NURSING INTERVENTIONS FOR HEMODIALYSIS PATIENTS THROUGH CENTRAL VENOUS CATHETER

INTERVENÇÕES DE ENFERMERÍA NO PACIENTE EM HEMODIÁLISE POR CATETER VENOSO CENTRAL

INTervenciones de Enfermería en el Paciente en Hemodiálisis por Catéter Venoso Central

Objective: to discuss nursing interventions undertaken by nurses to nursing prescription in patients using temporary double-lumen central catheters for hemodialysis based on the Nursing Intervention Classification.

Method: descriptive exploratory study with quantitative approach conducted in a private hemodialysis unit in the state of Minas Gerais (MG), Brazil, with 57 patients, aged >18 years and <60 years undergoing treatment for 90 days. Results: two nursing interventions were identified: care with the vascular device; maintaining access for dialysis. Eight activities were selected: measuring temperature; dressing; monitoring signs and symptoms of infection; maintaining the aseptic technique; standard precaution; changing protectors; use of heparin in the lumen; guiding the patient and the family. Conclusion: nursing intervention is effective for maintaining the catheter, controlling and avoiding complications; it has scientific basis and promotes safety and well-being. The nurse must perform nursing care in patients using temporary double-lumen central venous catheter.

Descriptors: Renal Dialysis; Renal Insufficiency; Catheters; Quality of life; Nursing.

RESUMO

Objetivo: discutir as intervenções de enfermagem assumidas por enfermeiros para a prescrição de enfermagem dos pacientes em hemodiálise por cateter venoso central temporário de duplo lúmen a partir da Classificação das Intervenções de Enfermagem. Método: estudo descritivo-exploratório, de abordagem quantitativa, realizado em unidade de hemodiálise privada, no interior do estado de Minas Gerais (MG), Brasil, com 57 pacientes com idade >18 anos e < 60 anos, em tratamento há 90 dias. Resultados: foram identificadas duas intervenções de enfermagem: cuidados com o dispositivo vascular; manutenção do acesso para diálise. Selectadas oito atividades: aferir temperatura; curativo oclusivo; monitorar sinais e sintomas de infecção; manter técnica aséptica; precaução padrão; trocar protetores; uso de heparina no lumen; orientar o paciente e familiares. Conclusão: a intervenção de enfermagem é efetiva para a manutenção do cateter, controle e combate de suas complicações; possui base científica, promove a segurança e bem-estar. O enfermeiro deve realizar o cuidado de enfermagem no paciente em uso de cateter venoso central temporário de duplo lúmen.

Descritores: Diálise Renal; Insuficiência Renal; Cateteres; Qualidade de Vida; Enfermagem.

ABSTRACT

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INTRODUCTION

Chronic kidney disease (CKD) has diabetes and hypertension as main causes and has become a worldwide public health problem due to its high prevalence rate. Because of this, increasing numbers of patients need dialysis therapy for the rest of life, due to the irreversible failure of renal function. In Brazil, estimates of the Brazilian Society of Nephrology indicate that there are 100,397 patients undergoing dialysis, and that the number is increasing in the order of 3% per year.1-3

The substitutive method employed on large scale in patients with chronic kidney failure (CKF) in Brazil and worldwide is hemodialysis. This therapy requires a technological apparatus involving machinery, materials, trained professionals and the preparation of vascular access (VA) in the patient. The latter can be obtained basically through two ways; by creating an arteriovenous fistula (AVF) or by implanting a double-lumen central venous catheter.4

The catheter can be classified as long or short term. The first is implemented by a vascular surgeon and has one or more Dacron cuff in its structure. The aim is to form a mechanical barrier against microorganism penetration in the subcutaneous and vascular bed. The second type, the temporary double-lumen catheter (CVC), is usually implemented by a nephrologist through percutaneous technique and has no cuff. This is one of the main alternatives to obtain VA used in domestic clinical practice and its prevalence is 9.4%.2,5

There is a tight link between the process of hemodialysis and life maintenance, as this treatment partially replaces kidney functions. For this, systematic nursing action becomes necessary for patient care in hemodialysis CVC for maintenance and prevention against complications, whether infectious, thrombotic or traumatic. The CVC is the faster and more secure option of central venous access in the case of hemodialysis for short periods of time.1

The use of CVC was introduced in the mid of the last century and, from then on, became essential for hemodialysis. Although the intravascular device allows fast access to the bloodstream, its use is related to bacteremia and candidemia, with significant rates of morbidity and mortality and increased hospital costs.6-7

Because the CVC technique is a type of central venous catheter, it must follow the rules of asepsis and should be performed by trained professionals using maximum protection barriers, such as use of fields, gloves and sterile aprons, beanies, goggles and masks. Studies show that the incidence of central venous catheter infection in ICU patients is less than 8% over two weeks. In one month, 25% of catheters become infected and this percentage doubles in the second month. Catheter-related sepsis may occur between 2% and 20% of cases. This calls for reflections on the use of CVC in hemodialysis patients, and for criticism on aspects related to its use and maintenance.1-7,8

In the United States, more than 200,000 patients need hemodialysis and 30% do so through a catheter. It is estimated that 250,000 catheters are implanted per year and 87% of bloodstream infections are caused by them. In Brazil, the overall rate of catheter-related bloodstream infection is 17.05/1000 invasive devices per day, considering a percentile of 95%. This situation entails cost to the health system because it can lead to hospitalization, increasing the cost of treatment and reducing the quality of life of hemodialysis patients, besides increasing morbidity and mortality.6-7

Thus, the safe handling of CVC should be a priority of the entire nursing staff that provides assistance to these patients, so that technical and monitoring rigor and surveillance happen to prevent and control possible adverse events. Considering the complexity of deployment and use of this type of vascular access, technical standardization is indispensable. It is also important to note that prevention and control of CVC-related complications are mostly of the nursing staff responsibility. This must ensure the quality of health care, promoting safety for patients and professionals.6-7

The justification and relevance of the study is in the fact that the CVC is widely used in hemodialysis patients. Its use requires engagement from nurses in order to minimize risks to health by reducing morbidity and mortality in this clientele. Therefore, it is necessary to know the nursing interventions used in the care of patients using CVC, so that the relevance of each intervention be evaluated.

In order to avoid doubts, we need to conceptualize the term nursing intervention (NI). Nursing Interventions consist in any action focused on persons-humans, families, communities and treatments started by nurses or other professionals.8 With these...
considerations in mind, the present study had the following objective:

- To discuss nursing interventions undertaken by nurses to nursing prescription in patients using double-lumen catheterization for temporary hemodialysis based on the Nursing Intervention Classification.

**METHOD**

Descriptive study with quantitative approach carried out in a hemodialysis unit of a private institution located in the city of the countryside of Minas Gerais, Brazil. The unit has 180 patients undergoing dialysis and has a multidisciplinary team composed of three nurses and four doctors, all experts in nephrology; one pharmacist, a social worker, a nutritionist, a psychologist and a vascular surgeon.

Data collection was conducted from October 2014 to October 2015, totaling 12 months, by consulting hospital records of patients undergoing hemodialysis using CVC in the period studied. In this time interval, 175 patients underwent hemodialysis three times per week, with an average duration of four hours. Inclusion criteria were: adults of both sexes; age > 18 years and < 60 years; and undergoing treatment for at least ninety days. The sample was composed of 57 patients.

A data collection instrument was designed for registering the information on sociodemographic data, aspects related to the implant of the CVC, dialysis evaluation parameters, laboratory tests of interest, identification of nursing diagnoses made by nurses according to Taxonomy II, NANDA I, NIC, namely: care

**RESULTS**

Among the 57 patients undergoing hemodialysis using CVC, most (75%) were males, ages ranged between 20 and 59 years, 64% were married and 57% were Catholic Christians. As for education, 46% had primary education and 20% were illiterate. About implant of the CVC, it was observed that 70% were installed in the right internal jugular vein, while 12%, in the right femoral vein. As for the causes related to implant removal, 70% were due to AVF maturation, and 20% due to infection. Regarding hemodialysis dose measured by Kt/V, 70% values between 1.1 to 1.2; 82% had blood flow above 250 ml/min. Table 1 shows the causes of CKD in patients undergoing hemodialysis using CVC.

| Table 1. Etiology of patients undergoing hemodialysis using CVC - Unit of Renal Replacement in the State of Minas Gerais (MG), Brazil, 2015. |
|-----------------------------------|-----|-----|
| Etiology of CVC                  | n=57| %   |
| Hypertensive nephropathy         | 29  | 50  |
| Diabetic nephropathy             | 14  | 35  |
| Chronic glomerulonephritis       | 09  | 10  |
| Other                            | 05  | 05  |

Taking advantage of the Nursing Diagnosis of Taxonomy II of NANDA I, nurses established two diagnoses related to vascular access in hemodialysis patients using CVC and from these, professionals (100%) elected two titles of Nursing Interventions - NIC, namely: care with the vascular device and maintaining the access for dialysis. The association of activities present in the interventions made it possible to list actions for the formulation of eight nursing prescriptions to patients undergoing hemodialysis through CVC, namely: (1) measuring pre/post-treatment axillary temperature; (2) maintaining an occlusive dressing; (3) monitoring signs and symptoms associated with local and systemic infection; (4) maintaining the aseptic technique whenever CVC is manipulated; (5) maintaining standard precaution; (6) replacing the protective covers of the CVC after each hemodialysis session; (7) maintaining permeability of the access with heparin after hemodialysis session; (8) guiding the patient and the family on maintenance of the CVC.

**DISCUSSION**

The study identified the prevalence of males among hemodialysis patients using CVC. Survival studies with patients using this therapeutic modality indicate the predominance of males, and they cite especially cardiovascular disease as the leading cause of mortality. Age ranged from 50 to 59 years in the studied clientele. This
variable has been listed as a risk factor for mortality and diminished health-related quality of life (HRQOL).9

The HRQL is defined as the person's perception of their own health through a subjective evaluation of symptoms, satisfaction and adherence to the proposed treatment. The CKF reduces the physical and working functions of individuals to a great extent, as well as affects the people's perception of their own health. This results in negative impacts on energy levels and vitality, which can reduce or limit social interactions and cause problems related to the mental health of the patient.10

In the study, 57% of patients reported having the Catholic faith. The mechanism by which spirituality influences the health and well-being of people is unclear, although researchers and clinicians believe that spirituality and health have important connections. As for education, 46% of patients had primary education only, and 20% were illiterate. This condition is a risk factor for reduction of HRQL, a fact confirmed by several studies.1,2,7,13

As for etiology, 50% had hypertensive nephropathy as cause of CKF, 35%, diabetic nephropathy, 10%, chronic glomerulonephritis and 5% had other causes. These data were also found in the Brazilian Chronic Dialysis Survey of 2013. There was no significant change in these causal agents in the last three years. As for the site of CVC implantation, 70% were in installed in the right internal jugular vein. This is the site most often chosen because it presents less complications and easier access. The second site is controversial and should be set according to anatomical and functional characteristics of patients.2,7,13

As for causes that led to removal of the CVC, 70% were associated with maturation and 20% with AVF infection. It can be stated that catheter infection is a high risk factor and represents the most frequent complication. The incidence of bacteremia varies; it is greater among patients using non-tunneled catheter in the order of 4 to 6 for 1000 catheters/day. It is noteworthy that the infection associated with CVC can vary, and clinical findings are nonspecific and have low sensitivity.1,2,7,13

Furthermore, the dose of dialysis, as measured by Kt/V, is one quality indicator of the treatment. The recommended value for three sessions a week should be greater than or equal to 1.2. The Kt/V result obtained in this study varied from 1.1 to 1.2, with blood flow higher than 250 mL/min. The average is within the recommended by the Daugirdas formula.2,14

♦ Nursing interventions for handling patients using CVC

♦ Measuring pre/post-treatment axillary temperature

Body temperature is the difference between the heat generated by bodily processes and the heat lost to the environment. It is regulated by the hypothalamus, located within the brain. The anterior portion of the hypothalamus controls heat loss and the posterior region, heat production. It is known that several factors can affect body temperature, including age, hormone levels, chronic diseases, stress and heart rate.15

Various parts of the body can be used for measurement, but for the nursing staff, studies indicate the axillary site is most frequently used in adults. This route is safe, accessible and presents less risk. However, studies indicate that measurement of the tympanic membrane temperature with infrared device provides the best results, with correspondence with the internal temperature of the human body.15

Hemodialysis patients have peculiarities that must be considered when using the axillary temperature measurement technique. The first is that, for unknown reasons, 50% of patients have subnormal body basal temperature. Thus, a small change in the temperature represents an increased risk for infection.16

The second is that the vascular access site for hemodialysis is responsible for 50 to 80% of cases of infection related to the therapy. Such infection may cause the patient to develop bacteremia and in more severe cases, endocarditis, meningitis, osteomyelitis, paraspinal abscess and septic emboli. These situations are serious in clinical practice and corroborate the rise of morbidity and mortality.16

So, it is very important that nurses who assist hemodialysis patients using CVC, promote educational activities in the nursing staff to enable these professionals to recognize the value and importance of measuring the patient's temperature before and after treatment. Because of the CKF and of the risks of dialysis itself, these patients may be more exposed to contaminants and consequent infection.

♦ Maintaining occlusive dressing

Study shows that the maintenance of the occlusive dressing of the CVC is a way of protecting the catheter insertion site from colonization by microorganisms. There are
different dressings in the domestic scene. Gauze, tape and transparent polyurethane film are most commonly used. These dressings vary in durability, ease of application, probability to cause skin reaction and ability to prevent infection.\textsuperscript{17,8}

There is controversy in the literature on the use of prophylactic antibiotics in the CVC insertion site. For some, the prophylactic use of antibiotics does not determine the reduction of catheter infection rates and suggest that risks actually increase with this procedure. Blood infection associated with CVC, with Staphylococcus sp. as agent, is commonly found in the literature.\textsuperscript{17,8}

The Center for Disease Control and Prevention - CDC recommends the use of dressing composed of gauze and tape in the case of diaphoretic patient. This fact is based on scientific evidence that the transparent dressing does not have the ability to absorb exudate and, therefore, may predispose the patient to bloodstream infection. Fixing the bandage is considered also relevant, because this allows it to remain occlusive up to the next change, preventing colonization of the CVC implant site. The margins of the dressing are observed to come off easily from the skin in the case of transparent film. It is inferred that each person's skin characteristics may interfere with the quality of fixation. Diaphoretic patients or patients with higher oiliness on the skin have difficulty to keep the dressing steady, in general, regardless of the material used.\textsuperscript{17,8}

Another important aspect to maintain the CVC is the probability of the material of inducing local reaction. Studies indicate that the bandage made up of gauze and tape has been associated with greater probability of developing local reaction, most often, in the contact areas of the adhesive tape with the skin. On the other hand, there have also been observations that, though less incident, the local reaction is observed in the contact region of the transparent dressing adhesive portion to the skin. As for the interval between changes of the occlusive dressing, this depends on the type of material used and on the external aspect of the dressing. Thus, if sterile gauze is used in the occlusive dressing, a change must be processed every session and in the case of transparent film, every seven days or even sooner, if necessary.\textsuperscript{17,9}

It is known that the presence of skin injury increases the risk of infectious complications in patients using catheter. Thus, the procedure of maintaining an occlusive dressing can contribute to reduction of skin reaction, without increasing the risk of infection. This is confirmed by a study that analyzed the maintenance of occlusive dressings for central venous catheters used in intensive care patients, which were exchanged within intervals of 36 hours. Therefore, it is the responsibility of the nurse to establish strategies for preventing, combating and controlling adverse events related to the use of CVC.\textsuperscript{17,8}

\textbullet Monitoring signs and symptoms associated with local and systemic infection

Infection is the second cause of mortality among CKF patients, surpassed only by cardiovascular complications. Thus, it is very important that nurses have a critical attitude towards the assistance to this population, especially the continuous search for the best scientific evidence available for handling the vascular access, and recognizing the value of signs and symptoms monitoring associated with local and systemic CVC infection.\textsuperscript{18}

In this sense, it is clear that CKF patients undergoing hemodialysis run a high risk of infection due to compromised immunity, comorbidity, inadequate nutrition and the need to maintain the CVC for long periods. Another relevant factor is the collective environment in which the hemodialysis session most often takes place. This facilitates the spread of microorganisms by contact through devices, products, equipment, surfaces or hands of the nursing staff and other health professionals.\textsuperscript{18}

Data from the National Healthcare Safety Network (NHSN) of the US show that bloodstream infection rates, according to the types of access, are: arteriovenous fistula (AVF) 0.5, graft 0.9, long stay central venous catheter (CVC) 4.2, and short stay CVC 27.1 per 100/patient-month. Microorganisms isolated in blood cultures were skin contaminants, among them, the coagulase-negative \textit{Staphylococcus} sp. Regarding the resistance profile of microorganisms, 42\% of \textit{S. aureus} were resistant to methicillin, and 39\% of \textit{Enterococcus} sp to vancomycin resistant. The risk of CKF patients undergoing hemodialysis with CVC developing bacteremia is seven times higher than those with arteriovenous fistula.\textsuperscript{17,9}

The pathogenesis of the infection associated with CVC can be observed arising from infection of the exit point, followed by microorganism migration to the outer surface of the catheter, colonization and contamination of the lumen and, finally, hematogenous infection. Clinical data of patients in this situation are nonspecific and...
have low sensitivity. Thus, the presence of infection signs and symptoms (fever, malaise, chills, pain or exudate in the exit site), without evident source, must necessarily lead professionals to consider the CVC presence in the patient as the source of the situation.7,13

The most common clinical sign is fever, which has a great sensitivity but low specificity. In the other hand, the presence of inflammation and purulent exudate around the implant site has great specificity. Furthermore, in case of the suspicion of CVC-related infection, blood culture must be done in order to accurately assess whether there is concomitant bacteremia.1,2,7,13

Thus, it is necessary that nurses be attentive and aware, because adverse events related to CVC infection are serious and can cause the patient significant loss of quality of life, and even death. With the information available and the existing technological resources, there is no alternative other than the strict monitoring of clinical aspects in patients using CVC.

♦ Maintaining the aseptic technique every time the venous access is handled; maintaining standard precaution; exchanging occlusive protectors of the CVC after each hemodialysis session.

In this study we chose to discuss these nursing interventions/activities in association, given its close relationship with biosecurity. The application of these actions aims to prevent infections associated with the use of CVC and bloodstream infections.

Catheter-related bloodstream infection (BSI) refers to the situation in which isolated microorganisms on the culture from the lumen device are found in the bloodstream. BSI rate related to presence of catheter varies according to the site and insertion technique, the number of the lumen, catheter type, length of stay and idiosyncrasies of the patient.16

The CDC developed the Guideline on Blood Stream Infection for the use of catheters. This publication is important to guide the care practice in accordance with technological and scientific advances. This movement was adopted by the World Health Organization to support patient safety, resulting in a manual to prevent and control BSI. This guideline addresses BSI as important complications caused by the use of catheters and points to adherence to standard precautions (SP) as a strategy to prevent it. The guide also emphasizes the need to incorporate measures such as hand hygiene (HH), use of protective equipment and aseptic technique during insertion and manipulation of the catheter.16

It is noteworthy that the rates of adherence to HH practice are still low. However, every effort should be undertaken to overcome the obstacles to the use of this technique. In view of various situations of clinical practice, HH can be performed using antiseptic solutions, and usually 70% alcohol gel has been used because it has low cost, and good effectiveness and acceptability. This measure promotes cleanliness, and eliminates or inhibits the growth of microorganisms, preventing their penetration in the bloodstream. The application should be broad, subject to one-way direction, and its effectiveness depends on the friction for 30 seconds, which corresponds to five movements.20

It is important to respect fundamental aspects for maintaining the dressing in the CVC implant site. Thus, it is the nurse responsibility to undertake the following actions: (1) proceed hand hygiene; (2) use of mask, goggles and apron; (3) put on examination gloves; (4) put the mask on the patient; (5) remove the dirty bandage; (6) removing procedure gloves; (7) wash hands again; and (8) put on sterile gloves for handling sterile material for preparation of the dressing. As for replacement of connectors (cover), the safe practice recommends replacing any and all device that is designed for sterile and single use. This must be replaced by another with the same specification.16,18-9

♦ Maintaining permeability of the catheter

Maintaining CVC represents a great challenge, especially related to prevention against obstruction and infection. Thus, new solutions have been studied for use in filling the catheter lumen. In clinical practice, after the dialysis session, the lumen is filled with heparin and some services employ it without any dilution.21

Heparin acts on the coagulation system by inhibiting platelet aggregation. Nevertheless, the trivial use of heparin for maintaining permeability of the CVC may cause adverse effects such as alopecia, allergic reactions,
thrombocytopenia, bleeding and respective impacts on patient safety.\textsuperscript{22}

The dose of heparin used has been a source of controversy in the literature. Studies indicate that the use of heparin 1000 IU/mL presents lower risk of systemic heparinization than the standard dose of 5000 IU/mL without loss of the conditions for use of CVC. However, when 1000 IU/mL is used in CVC, this demand at some point greater use of instillation of thrombolytics for clearance.\textsuperscript{21}

Other solutions have been studied for maintaining the CVC, notably antibiotic solutions and thrombolytics. A multicenter study using a solution composed of sodium citrate, methylene blue, methyl paraben and propylparaben, as compared to heparin, showed significant reduction in catheter-related infection rates. Another study showed similar results using minocycline and EDTA solution.\textsuperscript{22}

Alternatively the use of these solutions, the use of saline solution at 0.9\% has been reported in single lumen catheters in intensive care unit patients, with satisfactory results on permeability of this type of vascular access. However, there is no evidence indicating the success of its routine use in the clinical practice related to patients undergoing hemodialysis with CVC.\textsuperscript{21-2}

\textbullet Guiding the patient and the family on maintenance of the CVC

Education of patients, caregivers and professionals is recommended as strategy for the prevention of hemodialysis infections. This must take into account the context of the reality of patients' life. When patients and caregivers receive guidance regarding the maintenance of vascular access, they become solidary in the pursuit of reaching the therapeutic goal. In this sense, citizenship and autonomy shall be exercised in an effective and productive way.\textsuperscript{18}

It also important to point out that the educational process should not be restricted to the patient. Although the patient must be the target of this nursing intervention, guidance to patients and families may stimulate, along with the health team, permanent education and thus better results in maintaining the CVC in patients undergoing hemodialysis. A study conducted in a university hospital in São Paulo showed a 40\% reduction in catheter-related bloodstream infections after implementation of a care team education program focused on standard precaution. This is the primary strategy for preventing healthcare-related transmitted infections and should be used in patient care, environmental cleaning, appropriate processing of materials, equipment and immunization of all subjects involved.\textsuperscript{18-21,5}

CONCLUSION

Two nursing interventions related to the care of patients undergoing hemodialysis with CVC were identified and discussed, according to NIC, namely: care with the vascular device and maintaining access for dialysis. These made it possible to list and discuss eight nursing activities, namely: measuring pre/post-treatment axillary temperature; maintaining an occlusive dressing; monitoring signs and symptoms associated with local and systemic infection; maintaining the aseptic technique whenever CVC is manipulated; maintaining standard precaution; replacing the protective covers of the CVC after each hemodialysis session; maintaining permeability of the access with heparin after hemodialysis session; guiding the patient and the family on maintenance of the CVC.

Due to the technical specificity of the basis of hemodialysis, nurses associated, in a plastic and dynamic way, intervention activities in order to formulate a current and relevant nursing prescription for patient safety. The activities listed have robust scientific basis in the literature and this legitimizes their use for the maintenance of the CVC in the fight and control of infectious, traumatic or thrombotic complications. Therefore, nurses must assume the care of patients using CVC as their function, as this is a highly complex procedure.

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Corresponding Address
Gilberto de Lima Guimarães
Escola de Enfermagem
Departamento de Enfermagem Básica
Av. Alfredo Balena, 190, Sala 214
CEP: 30130 100 – Belo Horizonte (BH), Brazil