Revisiones, Metaanálisis y Ensayos

The role of nursing in the prevention of catheter-associated infections in hemodialysis: A literature review

El papel de la enfermería en la prevención de las infecciones asociadas al catéter en hemodiálisis: revisión de la literatura

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RESUMEN

Introducción: Las infecciones asociadas al catéter venoso central son la principal causa de morbilidad y mortalidad en los pacientes en hemodiálisis. El personal de enfermería es el que principalmente realiza la manipulación del acceso vascular en el momento de la inserción, mantenimiento o retirada del catéter. El papel del personal de enfermería es fundamental en la prevención de infecciones locales y sistémicas.

Objetivo: Determinar las principales intervenciones implementadas por el personal de enfermería para reducir el número de infecciones asociadas a catéter en hemodiálisis.

Metodología: Se realizó una revisión bibliográfica en el periodo agosto 2021 a enero 2022. La búsqueda fue realizada en bases de datos como PubMed, Scopus, Access Medicine, Wed of Science, Medigraphic, EBSCO, Science Direct, y Google Scholar. Los términos de búsqueda fueron: (infections) AND (hemodialysis) AND (nursing).

Resultados: Se seleccionaron 94 estudios de los cuales se identificaron las principales medidas para la prevención de infecciones durante la instalación, mantenimiento y remoción del catéter para hemodiálisis. Ademas, se identificaron las limitantes de la evidencia para algunos procedimientos y los puntos que requieren mayor investigación.

Conclusiones: Las principales estrategias utilizadas para reducir la bacteriemia relacionada con los catéteres en hemodiálisis son: 1) el uso estricto de medidas higiénicas por parte del personal sanitario, 2) el uso de profilaxis antibiótica en el lugar de salida 3) la impregnación en la luz del catéter con solución antimicrobiana de bloqueo, 4) la formación continua y 5) la aplicación de un protocolo.

Palabras Clave: Catéter venoso central; infecciones; bacteriemia; hepatitis viral; intervención de enfermería.

ABSTRACT

Introduction: Central venous catheter-associated infections are the main cause of morbidity and mortality in hemodialysis patients. The nursing staff is the one who mainly performs the manipulation of the vascular access at the time of insertion, maintenance or removal of the catheter. The role of the nursing staff is fundamental in the prevention of local and systemic infections.

Objective: To determine the main interventions implemented by nursing staff to reduce the number of catheter-associated infections in hemodialysis.

Methodology: A literature review was conducted from August 2021 to January 2022. A search was conducted in databases such as PubMed, Scopus, Access Medicine, Wed of Science, Medigraphic, EBSCO, Science Direct, and Google Scholar. The search terms were: (infections) AND (hemodialysis) AND (nursing).

Results: Ninety-four studies were selected from which the main measures for infection prevention during hemodialysis catheter installation, maintenance, and removal were identified. In addition, we identified the limitations of the evidence for some procedures and the points requiring further research.

Conclusions: The main strategies used to reduce catheter-related bacteremia in hemodialysis are 1) strict use of hygienic measures by healthcare personnel, 2) use of antibiotic prophylaxis at the exit site 3) impregnation of the catheter lumen with antimicrobial blocking solution, 4) continuous training, and 5) implementation of a protocol.

Keywords: Central venous catheter; infections; bacteremia; viral hepatitis; nursing intervention.

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INTRODUCTION

Chronic kidney disease is one of the most frequent pathologies, worldwide one in ten people suffers from it[1, 2]. During chronic kidney disease, the kidney gradually loses the ability to perform physiological functions such as deleting metabolism products (acids and nitrogenous wastes) and regulating water, salts, and minerals in the blood[3].

In 2017, the global prevalence of chronic kidney disease was 9.1% and caused 1.2 million deaths, being the 12th leading cause of death in the world[4, 5] if the incidence is not reduced or controlled, it will rise to fifth place as a cause of death in 2040[6]. Currently, it has been reported a continuous increase in the need for renal replacement therapy, such as peritoneal dialysis, hemodialysis, and renal transplantation[7].

In hemodialysis, artificial equipment is used to perform the function of filtering the blood of the kidney, excess water and solutes are removed to maintain homeostasis when there is a loss of kidney function[8]. Nevertheless, hemodialysis therapy exposes patients to various life-threatening complications, such as dialysis imbalance syndrome, thrombosis, air embolism, venous needle displacement, hemolysis, cardiac arrest, hypotension, vascular access bleeding, infections, and sepsis[9, 10].

An infection is the main morbidity factor and the second cause of mortality in hemodialysis patients. Among the vascular accesses for hemodialysis, the central venous catheter (CVC) is the one with the highest risk of infection[11]. The hospitalization rate for CVC patients is 15.7 per 100 patients per month, while the hospitalization rate for patients with arteriovenous fistula is 7.7 per 100 patients per month[12]. The magnitude of this problem not only generates a critical situation and exposes patients at risk of infection, but also has high costs in health care[13].

Vascular access infections can occur at the time of insertion, maintenance, or removal of the catheter[14-16]. Nursing personnel participate in all these stages and play a fundamental role in preventing catheter-related infections. Many of the recommendations to reduce infection rates are applied directly by this personnel, in addition, they participate in patient education on vascular access care[11, 17]. Nursing indoctrination in vascular access management has been associated with a better prognosis and lower infection rates, the application of protocols based on the guidelines of the Dialysis Outcomes Quality Initiative (DOQI) reduces bacteremia rates by 6.97 per 1000 catheter days to 1.68 per 1000 catheter days[18].

Despite the above, there is a poor follow-up of the recommendations to reduce the rates of catheter-related infections, e. g., a study showed that only 70% of the nursing staff perform adequate hand hygiene, in addition, only 52% assess signs of infection[17]. Therefore, continuous education and updating of the nursing staff are essential. In this paper we performed a systematic review of published works related to the main CVC-associated infections, highlighting the main maneuvers and procedures performed by nursing staff to reduce the rate of CVC-related infections in hemodialysis. In addition, we discuss the limitations of the evidence and possible areas of research.

METHODOLOGY

The literature search was conducted from August 2021 to January 2022. A search was conducted in databases such as PubMed, Scopus, Access Medicine, Wed of Science, Medigraphic, EBSCO, Science Direct, and Google Scholar. The search terms were: (infections) AND (hemodialysis) AND (nursing). Articles in English and Spanish were included, including original articles, guidelines, protocols, meta-analyses and reviews. The criteria considered for the selection of information are as follows:

1) Inclusion: a) the information was published in specialized and indexed journals, b) articles addressing nursing measures for the prevention of catheter infections in hemodialysis, c) language: English/Spanish, d) region: international and national (Mexico).
2) Exclusion: a) journalistic notes, conference proceedings, web pages and publications without peer review.

Two collaborators independently reviewed all the titles and abstracts generated by the search, from which studies were selected for full review, leading to the identification of eligible studies.

RESULTS

Studies in English and Spanish with full access to the article were included. No restriction on the publication period of publication was applied. The main recommendations for nurses to avoid catheter infections in hemodialysis were obtained from the articles and a narrative systematic review was performed. **Figure 1** shows the flow diagram of the search and selection of studies.

Vascular access: catheters for hemodialysis

Vascular access refers to the area where the machine interacts with the patient and the nurse will have to manipulate it for therapy to take place. Vascular access must follow criteria such as allowing a safe and continuous approach to the vascular system, providing sufficient flow for the hemodialysis dose, and being free of complications[3].

There are three types of vascular access, the preferred one is the arteriovenous fistula, this is carried out by anastomosis of an artery and a vein; other vascular access is the arteriovenous prosthesis whose implantation must be performed three to six weeks prior to its use; the third is the CVC, considered a temporary catheter[19]. The guidelines suggest that the first option is the arteriovenous fistula and the last the

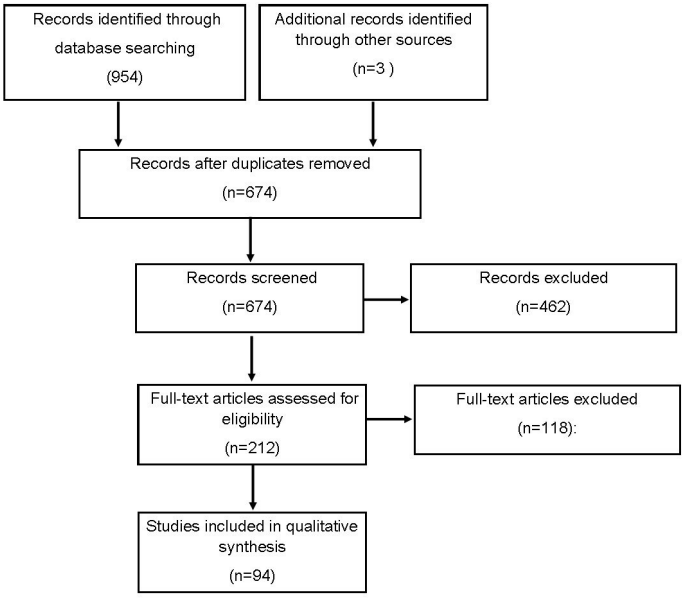

Figure 1. Flow diagram of the publication search and selection process.

CVC, due to the increased risk of sepsis. The fact is that infectious complications are multiplied by 4 with the use of temporary catheters compared to definitive catheters[20]. CVC is recommended when the expectation of hemodialysis is short or the life expectancy of the patient is limited, as in the case of metastatic cancer, severe heart failure, or advanced age[20].

The CVC has multiple functions such as drug administration, fluid therapy administration, total parenteral nutrition, hemodynamic monitoring, and hemodialysis therapy[21]. CVCs can be tunneled for long-term use (≥ 3 months) or non-tunneled for short-term use (<14 days)[22]. The use of uncuffed and non-tunneled catheters has been associated with an increased risk of infection[23]; these types of catheters are applied when immediate hemodialysis is required, imaging guidance is not available, or the patient presents sepsis or coagulopathy[11].

Complications caused by the catheter installation

The risks and complications of the hemodialysis therapy can occur at the time of insertion, during maintenance, or removal of the CVC[14]. Some of the complications are immediate, such as arterial puncture, which occurs in 4.4% to 9.3% of all CVC placements[24].

An arterial puncture can produce bruising, cerebrovascular accidents, thrombosis, cardiac tamponade, and in some cases when the CVC is placed inguinal, ischemia in the extremities[24]. Although bleeding is rare, in 4.7% of cases bruises can form on the neck, putting the patient's life at risk[25]. Also, thrombosis occurs as a result of trauma and endothelial inflammation. The use of anticoagulants is a preventive option in 70 to 80% of cases of deep vein Thrombosis[21].

A bad puncture can also cause a lesion in the pleural membrane, causing the entry of air from the atmosphere into the pleural cavity and leading to a pneumothorax. An indicator of this problem is observing air in the syringe when performing the procedure[26]. Likewise, arrhythmias are frequent problems, they occur when the guide is inserted in the right side of the heart more than 16 cm, producing irritation in the muscle of the superficial cardiac tissue. Arrhythmias present as supraventricular in 40%, ventricular in 25%, and bigeminy or other types of ventricular ectopias in 11%[24].

Air embolism is another serious complication, moreover, it is the one that goes unnoticed the most; it can occur both when the catheter is inserted and when is removed. Triggers that contribute to the development of a venous air embolism include poor patient positioning, hypovolemia, spontaneous inhalation during the procedure, and failure to seal the catheter[21].

Infections associated with the hemodialysis catheter

Other complications are late, such as the development of infections. These infections mainly cause have high rates of hospitalization and mortality, and an increase in medical care costs in CVC patients[27]. The diagnosis of an infection depends on the clinical manifestations and the results of microbiological studies. Clinical manifestations include fever (≥ 38° C), chills, hypotension, pus, redness, and pain[28].

Invasion of the pathogen occurs by four different routes: 1) colonization of the catheter tip and cutaneous tract with cutaneous microbiota, 2) colonization of the catheter lumen caused by contamination, 3) hematogenous seeding of the catheter from another infected site, and 4) contamination of the catheter lumen with infusion[29, 30]. The microorganisms adhere and colonize the catheters, in some cases, they can form biofilms from which they achieve hematogenous dissemination[27].

Bloodstream infections

Bloodstream infections or bacteremia are one of the most frequent, extremely fatal, and costly complications of a central venous catheter; these are the most common cause of nosocomial bacteremia[27]. The KDOQI-2019 guideline defines CVC-related bacteremia as the presence of clinical manifestations such as fever, chills, or hypotension, and at least one positive blood culture from a peripheral resource (vein or dialysis circuit) that identifies the same organism as a culture of a segment of the catheter (hub or tip), in addition to any other apparent source of infection[11]. Symptoms present during CVC-related bacteremia also could include vomiting, changes in mental status, malaise, and nausea. Erythema, swelling, tenderness, and purulent drainage are seen at the catheter exit site[27, 31]. When observing the presence of these symptoms, a sample for blood culture should be taken before starting antibiotic treatment.

Bacteremia is usually caused by microorganisms that colonize the skin such as *Staphylococcus aureus*, Coagulase-negative *Staphylococcus*, *Corynebacterium* spp, *Bacillus* spp, *Candida* spp, among others[32]. Some studies have shown that gram-positive bacteria affect the patient the most[33]. Short-term catheters are colonized by any of the aforementioned microorganisms, while most long-term catheters are colonized by *Staphylococci*, especially *Staphylococcus epidermidis* and *S. aureus*, reaching values greater than 90%[14]. Non-tunneled CVC causes 90% of vascular catheter-associated bacteremia in intensive care units[14].

Treatment of CVC-related bacteremia should be immediate and include broad-spectrum antibiotics[11]. Antibiotics are selected considering the results obtained by blood culture tests. If the patient's symptoms are unstable, empirical treatment is recommended. The application of a lipopeptide such as daptomycin, associated with an aminoglycoside such as tobramycin or amikacin, a monobactam such

as aztreonam, or a third-generation cephalosporin can be the empirical therapy of choice in most circumstances. In situations where they are multi-resistant bacteria, carbapenem can be used; and fluconazole in candidemia[14].

When using an empirical treatment for bacteremia, it is important to consider the epidemiology of each hospital, which should be constantly updated approximately every 6 months. It is recommended to have an empirical treatment that includes coverage for the most frequent gram-positive cocci and gram-negative bacilli[34]. If the infection is not controlled in time, a stage of severe sepsis and infectious complications such as infective endocarditis, septic arthritis, osteomyelitis, spinal epidural abscess, or septic emboli can occur[35].

Endocarditis

Endocarditis is another complication associated with the use of vascular access, mainly the mitral valve and the aortic location are affected. The most common symptoms are febrile syndrome, hypotension, and leukocytosis. Blood cultures and transesophageal echocardiography are used for diagnosis[36].

The microorganism that most frequently causes endocarditis is *S. aureus*; the most commonly used antibiotics are vancomycin and carbapenems, which are administered for prolonged periods, in high doses and intravenously[37]. The duration of treatment will be prolonged until the blood cultures are negative, in special cases where the affectation is on the valves, the duration of treatment is between 4 to 6 weeks[38].

Viral hepatitis

Virus infections are more common in hemodialysis patients than in the general population, since patients are frequently transfused, immunosuppressed, and constantly subjected to this invasive procedure where there is blood manipulation[39, 40]. Hepatitis C virus infection in hemodialysis patients can manifest asymptomatically and has a slower progression, which is a different course of infection in patients with normal renal function[41].

It is recommended to carry out serological and molecular studies to detect the viral particle, its antigens, or DNA, and thus rule out the presence of hepatitis B or C viruses at the beginning of hemodialysis therapy; subsequently carry them out annually[39, 40, 42]. Early diagnosis allows immediate treatment and isolation of hepatitis B or C positive patients. Another measure that reduces the transmission of hepatitis B or C in hemodialysis centers is mandatory vaccination before beginning therapies[40].

It is also advisable to maintain adequate hygiene conditions during the transfer of fluids, for which the circuit lines must be strictly inspected hence the blood is not contaminated. The ideal is to decontaminate the machines used in each session and employ a different machine for patients infected by a virus[43].

Prevention of the spread of COVID-19 and hemodialysis catheters

During the COVID-19 pandemic by SARS-CoV-2, stricter measures have been imposed on the care of patients in hospitals, e. g., the visits are not allowed or have a reduced time, in addition, the hospital staff wears face masks, gloves, and a regular hand washing is carried out. This procedure reduces the interaction between the physician, nursing staff, and patients, which has reduced the rate of infections in different procedures such as neurological[44] and the application of intravenous catheters. Catheter-related bloodstream infections have been reduced by up to 83%[45].

The role of nursing in the prevention of infections related to hemodialysis catheters

The nursing staff is responsible for maintaining the integrity of the vascular access, moreover, they play the primary role in preventing catheter-associated infections[46]. Their interventions must be aimed at preventing infections in hemodialysis; therefore, it is important to use an adequate protocol. Knowledge and follow-up of this protocol, continuous training, and the use of barrier measures have made it possible to reduce the rate of catheter-related bacteremia[47-50]. In the following, we describe the main recommendations for the installation, maintenance, and removal of the vascular catheter in order to reduce the rate of catheter-related infections (**Table 1**).

Recommendations for the installation of the vascular catheter

Patient education is an important factor to consider before the installation of the vascular catheter, the explanation can be verbal and supported by printed material. Information should be included on where the catheter will be placed, how will it be placed, and how to take care of it[46].

CVC must be implanted at the time that treatment is required. The most common insertion site is in the right internal jugular vein due to its structure, location, straight intravascular route, and lower risk of forming thrombosis[51]. Other recommended places for CVC installation include the subclavian vein and the femoral vein[52].

Fluoroscopic and ultrasound image-guided CVC placement is recommended to improve insertion success[11, 51]. Placement should be carried out using the aseptic technique. The nurse responsible for the procedure must perform surgical handwashing, then put on a face mask, a cap, and a sterile gown, all professionals around 1 m from the patient must wear a face mask[52, 53].

The insertion site is marked with an indelible marker and prepared with a sterile drape[54]. The skin is disinfected with 2% chlorhexidine, emphasizing the use of antimicrobial and tunneled catheters with a handle, in addition to local topical treatments and the use of antimicrobial blocking solutions. The femoral site should also be avoided as far as possible[55, 56]. If the CVC has been installed non-aseptically, it must be replaced in less than 48 hours[21, 57].

Recommendations for the maintenance of the vascular catheter

The nursing staff is the one who performs the follow-up and the first detection of a CVC-related infection[46], they must be alert to the emergence of signs of infection such as swelling, erythema, fluctuation, fever, and pain to palpation[11].

Table 1. Recommendations for the installation, maintenance, and removal of catheters for hemodialysis.

Phase	Recommendations	References
Installation	– Proper hand hygiene before and after inserting and handling a vascular catheter. – Wear protective equipment (gloves, face mask) when handling the catheter. – Use 2% aqueous or 0.5% alcoholic chlorhexidine in the preparation of the skin. – Use ultrasound guidance for all cuffed and tunneled CVC insertions. – Make sure the lines are correctly fixed to avoid the discharge of secretion or solution. – Use topical bacitracin/gramicidin/polymyxin B ointment or povidone-iodine ointment at the catheter exit site.	11, 56, 81, 83-85.
Maintenance	– Use the exclusive catheter for hemodialysis. – Remove the heparin from the catheter lumen prior to connection. – The catheter must be kept dry and secure to avoid pulling. – Prevent getting air into the catheter. – Close the catheter clamps when not in use. – Use the appropriate dose of heparin to block the HD catheter. – For femoral catheters, prolonged sitting should be avoided due to the risk of thrombosis. – Carry out the aseptic practice of the implant and cleaning of the catheter after routine use. – Use antimicrobial blocking solutions or ethanol on the catheter – Clean the intravenous ports for 15 s with chlorhexidine. – Place a 2% chlorhexidine gluconate dressing. – Clean the patient's hands with 2% chlorhexidine, three times a day. – Daily patient bath with 2% chlorhexidine wipes. – Daily evaluation of the patient by the head of nursing. – Instruct the patient to go for a medical check-up in case of bleeding. – In case of pain, pus discharge, redness, fever, refer to review for possible infection. – Evaluate the need to continue using the central venous catheter.	64, 84, 86-91.
Removal	– Place the patient in the supine or Trendelenburg position to prevent air embolism. – Teach the Valsalva maneuver to patients who can cooperate in preventing air embolism by increasing central venous pressure, or failing that, by removing the catheter during active expiration of the patient. – Do not remove the catheter in case of physical resistance and request the evaluation of an intensivist doctor. – Apply digital compression to the ostium for 5 min to promote hemostasis. – Keep the patient in the supine position for at least 30 min after removing the CVC. – Apply a sterile adhesive cover for 24 hours.	92-94.

Some recommended strategies to reduce the rates of catheter-related infections include minimizing CVCs manipulation, limiting CVC use to trained personnel, and regularly training staff[11]. Instructing the patient, medical and administrative personnel about the current guidelines to avoid infections related to vascular catheters is part of the multidisciplinary protocols. Furthermore, the daily establishment of the need to continue with CVC is part of the best catheter maintenance practices[58].

The KDOQI guide recommends establishing an infection control program that includes monitoring CVC-related infection, hospitalization, and death rates[11]. A possible method to reduce bacteremia is to perform cultures of the CVC lumen before hemodialysis therapies, if the cultures are positive, a blocking therapy with antibiotics can be used to eliminate the bacteria in the catheter biofilm[59]. Although, there is little evidence to support the cost-benefit ratio of this practice[11].

Also, the use of antibiotic blocking solutions is suggested in patients who require a long-term CVC and have a high risk of catheter-associated infections[11]. The use of antimicrobial blocking solutions in hemodialysis catheters is superior to the use of heparin solutions alone[60-64]. The use of antimicrobial blocking solutions has not shown consistent adverse events and there is no evidence of the development of antimicrobial resistance at 12 months[60]. Some of the antibiotics used as a blocking solution are gentamicin, taurolidine, minocycline, cefazolin, and cefotaxime[65-69].

The use of topical and intraluminal antibiotics reduces bacteremia rates and the need to remove the catheter. However, due to the length of the studies, it has not been established whether these treatments promote bacterial resistance to antibiotics[64]. Concern about bacterial resistance to antibiotics means that the use of antibiotic blocking agents is recommended only in patients at high risk of bacteremia, such as *S. aureus*-positive patients, or in units with high rates of bacteremia[11].

The nursing staff supervises the dressing[46], at the time of dressing change, the skin should be cleaned with a chlorhexidine solution, and care should be taken not to touch the open ports and the ends of the CVC with hands or gloves. If the patient is allergic to chlorhexidine, a povidone-iodine solution can be used as an alternative[11]. No advantages have been described in the use of transparent dressings compared to non-transparent dressings[70]. Dressing changes should be done at the discretion of the physician, a minimum of once a week. Routine application of ointments containing mupirocin, povidone-iodine, medical-grade honey, or topical antibiotics to the CVC outlet site reduces the risk of catheter-related bacteremia by between 75% to 93%[11].

Recommendations for removal of the vascular catheter

The using time of a non-tunneled, cuffless dialysis catheter should be limited to a maximum of two weeks to reduce the risk of bacteremia[11]. Regarding the tunneled and cuffed catheter, there is no maximum time limit, but its continuity should be evaluated to consider other alternatives[11]. The catheter can be removed by trained nursing staff due to a catheter-related infection or by prescription[46]. The position of the patient when removing the CVC will depend on the type of it. In the case of tunneling, it can be removed with the patient seated, whereas in the non-tunneled patients is removed in the supine or Trendelenburg position[46].

During an infection, late removal of CVC has been associated with higher mortality, at approximately 30 days[71, 72]. CVC reinsertion in patients with catheter-related bacteremia increases the prevalence of persistent bacteremia compared to patients without reinsertion. However, there are no differences in the prevalence of persistent bacteremia between patients who had early reinsertion (3 days after removal) and those with late reinsertion (more than 3 days)[73].

Approximately 28% to 100% of CVCs are surrounded by a fibrin sheath that in some cases can calcify[74]. This fibrin sheath can facilitate the formation of bacterial biofilms from which an invasion into the bloodstream can occur[75]. When removing the CVC, the presence of the fibrin sheath can increase the risk of pulmonary embolism[76]. The fibrin sheath may persist within the vein after catheter removal, which can lead to complications such as arterial thrombotic events and ectopic calcification[77].

The risk of developing a fibrin sheath and a biofilm depends on the presence of prothrombotic factors and the degree of procalcifica-

tion, mainly in patients with systemic lupus erythematosus, kidney disease, infection, or a prolonged time of catheter use[74]. It is important to identify these risk factors in patients to implement the appropriate surveillance measures. Some prevention measures include keeping serum calcium and phosphorus at normal levels[74]. The KDOQI guidelines recommend that the decision to rupture the fibrin sheath during central catheter removal be based on clinical judgment[11].

Challenges in monitoring protocols

Despite the existence of clinical practice guidelines on the management of CVCs for hemodialysis, a wide variation has been identified in the practice of nursing staff[46]. Reasons that could be cited for lack of adherence to clinical practice guidelines include lack of confidence in the evidence from studies, as well as the belief that the recommendations cannot be applied to all cases[46, 78].

Deficiency of aseptic technique during cannulation and decannulation, lack of periodic follow-up and assessment of vascular access, lack of instructions given to patients for vascular access maintenance, and inadequate management of vascular access complications have been reported[79]. For this reason, the importance of training nursing staff in the application of updated protocols, risk monitoring, and improvement plans to reduce the risk factors for infection of hemodialysis catheters is highlighted.

It is necessary to implement measures such as continuous education and evaluations through the development of a comprehensive safety plan based on the following points: 1) evaluate the safety culture (basal and periodic measurement), 2) training in patient safety, 3) identify errors in routine practice, 4) establish alliances with the institution's management to improve security, and 5) learn from mistakes[80, 81].

Another problem to consider is the quality of information available on the effectiveness of programs that seek to reduce vascular catheter complications. A meta-analysis evaluated the evidence on whether nursing care during insertion, maintenance, and removal reduces the occurrence of adverse events due to the use of CVCs. The outcomes showed that the evidence is of low quality because many studies use a pre-test-post-test design, which is susceptible to bias - only one study was a randomized clinical trial[58]. Therefore, rigorous studies with consistent designs are required to evaluate the efficacy of nursing interventions in the care of patients with catheters for hemodialysis, especially in the intensive care unit.

Some issues that require further study include determining the usefulness of medical history, physical examination, and monitoring to avoid CVC dysfunction, infections, and other complications[11]. It is also necessary to evaluate whether the use of blockers with antibiotics increases long-term bacterial resistance, both patients and at the institutional level. It is necessary to develop projects in which patients are classified according to their risk of bacteremia and evaluate the advantages of prophylactic treatment.

Finally, the lack of nursing staff is a factor that significantly affects the incidence of catheter-associated infections[82]. Besides, the administrative staff must ensure the conditions of infrastructure and supplies necessary to provide safe and quality care to patients[58].

CONCLUSION

Since it is the nursing staff who perform the installation, maintenance and removal of hemodialysis catheters, their role in reducing infections is fundamental. The strategies used to reduce bacteremia related to hemodialysis CVCs have proven to be useful, the main ones being the strict use of hygienic measures by healthcare personnel, the use of antibiotic prophylaxis at the exit site and the impregnation of the catheter lumen with antimicrobial blocking solution. The application of antibiotics has been shown to be a safe strategy that does not generate microbial resistance. In addition, continuous training, multidisciplinary work, and the application of a protocol are essential to reduce the rate of catheter-related bacteremia in hemodialysis.

The lack of adherence to guidelines and the validity of the evidence of some practices are two of the main challenges to be faced. On the other hand, several studies evaluating the efficacy of interventions to reduce CVC-related infections are based on designs that are considered biased, so it is necessary to determine the efficacy and cost -benefit ratio of various practices, in addition to validating some already established with adequate designs such as randomized clinical trials. Among the aspects that require further research is to evaluate the usefulness of catheter lumen culture prior to hemodialysis therapy and to evaluate the efficacy of prophylactic treatments in patients at high risk of infections.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

DISCLOSURE OF GRANTS

None.