

Infections in temporary access for hemodialysis in chronic renal failure patients

Infecção em acesso temporário para hemodiálise em pacientes com insuficiência renal crônica

Infección en el acceso temporal para hemodialisis en pacientes con insuficiencia renal crónica

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ABSTRACT

Objective: To value the occurrence of infections in chronic renal failure patients with use of catheter double-lumen temporary (CDL). **Methods:** Prospective study and follow-up, realized in a Clinical Nephrology, in Recife (PE), Brazil, between the months of January 2009 to December 2010. In this study 88 chronic renal failure patients participated (CRF) and who are undergoing hemodialysis. **Results:** the temporary double-lumen catheters enable the execution of the hemodialysis right after implantation, but it presents an inferior operational implant cost in comparison to the fully implantable ones or to the arteriovenous fistula (AVFs). **Conclusion:** It is prime to raise awareness of the health team regarding cares when implanting and manipulating the catheter (during the hemodialysis sessions and realization of bandages). The patient's hygiene conditions contribute with infectious processes, they need therefore to be informed about infection risks.

Descriptors: Renal insufficiency, Infection, Catheters for hemodialysis.

RESUMO

Objetivo: Avaliar a ocorrência de infecções em pacientes com insuficiência renal crônica em uso do cateter temporário duplo-lúmen (CTDL). **Método:** Estudo prospectivo ou de seguimento realizado em uma Clínica de Nefrologia, em Recife (PE), Brasil, entre os meses de janeiro de 2009 a dezembro de 2010. A coleta foi realizada por meio da avaliação clínica e de prontuários de 88 pacientes com insuficiência renal crônica (IRC) em tratamento hemodialítico. Os dados foram analisados por meio da quantificação das variáveis contidas no instrumento de coleta. **Resultados:** A infecção do sítio de inserção do cateter ocorreu em 52,3% dos pacientes, e em 47,7% foi verificada a infecção da corrente sanguínea associada ao cateter. **Conclusão:** É primordial a conscientização da equipe de saúde em relação aos cuidados na implantação e manipulação do cateter. As condições de higiene do paciente contribuem com processos infecciosos, sendo assim, ele precisa ser informado sobre os riscos de infecção.

Descritores: Insuficiência renal, Infecção, Cateteres para hemodiálise.

RESUMEN

Objetivo: Evaluar la ocurrencia de las infecciones en pacientes con insuficiencia renal crónica en uso del catéter temporario doble lumen (CDL). **Métodos:** Estudio prospectivo y seguimiento, realizado en una Nefrología Clínica, en Recife (PE), Brasil, entre los meses de enero

2009 a diciembre 2010. El estudio incluyó 88 pacientes con insuficiencia renal crónica (IRC), sometidos al tratamiento de hemodialisis. La colecta de datos fue realizada mediante la evaluación clínica y del archivos. **Resultados:** El catéter temporario doble lumen (CDL) permite la actuación de hemodialisis poco después del implantación, sin embargo tiene menores costes operativos en comparación con el totalmente implantable o las fistulas arteriovenosas (FAVs). **Conclusión:** Es de suma importancia la sensibilización del personal de salud respecto a la implementación y manipulación del catéter (durante las sesiones de hemodialisis y vendajes). Las condiciones de higiene del paciente contribuye con procesos infecciosos, siendo así, ellos necesitan estar informados sobre los riesgos de infección.

Descriptores: Insuficiencia renal, Infección, Catéter para hemodialisis.

INTRODUCTION

Chronic Kidney Disease (CKD) consists of abnormalities in the structure or function of the kidneys, which have been persistent for more than three months. These causes are related to obstructive and primary kidney diseases (glomerulonephritis and pyelonephritis), systemic diseases such as hypertension, diabetes mellitus and gout, (Alport syndrome, bilateral renal hypoplasia, and posterior urethral valve).¹ This syndrome is classified according to the degree of involvement of the glomerular filtration rate (GFR) in six stages with present renal damage. The first stage is characterized by normal condition and GFR greater or equal ≥ 90 mL/min; in the second stage there is a slight reduction in GFR (60-89 mL/min); the third stage is divided into two phases (3a and 3b), in phase 3a there is GFR between 45-59 mL/min and between 30-44 mL/min in phase 3b; renal failure is present in the fourth stage (GFR between 15-29 mL/min) and in the fifth stage (GFR ≤ 15 mL/min) there is indication of either renal transplantation or renal replacement therapy.^{1,2}

Chronic Renal Failure (CRF) is a progressive and generally irreversible syndrome of renal glomerular filtration function characterized by deterioration of the biochemical and physiological functions of all organ systems secondary to the accumulation of catabolites (uremic toxins).³ Furthermore, changes in the hydroelectrolytic and acid-base balance, metabolic acidosis, hypovolemic event, hyperkalemia, hyperphosphatemia, anemia and hormonal disorder, hyperparathyroidism, infertility, growth retardation, among others.¹

This syndrome is considered a serious global public health problem due to the high morbimortality and increased risk of cardiovascular diseases as well as the risk of chronification, which has been related to changes in the routine life and high maintenance costs of these patients.^{3,4}

Studies show, in relation to the incidence and prevalence of CRF, an increase in epidemic proportions in Brazil and in the world. In Brazil, in 2014, epidemiological surveys estimated 112,004 patients under dialysis treatment and prevalence and incidence rates of 552 (range: 364 in the North region and 672 in the Southeast) and 180 patients per million of the population.¹ Considering the prevalent patients, 91% were on hemodialysis and 9% on peritoneal dialysis, 32,499 (29%) were on the waiting list for transplantation. Data from 2012 revealed the increase in treatments for renal replacement

therapy year by year in our country, doubling from 2002 to 2012. The percentage of patients with central venous catheter access was 16.6% (short stay: 9.2%, long stay: 7.4%) and in use of vascular graft (prosthesis) was 4.1%.^{1,2,4}

CRF can be treated initially by conservative therapies such as: dietary, drug treatment and blood pressure control. The indication of the dialysis program will be made when the conservative treatment is not able to maintain the quality of life of the patient and when there are signs and symptoms of uremia.

Among the dialysis methods offered to the patient with chronic renal failure, hemodialysis is the most commonly used substitute program for blood clearance, in which a dialyzer is used as the medium for diffusion between blood and dialysis fluid.⁶ Obtaining a via access to blood coagulation, use of appropriate materials and equipment, availability of specialized professionals, contributes greatly to the success of hemodialysis.⁷ In turn, the association or the achievement of these requirements has generated a high operational cost of hemodialysis, considering its high complexity technology.^{7,8}

Nowadays, the temporary double-lumen catheter (TDLC) and arteriovenous fistula (AVF) are the devices most commonly used as access routes to the vascular system for hemodialysis.⁶ Double-lumen catheters are central venous accesses generally used as temporary vascular accesses; has the advantage of the possibility of immediate use after its implantation.⁷ AVFs are considered permanent vascular accesses and are indicated in patients with terminal chronic end-failure.^{3,7}

Despite being widely used in emergency services, unlike AVF, TDLC is related to higher rates of complications related to infections by microorganisms that colonize the skin or by those that eventually contaminate the equipment and the perfused solutions.^{9,10} Likewise, the techniques applied in the management of catheters, health professionals, underlying disease and patient hygiene are all considered inherent factors in the infection control process related to temporary access.¹¹

The use of TDLC is related to about 48 to 73% of the bacteremia present in the patients being treated. A study conducted in the North of Paraná State about risk factors associated with device-related infections in patients undergoing dialysis in a school hospital revealed that 48.8% had catheter-related infection.^{4,10} Other research with 156 individuals undergoing dual lumen central venous catheterization at the *Universidade de São Paulo (UNIFESP)*, reported the presence of bloodstream infection in 94 of the patients.¹²

If, on the one hand, the quality of dialysis, and consequently the patient's well-being and survival depend on vascular access, on the other hand, it is considered the greatest risk factor for infection particularly of bacteremia in this group of patients.

Given the aforementioned, the guiding question is the following: What are the characteristics of the infections present in patients bearing chronic renal failure and undergoing hemodialysis treatment? Considering the lack of further studies on infections in outpatients undergoing hemodialysis, this study aimed to investigate and evaluate the occurrence of these infections in patients with chronic renal insufficiency submitted to the use of the temporary double-lumen catheter in a Nephrology Clinic.

METHODS

It is a prospective study that was carried out in a Nephrology Clinic located in Recife city, Pernambuco State, Brazil, and over the period from January 2009 to December 2010. This research counted with the participation of 88 patients bearing chronic renal failure and undergoing hemodialysis treatment by means of the double-lumen temporary catheter (TDLC) that accepted to participate in the study and implanted the referred catheter in the pre-established period from January 2009 to December 2010. Therefore, for inclusion in the study was established one of two consecutive years. Data were collected through clinical assessment and medical records.

It should be clarified that the group of patients selected was evaluated for implantation to final removal of the catheter. The study was approved by the Research Ethics Committee with Human Beings. The patients were clarified as to the study, objectives, secrecy of their identity, as well as the guarantee of freedom to abandon the research at any time. In addition, the Free and Informed Consent Term granted in its participation in accordance with the Resolution 466/12 from the National Health Council with the *Certificado de Apresentação para Avaliação Ética (CAAE)* [Certificate of Presentation for Ethical Appraisal] No. 0094.0.236.000-11. For the analysis of the results, the appropriate quantification of each of the variables contained in the instrument of data collection was carried out and a database was elaborated through the program Microsoft Excel.

This type of research includes studies that propose the construction of conceptual theories and milestones by the method of evaluation and conference of the results of the exams. Studies conducted to draw an image of the knowledge produced or the voids in a given phenomenon allows the researcher to analyze results of several studies who have researched the same phenomenon and therefore, their source of information consists of reports of completed research.¹²

The process of collecting patient exams developed from an instrument completed by the professional who was attending it. Being that the literature used was through the electronic means (internet) and research in a library collection.

RESULTS

The study group corresponded to 88 patients out of a total of 329 individuals who are clients of the clinic, who had CRF in hemodialysis treatment through TDLC. Sex-related data indicate that 63.6% of the individuals were male.

Considering the TDLC use in the sample, it was observed that 66 patients (75.0%) had a single implant, whereas 12 patients, i.e., 13.6% had two implants, 4 patients (4.5%), three implants and six patients (6.8%) from four to seven.

Observing the place of insertion, the right and left internal jugular veins were the most used accesses, 84.1% of the implants, followed by 9.1% in the right internal subclavian vein. Regarding the time of permanence of the 88 implants used was on average 30 days, with 19 days of the median.

Table 1 - Distribution of the evaluated infection cases.

Infection	N	%
Infection TDLC insertion site	46	52.3
Bloodstream infection by catheter-associated microorganism	42	47.7

Source: Research data.

The infection of the catheter insertion site occurred in 52.3% of the patients with an average of 22 days of use, for the appearance of the signs. In 47.7%, the infection of the bloodstream associated with the catheter was verified, with an average of 30 days of use. (Table 1) From the study group, 78 blood culture samples were collected, with 44.3% positive results.

Table 2 - Symptoms reported by the patients that had blood culture collection.

Symptoms	N	%
Fever	24	30.76
Chills	23	29.48
No symptoms	31	39.74

Source: Research data, 2010

Considering the main symptoms reported by patients with blood culture collection (Table 2), fever was present in 30.76% of the patients and chills in 29.48%, and 39.74% of the patients had no symptoms.

Table 3 - Distribution of isolated microorganisms in the blood cultures of patients bearing CRF and undergoing hemodialysis treatment by TDLC.

Microorganism	n	%
Gram +		
Staphylococcus aureus	28	71.8
Gram -		
Acinetobacter baumannii	01	2.6
Bacillus Gram - Non-fermenter		
Enterobacter aerogenes	04	10.3
Klebsiella pneumoniae	01	2.6
Pseudomonas aeruginosa	02	5.1
Achromobacter xylosoxidans	02	5.1
Fungi		
Candida parapsitosis	01	2.6
Total	39	100%

Source: Research data, 2010

Gram-positive bacteria were the most isolated in blood cultures, with *Staphylococcus aureus* in 71.8%, followed by *Enterobacter aerogenes* in 10.3%, and the others had a lower incidence.

DISCUSSION

Sex-related data in this study showed a predominance of chronic renal failure in male patients. These results corroborate with those found in the literature. Moreover, the Brazilian epidemiological survey revealed that fifty-eight percent of CRF patients were of the same gender.^{1,3,4}

TDLC is a temporary access route when the patient does not have definitive vascular access such as AVE.¹³⁻⁴ In this study, it was identified that the number of urgencies to initiate

the hemodialysis treatment is significant, and this fact the nephrologists to implant the TDLC as a temporary access.

Concerning the puncture site at the TDLC insertion, the jugular, subclavian and femoral veins are preferably used.¹⁵⁻⁶ The National Kidney Foundation-Dialysis Outcomes Quality Initiative (NFK-DOQI) recommends the internal jugular veins the first choice puncture site for the implant. The mean length of stay of these catheters was 30 days, which exceeded that recommended by NFK-DOQI and the Centers for Disease Control (CDC), as well as national standardization.¹³ In this study, internal jugular veins were the most used, which meets the scientific recommendations.^{12,14-5}

In the national and international scientific literature, it is described that the double-lumen temporary catheter for hemodialysis should be maintained up to 5 days in the femoral vein, 21 days in the jugular and subclavian veins,^{13,17-8} fact not informed by the institution justifying the long time of the catheters.

Herein, a high infection rate was detected at the catheter and bloodstream insertion site. It is noteworthy that infection is the second cause of death among patients with renal insufficiency, losing only to cardiovascular diseases.¹⁶ Many of these infections are associated with vascular access, especially the double-lumen temporary catheter.^{10,12,15}

Bacteremia, in most cases, presents an elevation of body temperature, but there are cases where there is only hyperthermia resulting in an infectious complication not associated with bacteremia.⁹ There is a discrepancy between the indices presented in O'Hanlon and Reddan's studies (2005), which may be related to the techniques adopted by the teams in the handling of these devices. These techniques include, among other strategies of prevention, adequate disinfection of the hands, an aseptic technique in the insertion of the catheter, accomplishment of dressings free of contamination.

It is mentioned that one of the risk factors for infection at the insertion site of the TDLC is excessive staying and its manipulation of disconnecting and connecting the catheter protectors 2 to 3 times a week for hemodialysis.^{4,11} Therefore, rigorous asepsis care are emphasized to break the chain of cross-infection.¹³⁻⁴

Infectious complications are common in vascular access of patients undergoing hemodialysis.³ There is controversy over the source responsible for the colonization of the temporary double-lumen catheter. Some authors point out that the skin around the catheter is the most important source of infection, others argue that the catheter connection is more important, in other words, the intraluminal contamination.^{3,4,11} Other potential sources of intraluminal contamination may be the hands of health professionals, who manipulate the catheter connection in the treatment process. Other possible causes are added, such as the catheter insertion site, number of hospitalization, albumin level, HIV infection, age, diabetes mellitus, which are favorable for infection.^{1,2,12}

Infectious complications of vascular access are major sources of morbidity and mortality among hemodialysis patients.⁹ According to studies, in about 48% to 73% of all bacteremia occurring in treatment, TDLC is primarily responsible for these complications.¹⁴

The number of patients undergoing hemodialysis using a temporary double-lumen catheter with infection and requiring hospitalization is significant.^{15,13}

Different studies related to bacteremia in patients with TDLC have pointed out that the presence of *Staphylococcus aureus* in the results of blood cultures as well as in catheter-tip cultures is significant.¹⁴

Authors report that frequently bacteremia in hemodialysis patients is related to infection of the vascular access, and may progress to pneumonias acquired by the hematogenous route.¹⁹ The most frequent germs are *Staphylococcus aureus*, *Escherichia coli*, *Staphylococcus epidermidis*, and other Gram-negative bacteria.⁷

The theme of infection is wide-ranging, complex and refers to the reflection of basic aspects, such as hand hygiene. Transmission of microorganisms by the health team is the most important route for exogenous infections, considering that the pathogen is introduced in a susceptible site, mainly through an invasive procedure.^{20,10}

Recognition of the seriousness of complications has led professionals to plan prevention and control measures, especially infection.^{3,5} Another concern is the type of dressing performed at the catheter insertion; these should be inspected daily and exchanged whenever the patient is dialyzed using aseptic technique and antiseptic solutions mentioned in the national legislation.^{1,4} During the bandage, the presence of hyperemia, secretions, bruising and questioning the patient should be inspected such as hyperthermia, pain in the insertion of the catheter, local bleeding, among others.^{1,5}

The development of early arteriovenous fistula is the most preventable complication.¹¹ The specialized training of professionals handling the dual-lumen temporary catheter helps to reduce the incidence of these infections.^{6,8} It is worth noting that despite the infectious complication, the TDLC been an important advance for people who require hemodialysis in emergency situations.

CONCLUSIONS

Infections related to hemodialysis catheters are most often caused by *S. aureus* since this agent is a natural resident of the skin. Nonetheless, it is observed that colonization can also occur by bacteria of the genus *Staphylococcus* (*epidermidis* the most frequent).

These microorganisms are able to adhere and colonize any biomaterial surface. When these microorganisms reach the bloodstream, either in the insertion of the catheter or in the manipulation of the same, bacteremia occurs, which when not contained can cause an infection with serious clinical compromises, which may result in septicemia or even death.

By knowing that infection is the second cause of mortality and morbidity of patients with CRF, only less than cardiovascular causes, it is concluded that is prime to raise awareness of the health team with regards to being very careful when implanting and manipulating the catheter (during the hemodialysis sessions and realization of bandages). Hence, nurses have a primary role in preserving the quality of care offered and in the health education process, since it accompanies patients from the implantation of the catheter to maintenance.

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