



## Survival and Catheter Related Complications Among Iranian End Stage Renal Disease Patients: Hasheminejad Kidney Center, 2010 to 2011

Mohammad Kazem Shahmoradi<sup>1</sup>, Morteza Khavanin Zadeh<sup>2\*</sup>, Zeinab Tamannaie<sup>1</sup>, Mohammad Vaziri<sup>1</sup>

<sup>1</sup> Minimally Invasive Surgery Research Center, Tehran University of Medical Sciences, Tehran, IR Iran

<sup>2</sup> Hasheminejad Kidney Center, Tehran University of Medical Sciences, Tehran, IR Iran

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### ABSTRACT

**Background:** The invention of central venous catheters (CVC) for hemodialysis (HD), brought about a fundamental change in the treatment of patients who needed HD, from the late 1970's till the present time. Nowadays the use of CVC is a common medical procedure. Increasing use of these methods necessitates clarification of the exact nature of the effects, and potential complications for surgeons.

**Objectives:** This study attempts to determine the frequency of CVC; complications, survival rates and outcomes in HD patients, treated at the Hasheminejad Kidney Center, Tehran from January 2010 till June 2011.

**Patients and Methods:** In this cross-sectional descriptive study, we collected data (using the census method) from the records of all patients over the age of 18 years, who had been referred, from January 2010 till June 2011, for CVC insertion. Catheter sites, related complications, creatinine (Cr), hemoglobin (Hgb), survival rate of catheters and the patients' demographic data, were collected and analyzed.

**Results:** In this study, 150 patients were evaluated, 122 participants (81%) were male and 28 (19%) were female. The patients' average age was  $56.2 \pm 5$  years (19 to 87 years). Regression analysis between the patients, with and without complications, showed that increasing age ( $P = 0.003$ ,  $RR = 0.78$ ), decreases in Hgb ( $P = 0.04$ ,  $RR = 0.34$ ) and also increased Cr ( $P = 0.023$ ,  $RR = 0.45$ ), and BUN ( $P = 0.014$ ,  $RR = 0.37$ ) are significantly correlated with catheter-related complications as independent risk factors. The one month survival rate of temporary catheters was 77.3% and their two-month survival was 60%.

**Conclusions:** The overall rate of complications in the present study was no higher than in other similar studies. Anemia rates, however, were much higher in our patients. Most of the complications involved catheter infections, followed by catheter thrombosis. CVC survival rates in Iran have an acceptable outcome and results of this study were similar to those of past studies.

### ► Implication for health policy/practice/research/medical education:

The article will announce the outcomes of catheter insertion and will help surgeon, vascular surgeons, nephrologist, emergency medicine, anesthesiologist and nurses in predicting and planning correct strategies for Catheter insertion to reduce its complications and increase Survival.

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\* Corresponding author: Morteza Khavanin Zadeh, Hasheminejad Kidney Center, Tehran University of Medical sciences, Tehran, IR Iran. Tel: +98-2166555447, Fax: +98-2122308515, E-mail: mkhavanin@yahoo.com

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## 1. Background

The invention of central venous catheters (CVC) for hemodialysis (HD) induced a fundamental change in the treatment of patients who required dialysis in the late 1970's. The use of CVC at present is a common and useful therapeutic method. The passage of blood through a catheter should be approximately 250 mL per minute, for at least two hours. This condition is very sensitive and somewhat unpredictable, catheter function and performance is approved by the passage of a given value of blood flow (1, 2). Of the renal failure patients, who are in the final stages of the disease, 20% of these patients, either permanently or occasionally undergo HD treatment, and this often requires the use of CVC during their treatment (3). CVC placement in the internal jugular vein, which is the most appropriate location for the placement of the device, may also be accompanied by complications and mortality (3-6). The most common complication of CVC is related to the trauma of its placement area, with the possibility of; pneumothorax, hemothorax, hematoma, or neural plexus damage. Pneumothorax is diagnosed with symptoms such as dyspnea, and a chest X-ray can provide evidence for this condition. Additionally, some of the early complications are also very important and can be life threatening, for example; air embolism and cardiac arrhythmias, although they are relatively uncommon. Among the long-term side effects of CVC infection and central venous thrombosis are common (3, 5). To achieve a good dialysis result, we require an adequate blood flow, long life and low complication rate for the implementation of the procedure. Although, none of the existing catheters combine all of the above mentioned features, among the various options, AVF is closer to our expectations, given the fact that the ideal circumstances for its placement are not always possible. Overall, we have found a greater necessity for the use of CVC (7).

## 2. Objectives

In this study, we have attempted to study patients in whom a CVC was placed. In addition, we have provided accurate information in connection with the benefits of this approach, its efficiency, complications and determination of their survival rate.

## 3. Patients and Methods

In a prospective study, patients over 18 years old, who had been referred to the Hasheminejad Kidney Center from January 2010 till June 2011 for CVC placement, were assessed. The data was collected using the census method. The exclusion criteria for patients were; age less than 18 years, and coagulating or clotting problems. A total of 150 patients were included in our study. Information collected from the patients included; age, gender, marital status,

Hemoglobin (Hgb) levels, blood urea nitrogen (BUN), creatinine (Cr), average Prothrombin time (PT), partial thromboplastin time (PTT), body mass index (BMI), history of diabetes and/or hypertension, duration of chronic kidney disease or end stage renal disease (ESRD), catheter insertion site, and various types of catheter-related complications. Catheter survival and longevity were followed up and monitored for at least six months. None of the patients received antibiotic before or after catheter replacement. Considering the prevalence of catheter infection in admitted patients, first, we ruled out other possible causes of infection, if there was no definite cause, especially in cases with fever and chills during the dialysis, we made the decision that the diagnosis was a catheter related infection. Local infection was diagnosed when there was; discharge, swelling, or tenderness observed at the site of the catheter placement. We considered a systemic infection when a patient suffered from symptoms such as; fever, chills and distress, the presence of leukocytosis might also be diagnostic in this condition and the source of the infection could be found by blood culture. Although, a systemic infection is not considered to be a significant complication for our population, however, it can have an effect on the outcomes of catheter usage and cause a removal effect on the catheter. The removal effect of catheters includes; reduction in their efficacy, fever, systemic infections and venous thrombosis.

Following the CVC placement procedure, each of the patients had a standard chest X-ray, by which, we could comment on the presence of; pneumothorax, hemothorax and catheter malposition. Concerning central vein thrombosis, when the catheter performance or function was disturbed (i.e. blood passing through was less than 200 ml per minute), demonstrated by a dialysis machine alarm, in this condition, complications and stenosis in the catheter location were examined. Moreover, regarding arrhythmias and other complications of the heart, these patients routinely undergo cardiac monitoring and if there were abnormal findings, they were followed-up by a cardiologist. We considered anemia as Hgb under 10 mg/dl for this group of patients. Analysis were determined by using SPSS software, version 13 (Inc. Chicago, IL) and descriptive analysis was carried out for the quantitative data. For qualitative data frequency analysis was performed. Analysis of the data distribution was assessed by a Kolmogorov-Smirnov test. For normally distributed data, an independent-sample t-test was used, and for comparison of qualitative variables a chi-square statistical test was used. To determine the survival rate of catheters, we used a Kaplan-Meier test. In all of these tests, the significance level was considered to be  $P < 0.05$  and as two ranges or domains.

## 4. Results

Records of 150 patients were examined in this study. A

total of 122 participants (81%) were male and 28 participants (19%) were female. The patients' average age was  $56.2 \pm 15$  years (19 to 87 years), and 145 patients (96%) were married. Average incidence of ESRD in these patients was  $3.5 \pm 1.1$  months, 15 patients (10%) had a history of diabetes and were suffering from diabetic nephropathy, and 16 patients (16.8%) also had a history of hypertension. There were 77 patients who noted a history of heart disease. Pre-dialysis creatinine average was  $10.2 \pm 5.3$  (1.8 to 32), the mean Hgb was  $8.8 \pm 1.2$  (4.8 to 13.2) and all of the examined patients were affected by anemia in relation to their gender. Patients' average BUN was  $88 \pm 22.3$  (12 to 288), and their mean BMI was  $24.4 \pm 2.3$  (29 to 19). Average PT and PTT, respectively, were  $13 \pm 3.3$  and  $33.1 \pm 18.5$ . Frequency of the various catheter sites and also the major complications after insertion are shown in Table 1. Regression analysis between patients with and without complications showed that increasing age ( $P = 0.003$ ,  $RR = 0.78$ ), lower Hgb ( $P = 0.04$ ,  $RR = 0.34$ ) and also an increase in Cr ( $P = 0.023$ ,  $RR = 0.45$ ) and BUN ( $P = 0.014$ ,  $RR = 0.37$ ) are significantly correlated with catheter-related complications as independent risk factors. No death was seen due to catheter placement. In one case, pneumothorax was observed after placement through the left jugular vein route. In addition, the catheters survival rate was also calculated (in cases where the catheter was removed due to use of AVF, this was not considered to be a catheter deficiency). Accordingly catheter survival is given in Table 2 separated by month.

**Table 1.** Frequency of Various Catheter Sites and Their Complications

	Frequency, No. (%)
<b>Catheter site</b>	
Right jugular	132 (88)
Left jugular	6 (4)
Right femoral	4 (2.6)
Left femoral	5 (3.3)
Right subclavian	3 (2)
<b>Causes of catheter DC</b>	
Cardiac arrhythmia	2 (1)
Topical infection	32 (21)
Systematic infection	18 (12)
Thrombosis	40 (27)
Arterio-Venous Fistula Use	56 (37)

**Table 2.** Catheter Survival Based on Months Elapsed From Treatment

	Survival Rate, %
End of first month	77.3
End of second month	60
End of third month	49.7
End of fourth month	44
End of fifth month	35.3
End of sixth month	34.4

## 5. Discussion

The main objective of this study was to observe the complications and average lifespan of CVC. Therefore, the studies and researches in this area have focused on examining the effects of catheters. Several studies in general, and those headed by the Dialysis Outcomes and Practice Patterns Studies (DOPPS) have shown that the method of dialysis in ESRD patients typically follow different patterns in different countries. For example, in Europe about 25% of patients undergo HD initially using temporary catheters, while in America the use of CVC has been estimated to be up to 61% (8, 9). Thus, the use of catheters, fistulas, and also the placement of a temporary device are influenced by several factors that have not been addressed in many studies. Given the significance of these issues, it is recommended that future studies address these concerns, as well as the factors involved in the mentioned methods of selection. Our study has shown that a significant number of patients treated in our kidney center have benefited from the advantages of these catheters, and they have not been directly affected by the complications caused by these types of catheters or their placement. In this respect, one may say that the rate of complications in our country is no more than the overall rate of complications recorded in similar studies. It is further evidence of the fact that the advantages of using these catheters are greater than their disadvantages and complications (8-13). This study showed that the main complication observed is catheter site infection, and this result has been repeatedly confirmed in other earlier studies (8, 10-13). In some studies, in terms of the frequency, no difference was observed between levels of thrombosis and infection (8, 11). Moreover, in a number of studies, the thrombosis rate has even been suggested to be higher than the rate of infection (8, 10, 11, 13). For example, a study by Chan *et al.* in 2008 showed that the complications proposed regarding the CVC, are more frequently related to thrombosis rather than to catheter infection (14). This result is also confirmed in our study. Apart from Chan *et al.*, all of the previous studies have confirmed this finding, and Cho *et al.* also found this in their study as well (15). Although, this present study has not exclusively examined complications, it does insist on the point of caution regarding right jugular catheters. Our study has shown that this complication has a higher correlation among the group when the catheter was placed in the right jugular vein ( $P = 0.00$ ). Other complications posed were included secondarily to catheter thrombosis.

We also examined factors affecting complications. Among the most important factors affecting a higher rate of complications included; initial Cr levels, lower Hgb, intensity of the anemia and finally higher age. The ratio of higher age and also the intensity of the initial disease and its relationship with complications have been recorded in previous studies. However, despite the importance of

anemia, only a limited number of studies have addressed this issue, so far. Previous studies have shown that patients with chronic renal diseases suffer disproportionately from anemia. In European countries, anemia can be seen at a ratio of less than 50%. In these patients, the lowest levels were seen in Sweden (25%) and the highest in Far East countries, especially Japan (77%). All of our patients (100%) were suffering from anemia. This by itself is an important point that has not been addressed so far, and no accurate proportion of anemia had been reported in Iran. The reason for this high percentage was not among the points discussed in this study, nonetheless, the effect of anemia on catheter complications and their increased proportion was among the interesting points which were found in the present study. Putting it in plain language, this study revealed that the higher the level of anemia and age, the greater the possibility of complications in the patients.

In this study, one case of pneumothorax was reported, that was less than the number reported in earlier studies. Another important point was that previous studies usually stated that a jugular catheter does not bring about pneumothorax, but in this study the only pneumothorax case that resulted from the procedure, was associated with a left jugular catheter. We know that in our study there was a lack of balance between the right and left jugular catheter numbers, although our study had a prospective design. Our study confirmed that pneumothorax is an uncommon complication and this is supported by other studies. Among the novel issues addressed in the present study, other studies have focused less on this point (8, 10), is the estimation of the catheters' survival rate. In this study, the survival rate of the catheters was calculated separately for up to six months. The major proportion of inefficiencies and catheter removals in the first three month occurred due to reasons such as; thrombosis, along with local and systemic infection. Among the points which were not addressed in our study, was the proportion of temporary and permanent catheters used. Given the importance of this issue and the fact that there have not been any studies conducted in Iran regarding this subject, it is therefore recommended that future studies consider this aspect and examine the rate and proportion of catheter use. Further research should also include the reasons for their application of the proportion in a polycentric fashion, since those results could play a significant role in future studies and treatment planning.

Our study was conducted using an adequate sample size, but it only involved a single medical center. Given the important results obtained from the present study, it is recommended that future studies, are polycentric and conducted in several provincial centers. In order to confirm the results, one may need to include geographical distribution factors and also the level of health care in different regions of the country in these studies. The factors affecting the survival of these patients can be calcu-

lated in Iran and detailed comparisons of survival rates in different areas determined. Moreover, eliminating the etiology and initial disease, one can find the most important factors associated with the survival of these patients in furtherance of these studies. Cost benefits of treating these patients and complications are also important points which need to be addressed in subsequent studies. Consequently, this would enable the cost of various complications to be determined, and the most important factors in reducing or increasing these costs to be found, since this is an important aspect of these complications.

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## Authors' Contribution

30% first author, 60% corresponding author and 10% other authors

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