prescription; applying care to the insertion point, the skin, the catheter, and the infusion equipment; restoring perfusion in the case of blocked catheters; and observing for the appearance of possible complications in order to protect the patient from them.

Apaza et al. (2016) agree that the administration of intravenous medication and the healing of the CVC insertion site are routine procedures for ICU nurses and affirm that the proper application of techniques makes the difference in guaranteeing patient safety and quality of care. Executing procedures requires solid knowledge and technical expertise to reduce the rate of complications in using the device.

In addition to the necessary knowledge, biosafety requires consistent, timely, and appropriate attitudes and behaviors to prevent complications and minimize risks (Villanueva, 2016). On the other hand, Sánchez, Aguayo, & Galdames (2017) believe that the knowledge necessary to act in professional practice does not only come from initial academic training but is complemented by learning that arises from the experience of the practice itself and from the training and research activities that accompany professional performance (Villanueva and Sánchez cited in Vera Odar, 2020).

Vázquez Espinosa et al. (2021) use the term “venous capital management” to refer to this field of nursing practice, which includes, in addition to the skills required to perform the procedures, the criteria for the appropriate selection of the device according to the type of vascular access required, the appropriate choice of insertion site, the number of components and connections of the device, its fixation and regulation, the necessary identification label, and the type of activities to be planned for the prevention of complications. In order to develop criteria that will enable them to make these decisions, a certain amount of specific knowledge will be necessary to enable them to make the most of their daily experience. However, despite the importance of having a solid knowledge base and a practice of critical-reflective experience, professional practice must rely on the protocolization and standardization of care based on scientific evidence to adopt universally recommended forms. The nursing professional is the role of the health team responsible for the activities and maintenance of the CVC device and the percutaneous site through which it has been inserted.

A positive and statistically significant relationship between knowledge and care in patients with CVCs was demonstrated by Tirado-Reyes and Silva-Maytorena (2020) in a study of 240 nurses and 260 patients in a regional hospital in Mexico; the authors commented on the magnitude of the problem of caring for this type of patient and the awareness that needs to be raised. Complications from CVCs involve an increase in the morbidity and mortality rate, loss of timely diagnostic and therapeutic possibilities in patients in critical or chronic conditions, and additional healthcare costs in terms of resources and length of stay.

For their part, López Pérez et al. (2018) took a position based on the theory of Patricia Benner (From Novice to Expert: Excellence and Power in Clinical Nursing Practice, 1984), who argues that the more practical experience there is, the more predisposed one is to excellence, and they found a trend of a positive relationship between training and experience about the care of patients post-CVC installation. The measurement of 38 nurses was carried out before and after a specific educational intervention on the care of this type of patient, resulting in better performance by graduates compared to technicians and by the more experienced compared to the less experienced.

The everyday nature of this task could lead to a routinization of intravenous therapy practices with a loss of the necessary safety and quality recommendations. The authors have suggested that the main

factor influencing the variability of the technique for the care and maintenance of CVCs is the absence of written procedural protocols or, where they do exist, insufficient dissemination and socialization within the service; therefore, the creation and dissemination of institutional documents, together with activities to update and train nurses, appear to be an operational response to the problem raised. Furthermore, incorporating instruments to monitor the execution of techniques could significantly improve risk control in patient safety and favor the quality of care (Guerra de Campos & Aragón de Melara, 2017).

To consolidate CVC-related practice, Algieri et al. (2013) propose using protocols based on infection control recommendations and standards and broadening the focus to include economic considerations due to the impact of complications and adverse events linked to these practices. Specifically, using a Checklist for Patients with Central Venous Catheters can become a control and monitoring tool to evaluate the functioning of the hospital care system, identify adverse events or inconsistencies in the system, and provide helpful information in the decision-making process and interventions to solve problems. The authors, inspired by the WHO (2008) exhortations, place the issue of CVC patient care as one more item in the patient safety guarantee.

As a first general criterion in the care of patients with CVC, Vera Odar (2020) affirms that nursing actions are mainly focused on applying biosecurity measures that avoid exposing the insertion site and critical parts of the device to pathogens that can cause an associated infection. These measures are mainly hand washing, the use of gloves, and reducing the handling of the device to a minimum.

From the point of view of Vázquez Espinosa et al. (2021), the care of patients with CVCs should be considered from two fundamental elements: firstly, the aforementioned reference to following recommendations based on national and international guidelines and standards, and second, improving the professional mastery of nurses over the guidelines and care activities related to the management and maintenance of the device, the healing site and all the necessary measures for risk reduction, prevention and evolution of complications.

The Committee on Health Care Associated Infections and Patient Safety (IACS-SP) of the Argentine Society of Infectious Diseases (SADI) and the Critical Infectious Diseases Committee (CIC) of the Argentine Society of Intensive Care (SATI) on the approach to and control of infections in adult Intensive Care Units (ICUs) set out in Farina et al. (2019) make a series of recommendations and measures for the prevention of HAIs:

- Train healthcare personnel in the use of the CVC, proper insertion and maintenance procedures and measures to be taken to prevent BAC.

Periodically monitor the knowledge and application of guidelines by personnel assigned to these types of activities.

Only assign qualified personnel to these types of tasks.

Cover the insertion site with a transparent dressing or sterile gauze (preferably in patients with diaphoresis, exudate or bleeding).

- Follow aseptic technique for catheter insertion: surgical hand hygiene, use of sterile barriers (cap, mask, sterile gown, goggles, sterile gloves and sterile full-body drape), skin disinfection preferably with 2-4% chlorhexidine.
- Use 70% alcohol as an alternative antiseptic.
- Replace CVCs inserted with a non-aseptic technique within 48 hours and remove CVCs that are not necessary. In addition, do not routinely replace them unless they are considered to be infected. Anticoagulants should also not be used routinely to reduce the risk of infection.
- Change infusion sets as needed.
- Use a dedicated lumen for parenteral nutrition.
- Clean the connector with 70% alcohol every time solutions are administered.

The development of these strategies involves the multidisciplinary involvement of professionals who prescribe therapies, those who implant and maintain CVCs, infection control professionals, healthcare managers, and patients who can collaborate in the self-care of catheters.

A Central Venous Catheter (CVC) Maintenance protocol based on recommendations built on scientific evidence is published by Torres Muñoz et al. (2018):

1. As a general rule, when hygiene procedures and other activities that may pose a risk of contamination are carried out, the dressing and connections should be protected with clean textile material.

2. Daily monitoring of the insertion point of vascular catheters (without removing or handling the dressing) in search of warning signs and symptoms such as erythema, pain, and/or the presence of secretions, recording the checks carried out, date of healing, and dressing placement. To comply with this recommendation, use transparent, semi-permeable sterile dressings, except for bleeding or secretions when sterile gauze should be used. The dressing should be changed weekly, and the gauze should be applied every 48 hours or when visibly dirty, damp, or detached.

3. Hand washing and wearing sterile gloves in handling and healing procedures.

4. Healing of the insertion area, taking special care not to injure the skin when removing the dressing, and avoiding wetting the puncture point. As a general recommendation, contact with the insertion point should be avoided as much as possible.

5. Remove debris and blood stains with sterile gauze and saline solution.

6. Apply antiseptic (2% chlorhexidine) using iodine solutions or 70% alcohol as an alternative in cases of hypersensitivity. Then, leave to dry naturally. Do not topically use antibiotic- or antiseptic-containing ointments to protect the insertion point.

7. Handling equipment, connections, stopcocks, and connectors requires prior hand washing and gloves. The number of lumens and connectors of the CVC should be prescribed so that the installed catheter has no unnecessary lumens. Similarly, the number of stopcocks used will be minimal, and each lumen and stopcock will have its corresponding caps.

8. A single lumen of the three-way stopcocks will be used to administer boluses and intermittent solutions through a connector. This port will be protected with a cap that has been impregnated with an alcoholic solution for 30 seconds prior to removal. As a rule, the ports only receive connections of sterile material. A second line will be exclusively for parenteral nutrition.

9. Perfusion tubing, connectors, and stopcocks shall be replaced simultaneously and in total every 72-96 hours or when accidental disconnections have occurred. The date of replacement shall also be recorded.

10. The infusion of lipid-containing fluids that cannot be completed in 24 hours must be withdrawn and discarded; parenteral nutrition solutions and other lipid emulsions should be renewed every 12–24 hours.

11. The administration of blood products should be withdrawn if four hours have passed since the start of their infusion.

12. To maintain the patency of the catheter, it should be flushed with sterile physiological saline solution before and after medication administration and sealed at the end of the procedure. Flushing should be done with a minimum amount of saline (+/- 5 ml), using 10 ml syringes as recommended to preserve the integrity of the CVC. The CVC ports are sealed with a heparinized saline solution when not expected to be used immediately. The flushing and sealing procedures should be carried out using a positive pressure technique to avoid damaging reflux when disconnecting the syringe.

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CONCLUSIONS

Hospital-acquired infections pose a significant challenge to healthcare systems worldwide, especially in the context of managing medical devices such as central venous catheters (CVCs). This literature review article highlights that, although CVCs are essential tools for the medical care of critically ill patients, their use is associated with risks and complications that affect both morbidity and mortality, as well as healthcare costs.

The main complications related to CVCs are infections, which represent up to 14% of nosocomial infections and can lead to bacteremia and sepsis. Evidence shows that these complications are primarily preventable through the implementation of care protocols based on scientific evidence, strict biosecurity measures, and continuous training of healthcare personnel.

The role of nursing is critical in the prevention and management of complications associated with the use of CVC. Correctly selecting the device, applying aseptic techniques during insertion, maintaining and healing the catheter, and adhering to institutional protocols are fundamental actions to guarantee patient safety. However, the lack of standardized protocols and insufficient dissemination of clinical practice guidelines contributed to variability and the possibility of adverse events.

In addition, the review emphasizes the importance of multidisciplinary strategies to address the problem. These include specific training for nursing staff, regular monitoring of the implementation of guidelines, and using tools such as checklists to evaluate and improve care practices. Continuing education and practical experience are also highlighted as key elements to optimize professional performance and reduce the incidence of complications.

From a preventive perspective, biosecurity emerges as a priority. Basic measures such as hand washing, using sterile gloves, and disinfection of equipment and connections are essential to minimize the risks of extraluminal and intraluminal contamination. Likewise, the appropriate selection of the insertion site and the constant monitoring of the catheter insertion point are critical for preventing infections and other mechanical or thrombotic complications.

The economic impact of complications associated with CVCs is also considerable, not only because of the additional costs of treating infections and the prolongation of hospital stays but also because of the implications for patient's quality of life and the sustainability of healthcare systems. In this sense, investment in care protocols, staff training, and systematic monitoring is justified from a clinical perspective and an ethical and economic one.

Finally, the article highlights that the successful management of CVCs depends on a comprehensive approach that combines the practical experience of the staff, the use of appropriate technology, and institutional commitment to patient safety. Implementing national and international policies, such as those promoted by the World Health Organization and the Ministry of Health of Argentina, provides a valuable framework to guide actions aimed at reducing hospital-acquired infection rates and ensuring quality care.

In conclusion, preventing and managing complications associated with CVC requires coordinated action among the different health system actors, emphasizing training, protocol adherence, and continuous evaluation of care practices. This will not only positively impact clinical outcomes but will also contribute to the sustainability of health resources and the well-being of patients.

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CONFLICT OF INTEREST

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