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# Immediate and Late Complications of Temporary and Permanent Hemodialysis Catheters

ORIGINAL

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## Abstract

This study aimed to identify the immediate and late complications of temporary and permanent hemodialysis catheters in a nephrology service. This is an exploratory-descriptive study with quantitative approach performed in a Nephrology reference center in the State, located in Recife/Pernambuco. The study was conducted from April to September 2015 using an instrument developed by the authors consisting of socio-demographic and clinical data. The study included 40 patients who had a total of 57 complications. The most frequent immediate and late complications were hematoma (33.4%) and decreased blood flow (46.1%), respectively. Results led to the conclusion that the nursing staff, in particular, should be alert to the occurrence of complications. For this, it is suggested that training and continuing education be developed as a means to improve the performance of the nursing staff before any sort of problem related to hemodialysis catheters.

**Keywords**
Complications; Catheters; Renal dialysis; Nephrology.

## Introduction

Chronic diseases such as renal insufficiency have increased in recent years as a result of longest life expectancy and population aging as-

 

sociated with changes in lifestyle, particularly the progressive urbanization, industrialization and globalization [1].

When the renal system does not function properly, acute and chronic disorders may arise, which may cause, respectively, rapid or irreversible loss of kidney activity characterized by the inability of the kidneys to perform excretion and maintain the acid-base and electrolyte balance of the body [2].

The main causes of kidney disease are Systemic Hypertension and Diabetes Mellitus, but other factors are also related to its occurrence: glomerulonephritis, proteinuria, urinary tract obstruction, use of nephrotoxic drugs, trauma, cancer, autoimmune diseases, etc. [3].

The correct control and use of drugs for underlying diseases and other causes help preventing or delaying the onset of renal failure. Otherwise, the patient may experience Acute Renal Failure or an advance in the stages of Chronic Renal Failure and require renal replacement therapy, which is a treatment employed to replace kidney function [4,5]. This can be accomplished in three ways: kidney transplantation, peritoneal dialysis and hemodialysis [5].

The estimated number of people who depend on Renal Replacement Therapy in Brazil is 112,004, of which 91.4% undergo hemodialysis treatment [6].

Hemodialysis is the most widespread Renal Therapy Replacement in outpatient and hospital clinical services. This treatment consists in the use of an extracorporeal system that aims to remove excessive liquid and extract toxic nitrogenous substances from the blood through the semipermeable membrane present in the dialyser, and then return the filtered blood to the patient [7].

In order to perform dialysis, a venous access in the patient proper to blood flow is necessary. This can be an arteriovenous fistula, a graft, a temporary catheter or a permanent catheter [8]. The ideal access is one that, besides allowing proper flow, has good durability and low complication rates [9].

The use of hemodialysis catheters is very important in emergencies such as Acute Renal Failure or in the case of patients with Chronic Renal Failure who are awaiting the maturation of the final access or are unable to make it. However, although catheters allow the immediate initiation of hemodialysis therapy, among other purposes, their use is associated with numerous complications. These can be immediate or late complications and depend on several factors, such as the patient's clinical condition, puncture procedure, the insertion site and the time of use [10,11].

Furthermore, if catheters are not properly punctured and/or if the patient and staff do not handle them properly, they can bring disadvantages, compromising the comfort and the health of users.

In the light of the above, the concern with possible occurrences of complications with hemodialysis catheters is well founded. Patients who undergo this therapy already face various difficulties related to the treatment itself and, thus, any situation that may cause further harm to their health must be avoided. It is necessary, therefore, to investigate certain events and disseminate the results in order to serve as a support for the practice and planning of health professionals. Thus, this study aimed to identify the immediate and late complications of temporary and permanent hemodialysis catheters in a nephrology service.

## Methods

This is an exploratory-descriptive study with quantitative approach performed in the hemodialysis unit of a public hospital that is a reference in nephrology in the state. The hospital is located in Recife, Pernambuco, Brazil. The participants were individuals aged 18 years or older, undergoing hemodialysis (acute or chronic patients) and making use of temporary or permanent catheters (put in that hospital), which had presented any sort of complication related to the hemodialysis catheter in the period from

April 2015 to September 2015. Patients were excluded when they were discharged or transferred to another service before the catheter had been used at least once or before seven days of implantation.

The data collection plan was based on the completion of a follow-up form developed for the study addressing socio-demographic data (gender, age, level of education and income), clinical data (comorbidities, type of access, reason for catheter implantation, insertion site, duration of dialysis) and notes on complications associated to the catheter that arose during the research (noting the time between the implantation and the occurrence of complications). Socio-demographic data was filled by asking the questions to the patients. Clinical data and information related to complications were collected through the weekly reading of the patient's medical record, nursing report, medical report and catheter implantation record book.

For analysis, a database was built in a *Microsoft Excel* 2007 spreadsheet which was exported to the *Statistical Package for Social Sciences* (SPSS) program, version 18.0, where descriptive statistics were carried out. Percentage frequencies and respective frequency distributions were calculated to analyze the personal, clinical and treatment profile and the complications reported. The Chi-square test was used to compare the proportions found in the levels of the variables. Means and standard deviations were calculated for quantitative variables. The level of significance of 5% was adopted in the analysis.

The study was approved by the Ethics Research Committee of the Health Sciences Center of the Federal University of Pernambuco (CEP/CCS/UFPE) under Opinion number 992709 and CAAE number 40906915.5.0000.5208. The ethical principles established for research involving human subjects were respected.

# Results

In the period studied, there were 125 catheter implantations in the service studied, and complications happened in 57 (45.6%) implants of 40 patients. This means that some patients had more than one complication (1.42 complications per person on average). Patients were predominantly females (57.5%), aged 51-70 years (55%), with average age of 54 years and standard deviation of 15 years, with incomplete primary education (37.5%) and monthly income varying from one to two minimum wages (65%), according to data shown the **Table 1**.

**Table 1.** Socio-demographic profile of patients with respect to gender, age, level of education and monthly income. Recife/PE, Brazil, 2017. (N = 40)

| Variables | F | % | p-value[1] |
|---|---|---|---|
| Gender | | | |
| Female | 23 | 57.5 | 0.343 |
| Male | 17 | 42.5 | |
| Age | | | |
| 18 to 30 years | 2 | 5 | 0.001 |
| 31 to 40 years | 7 | 17.5 | |
| 41 to 50 years | 6 | 15 | |
| 51 to 60 years | 11 | 27.5 | |
| 61 to 70 years | 11 | 27.5 | |
| > 70 years | 3 | 7.5 | |
| Minimum - Maximum (19.0 – 85.0) | - | | - |
| Mean ± standard deviation (54.0 ± 15.0) | - | | - |
| Level of education | | | |
| Incomplete Primary School | 15 | 37.5 | 0.001 |
| Illiterate | 9 | 22.5 | |
| Complete Primary School | 7 | 17.5 | |
| Complete Secondary School | 7 | 17.5 | |
| Incomplete Secondary School | 1 | 2.5 | |
| Incomplete Higher Education | 1 | 2.5 | |
| Monthly household income* | | | |
| 1 to 2 minimum wages | 26 | 65 | <0.001 |
| Up to 1 minimum wage | 10 | 25 | |
| 3 or more minimum wages | 4 | 10 | |

[1]: p value of the Chi-square test for comparison of proportions (p-value <0.05, the prevalence found in the levels of the evaluated factor differs significantly).
*: Minimum wage during the study period: R$ 788.00.
**Source:** Research Data.

**Table 2.** Distribution of clinical and treatment profile of patients. Recife/PE, Brazil, 2017. Comorbidities (N = 40)[a]) Other variables (N = 57)[b]

| Variables | F | % | p-value[1] |
|---|---|---|---|
| Comorbidities | | | |
| Systemic Arterial Hypertension | 13 | 32.5 | 0.457 |
| Cancer | 12 | 30 | |
| Systemic Arterial Hypertension/ Diabetes Mellitus | 7 | 17.5 | |
| Others | 8 | 20 | |
| Access type | | | |
| Double Lumen Catheter | 52 | 91.2 | <0.001 |
| Long-term indwelling catheter | 5 | 8.8 | |
| Reason for catheter implantation | | | |
| Emergency dialysis (first hemodialysis in life) | 25 | 43.9 | <0.001 |
| Impairment of other temporary or permanent access | 19 | 33.3 | |
| Awaiting the preparation/maturation of Arteriovenous Fistula | 8 | 14 | |
| Loss of Arteriovenous Fistula | 5 | 8.8 | |
| Catheter insertion site | | | |
| Right internal jugular | 20 | 35.1 | 0.015 |
| Light internal jugular | 17 | 29.8 | |
| Right femoral | 16 | 28.1 | |
| Left femoral | 4 | 7 | |
| Dialysis time (days) | | | |
| Minimum – Maximum (1 – 1335) | - | | - |
| Mean ± Standard deviation (157 ± 307) | - | | - |
| Time between implant and occurrence of complication (days) | | | |
| Minimum – Maximum (0.0 – 101.0) | - | | - |
| Mean ± Standard deviation (30.0 ± 39.0) | - | | - |

[a]: The N of the variable "comorbidity" is 40, as the number of patients participating in the study is taken into account.
[b]: The N of the other variables in the table 2 is 57, as the total number of complications that participants in the study presented is taken into account.
[1]: p value of the Chi-square test for comparison of proportions (p-value <0.05, the prevalence found in the levels of the evaluated factor differs significantly).
**Source:** Research data.

Among the most common comorbidities in patients were Hypertension, in 13 (32.5%) patients, cancer, in 12 (30%) patients, and Hypertension/ Diabetes Mellitus, in 7 (17.5%) patients. Other causes, such as systemic lupus erythematosus, sepsis, chronic glomerulonephritis, leptospirosis, nephrolithiasis, and undetermined causes, were observed in 20% of patients. Regarding the type of access, 52 (91.2%) patients had implanted Double Lumen Catheters, while five (8.8%) had implanted long-term indwelling catheters, as shown in **Table 2**.

As for the reasons for catheter implantation, in 25 (43.9%) cases the reason was urgent dialysis (first hemodialysis in life), in 19 (33.3%) the reason was dysfunction of other temporary or permanent access, eight (14%) patients were awaiting the preparation/maturation of arteriovenous fistula and five (8.8%) had lost arteriovenous fistula. The most common insertion sites were right internal jugular vein, in 20 (35.1%) cases, left internal jugular vein, in 17 (29.8%) cases, right femoral vein, in 16 (28.1%) cases, and right femoral vein in four (7%) cases.

The average dialysis time was 157 days, with standard deviation of 307 days (the shortest dialysis time was one day and the longest, 1335 days) and the average time between the implant and occurrence of complications was 30 days, with standard deviation of 39 days (the shortest dialysis time was 0 days and the longest was 101 days). Data is shown in **Table 2**.

Regarding complications, 18 (31.6%) patients had immediate problems and 39 (68.4%) had late problems. Of the 18 who had immediate complications, six (33.4%) had hematoma, five (27.8%) had decreased blood flow, four (22.3%) had clogging/coagulation, one (5.5%) had hemorrhage and two (11.0%) had other complications, as shown in **Table 3**.

With respect to late complications, of the 39 cases, 18 (46.1%) had decreased blood flow/no flow, 15 (38.5%) had infection, three (7.7%) had clog-

**Table 3.** Distribution of immediate and late complications. Recife/PE, Brazil, 2017. Immediate (N = 18); Late (N = 39).

| Variables | F | % | p-value[1] |
|---|---|---|---|
| Immediate complications | | | |
| Haematoma | 6 | 33.4 | <0.001 |
| Decreased blood flow/no flow | 5 | 27.8 | |
| Clogging/Coagulation | 4 | 22.3 | |
| Hemorrhage | 1 | 5.5 | |
| Other | 2 | 11 | |
| Late complications | | | |
| Decreased blood flow/no flow | 18 | 46.1 | |
| Infection | 15 | 38.5 | |
| Clogging/Coagulation | 3 | 7.7 | |
| Other | 3 | 7.7 | |

[1]p value of chi-square test for comparison of proportions (p-value <0.05, the prevalence found in the levels of the evaluated factor differs significantly).
**Source:** Research data.

ging/coagulation and three (7.7%) had other late problems, as indicated in **Table 3**.

## Discussion

Although renal failure affects men and women alike, the data found in the present study are consistent with a study on individual and clinical characteristics of people with kidney failure in TRS held in Campos dos Goytacazes/Rio de Janeiro where the majority of participants (58.3%) was female [12]. However, considering the comparisons of proportions, gender was not significant (p = 0.343), indicating that the number of male and female patients in this study was not significantly different.

With respect to age, it was observed that most individuals are in the process of aging or have already reached the third age. Studies corroborate these results, revealing a higher rate of renal patients aged between 51 and 70 years [12-14]. It is evident that the world population is living longer. With this, the occurrence of chronic diseases in this age group has also increased. Thus, the impact that this generates on health services calls attention. Higher healthcare costs and more training to health professionals responsible for the care of this population group are necessary [15].

Low level of education predominated in the sample in the present study; most of participants had incomplete primary school or were illiterate, accounting for 60% of the sample. Similar results have been found in a population undergoing hemodialysis studied in Natal/Rio Grande do Norte, where incomplete primary school followed by illiteracy were the case of 57.5% of the participants [16]. Another study also reported predominance of incomplete primary school among renal patients [17].

The level of education is a key factor because it directly reflects the ability of patients to assimilate the information received. Low education makes the understanding of this disease difficult to the affected person, resulting in poor adherence to treatment in the case of some patients and undermining their ability to carry out self-care [17].

The findings on income proved to be in line with a research conducted in Teresina/Piauí and in six cities of Maranhão. In the latter study, household monthly income was between one and two minimum wages, in the case of 81.6% and 63.9% of the patients, respectively [18, 19].

Information on the economic situation of patients is important because this may help professionals take into account the individual needs of customers. Low income is linked to some problems such as difficult access to health care, inadequate nutrition and transportation and ineffective pharmacological treatment, leading to improper living conditions and poor dignity [17].

Hypertension was predominant among comorbidities, followed by cancer and hypertension/diabetes. In this research, this variable was not significant (p-value = 0.457), indicating that the results are explained by chance and not by the factors studied.

The occurrence of hypertension followed by the association between hypertension/diabetes [16] also prevailed in a study conducted in a satellite clinic in

Natal/Rio Grande do Norte. In two other studies, one in São Luís/Maranhão and another at three clinics in the city of Porto/Portugal, hypertension prevailed, followed by diabetes [20, 21]. The literature explains that hypertension and diabetes are the main underlying diseases of renal failure in Brazil, accounting for almost half of the cases of individuals undergoing dialysis [22].

We can infer that there was considerable prevalence of the comorbidity *Cancer* in this study because the Nephrology service in which the present research was conducted is a reference center for the whole state of Pernambuco, and a gateway to patients coming from various services that need hemodialysis, as for example the Cancer Hospital of Pernambuco (CHP).

The agents for the treatment of cancer are, in general, nephrotoxic, and some may not directly affect the kidneys, but cause different toxicities when renal excretion is not appropriate. These include chemotherapy agents, molecular targeted therapy, analgesics and bisphosphonates. Thus, a cancer patient may develop acute renal failure as a result of the treatment, or if such patient already has Acute Renal Failure, this may progress to Chronic Renal Failure [23].

Regarding the type of catheter, the vast majority of participants (91.2%) had implanted Double Lumen Catheters and a minority, long-term indwelling catheters. It is recommended that catheters be used only when other options are not available and that the Arteriovenous Fistula be the preferred form of maintaining the access. In case of use, it is recommended that temporary catheters (Double Lumen and Triple Lumen Catheters) be inserted in jugular and subclavian veins, remaining up to 21 days, and the ones placed in the femoral vein be kept up to 5 days. In the case of permanent catheters, because they are tunneled, literature recommends to keep them up to 12 months, at most for 18 months [8].

In this study, the average catheter permanence time was 30 days, with standard deviation of 39 days, which exceeded the recommended maximum time. The use of catheters for longer periods than the recommended, whether temporary or permanent, is related to higher rates of complications and mortality [24].

The main reasons for catheter implant were, firstly, urgency for dialysis, followed by dysfunction of other temporary or permanent access, wait for preparation/maturing of fistula and loss of fistula. This occurred in the present study and has also been cited in previous studies [25].

The frequent use of Double Lumen and Triple Lumen Catheters is related to patients with Acute Renal Failure and most often in patients with Chronic Renal Failure who delay to discover their problem to the point of having to start treatment with urgency, leaving no other options of access [25].

This study showed that most catheters were implanted in the left and right internal jugular veins, then followed by right and left femoral veins. No implants in subclavian vein were observed. This result is similar to other surveys that prioritize access through the julgular vein [16, 26].

The insertion into internal jugular veins is preferred because these consist in more direct routes. However, their long-term use is associated with the occurrence of infections. The femoral veins, which were the second choice, can be used for patients with limited upper central access or who have acute edema. However, this access is directly associated with increased risk of deep vein thrombosis. In turn, subclavian puncture is less indicated due to the high risk of occurrence of pneumothorax, hemothorax and deep vein thrombosis, besides stenosis and/or vessel occlusion, thus impairing venous return and future creation of fistula in the affected limb [16, 26].

Hematoma was most prevalent immediate complication, followed by decreased blood flow, clogging/coagulation and hemorrhage. Study identified hematoma as the second most common immediate complication, behind arterial puncture (a complication that was not reported in the present study) [27].

Regarding late complications, decreased blood flow was the most common, followed by infection and clogging/coagulation. This is similar to a survey where low blood flow due to inappropriate catheter operation was the most common problem [25]. However, although low flow and clogging/coagulation are complications that may also appear in the late phase and they deserve attention, the literature emphasizes that the most common complication is infection [8, 10, 16], which is not corroborated by the results found in the present study.

Hematoma is often described in studies that evaluate complications during catheter insertion procedure. Furthermore, hematoma is often secondary to arterial puncture. When the catheter insertion is assisted by ultrasound method, the risk of hematomas tends to fall considerably [10].

Decreased blood flow is associated in most cases to improper insertion of catheters or may occur as a result of kinking, thrombosis, increased venous pressure in hemodialysis system and improper positioning of the catheter tip [25].

Clogging consists in the coagulation of the catheter due to clots formed in the distal end, obstructing the lumen. These clots happen when the necessary precautions such as heparinization are not taken while washing the lumen, or when the catheter does not allow adequate blood flow [8].

Hemorrhage is related to the flow or to several repeated attempts to insert the catheter that end up damaging the vessel. If the patient has excessive uremic toxins in the body, hemostasis is impaired, as uremia may lead to difficulty in platelet aggregation and this, in turn, increases bleeding time [28].

The incidence of infection is linked to several factors, such as catheter insertion site, number of hospitalizations, infection by Human Immunodeficiency Virus (HIV), advanced age, diabetes, and so forth. It is noteworthy that infection is the second leading cause of death among renal failure patients, behind only to cardiovascular disease. Furthermore, the incidence of infections is higher among patients who use catheter compared to those with fistulae. To avoid this problem, it is necessary to be attentive to the time of permanence and manipulation of the catheter, placing greater emphasis on rigorous aseptic care when handling the catheter [16, 25].

## Conclusion

The study proved relevant to describe the sociodemographic, clinical and treatment profile of patients, besides revealing the main immediate and late complications related to temporary or permanent hemodialysis catheters.

The results showed that the main immediate complications were hematoma and low blood flow and the most common late complications were low blood flow and infection. Thus, it is suggested that training and continuing education be carried out with the multidisciplinary team, especially with the nursing staff, since this are the main professionals to detect the complications, since they are involved in the direct provision of care and spend more time with patients during hemodialysis sessions.

Therefore, it is important to emphasize that the team should always inspect the catheter insertion sites, be attentive to the occurrence of complications and seek to understand their causes, so that they may intervene and provide correct guidelines in face of any problems related to hemodialysis catheters. Moreover, health education activities for patients on self-care and hygiene notions are recommended, aiming to control infections and other problems.

This study has as limitation the fact that it describes the reality of only one service within a short period of time of data collection, what restricted the sample. Thus, further studies of this nature must be developed in several other institutions in order to deepen the scientific support to the subject studied.

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