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ORIGINAL ARTICLE

An inquiry into the efficacy of 20 cm and 16 cm catheters placed in the right femoral vein of hemodialysis patients

Mohsen Khaleghian[1], Mohammad Aref Emami[2], Zahra Ameri[3]✉

[1] *Assistant Professor of General Surgery, Department of Surgery, Faculty of Medicine, Zahedan University of Medical Sciences, Zahedan, Iran;*

[2] *Resident of Surgery, Department of Surgery, Faculty of Medicine, Zahedan University of Medical Sciences, Zahedan, Iran;*

[3] *General Physician, Ali ebn Abitaleb Hospital, Zahedan, Iran.*

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Abstract

Introduction: Today, temporary or permanent venous catheters are being increasingly used in patients with renal failure. It seems a necessity to be familiar with their clinical applications and complications as well as their efficacy. The aim of this study was to compare the efficacy of two catheters of 16 cm and 20 cm lengths.

Methods: This research project was a descriptive, analytic study conducted on 40 hemodialysis patients in Zahedan. The patients were randomly allocated into two groups (n=20 per group). Analyses were made using Kolgromorov-Smironov test (P > 0.05) to examine normal distribution, and chi-square test for qualitative data at the significant level of a=0.05. The data were analyzed by SPSS 15.

Results: Infection frequency rates in 16 cm and 20 cm catheter groups were 10% and 15% respectively. The difference was not significant (P=0.633). The 20 cm catheter was of longer efficacy duration (744.1±10.13) than the 16 cm catheter (625.2±45.12). Again, the difference was not significant (P=0.259).

Conclusions: Femoral catheters of 16 cm or 20 cm sizes do not differ in terms of infection or efficacy, and one cannot be preferable to the other in this regard.

Key Words: Catheter; Right Femoral Vein; Hemodialysis

Introduction

Chronic renal failure is a progressive and irreversible degradation of renal function. The main treatment for end-stage renal failure includes dialysis or, eventually, kidney transplantation [1]. The number of patients with chronic renal failure increases to double every 7 years [2-3]. On an annual basis, over 60 million people worldwide lose their lives because of kidney disease [2]. Statistics in Iran indicate a significant growth of chronic kidney disease such that dialysis patients accounted to 8,500 in 2002 [3] with a 15% increase rate per year [4], reaching over 24,000 patients in 2008 [5]. Of these, 48.5% were treated with kidney transplantation, 48.3% with hemodialysis, and 3.2% with peritoneal dialysis [6].

The central venous catheter is used for immediate access in hemodialysis of patients with

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Tel: +985614443041 (5533)
Fax: +985614440488
Po Box 97175-379
Email: jsurgery@bums.ac.ir

✉**Correspondence to:**
Zahra Ameri, General Physician, Ali ebn Abitaleb Hospital, Zahedan, Iran ;
Telephone Number: +98 5433295580
Email Address: mrs.ameri2010@gmail.com

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renal failure [2-4]. It is a useful tool for monitoring critically ill patients. Depending on the type of catheter, different areas are used for monitoring including the jugular, subclavian, femoral and brachial veins. The associated complications include infection, inability to place catheter, arterial puncture, improper catheter insertion, pneumothorax, hematoma, hemothorax, and cardiac asystole for unknown cause [7].

Given the increasing number of patients with renal failure, it is required to use procedures with more effective applications and lower complications in hemodialysis patients. Central venous catheters for hemodialysis are divided into two types: cuffed and non-cuffed. The non-cuffed ones are used for short-term use without causing skin tunnel [8]. Inefficient functioning of femoral catheter in patients who are in need of emergency hemodialysis can have irreversible complications for patients [9, 10]. On the other hand, the patients who require emergency dialysis due to shortness of breath and restlessness as well as those who are uncooperative for appropriate positioning on the operating room bed are also candidates for femoral catheterization. Nonetheless, placement of the femoral vein catheter is not recommended due to high risks of infection unless in cases where internal and external jugular veins cannot be used due to obstruction [11].

This procedure involves substantial complications and is usable for a shorter period of time than arteriovenous fistula. Silicone catheters are used either temporarily or permanently. The temporary catheter is associated with high risks of infection, thrombosis and venous stenosis, and lack of long-term applicability limited to a maximum time of 2-3 weeks [3-5].

Permanent catheters (permcaths) are being increasingly used because of the high number of dialysis patients in Iran and unavailability of kidney transplantation for all patients. It is not possible to insert catheter in jugular vein of patients admitted into intensive care units (ICUs) due to several reasons, making it an unavoidable choice to use femoral vein for catheter insertion [12]. Given the high incidence rate of venous thrombosis in permanent catheterization, on the other hand, it is necessary to use temporary catheters until permcaths are prepared for the patient who cannot use arteriovenous fistula. In Iran, hemodialysis catheters for adults are usually in 16 and 20 cm sizes. Placement of the femoral vein catheter is not recommended because of high risks of infection unless the internal and external jugular veins cannot be used due to blockage [12, 13].

Given the high prevalence of renal failure followed by treatment procedures such as dialysis and high incidence rate of complications from dialysis catheter insertion, this study attempted to compare the efficacies of 16 cm and 20 cm catheter placements in the right femoral vein of dialysis patients referring to Ali Ibn-Abitaleb Hospital of Zahedan in 2015.

Methods

After it was approved of in the Ethics Committee and Research Council at Zahedan University of Medical Sciences (Registration Code: 1628), this descriptive-analytic study was performed in due consideration of Codes 1 to 31 enacted in the Ethics Committee of Zahedan University of Medical Sciences. Considering α=5%, β=10%, and the power of 90% using Altman's nomogram and building on the calculated difference in similar studies, the sample size was determined as n=20 per group [6]. The participants were from among the patients under dialysis treatment referring to Ali Ibn-Abitaleb Hospital of Zahedan in 2015. After the required explanations were presented to all the patients, they provided informed consents and were allocated into two 20-member groups by block randomization method. The decision concerning type of catheter and its placement was made by a surgeon.

Background information including age, gender, cause of renal failure, concurrent diseases such as diabetes or blood pressure, history of cardiovascular disease or stroke, peripheral vascular disease, previous use of statins or anti-clotting drugs, and history of problems with catheter placement in jugular veins was obtained from the participants and cared for potential effect.

The patient was transferred to the operating room for catheter placement. Following topical preparations, and prep and drep, the right femoral vein was found and the guide wire was pushed into the right femoral vein by a (vein puncture) needle. Afterwards, the catheter was guided along the guide wire into the femoral vein path. After insertion of the catheter into the central vein, it was heparinized with 5000 units of heparin diluted in 200 mL normal saline solution, and was fixed to the skin at the insertion site. The patient was watched for early hematoma complications up until an hour following catheter insertion.

The patients who were operated within two weeks from the study onset were excluded. While they had femoral catheters, the patients were monitored for a maximum of two weeks for complications such as infection according to

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clinical symptoms (redness, pus discharge, enduration, and fever), laboratory demonstration of catheter and blood culture. Catheter failure was described as lack of adequate blood flow for successful dialysis (that stops dialysis). Catheter inefficiency was defined as the device giving insufficient blood flow and dialysis stop (lack of proper traction of the device). Catheter's efficacy was characterized, on the other hand, as successful dialysis without system alarm. The catheter used in this study was made by Arrow Company with a diameter of 12 French and 16 and 20 cm lengths.

Analyses were made in SPSS software (version 15) using percentage to describe qualitative data and mean, standard deviation, mean standard deviation, and minimum and maximum values for quantitative data. Kolgromorov-Smironov test (P>0.05) was used to examine normal distribution, whereby parametric (chi-square and t-test) and non-parametric tests (Mann-Whitney) were used to compare group means. To examine qualitative variables, chi-square test was applied at the significant level of a=0.05.

Results

In this study, 40 patients were included with 20 patients in 16 cm catheter group and 20 patients in 20 cm catheter group. In 16 cm catheter group, 55% of the patients were male and 45% were female. In the 20 cm catheter group, 60% were men and 40% were women. Chi-square test did not show a significant difference between the two groups in terms of gender.

The mean age of the patients using 20 cm catheter was 48.65±11.49 years and in patients using 16 cm catheter, it was 48.7±9.52 years. T-test showed no significant difference in the mean age of the two groups (P=0.988). As for data distribution, Kolmogorov-Smirnov test showed that P value is less than 0.05, indicating non-normal distribution of catheters' efficacy data. Thus, non-parametric test (Mann-Whitney) was used.

There was a 10% rate of infection prevalence in the 16 cm catheter group; in the 20 cm catheter group, the rate was 15%. Chi-square test showed no significant difference between the groups in this regard (p=0.404)(Table 1).

The mean efficacy duration in the 16 cm catheter group was 12.45 ± 2.62 days; in the 20 cm catheter group, it was 13.10 ± 1.77 days. Mann-Whitney test showed no significant difference between the groups in this regard (p=0.259)(Table 2).

Table 1: Infection in 16 cm and 20 cm catheter groups

Variable		Type of Catheter		Total
		16 cm	20 cm	
Non-infection	Number	18	17	35
	Percentage	90%	85%	87.5%
Infection	Number	2	3	5
	Percentage	10%	15%	12.5%
Total	Number	20	20	40
	Percentage	100%	100%	100%
Qui-square test		P=0.633	P=0.229	-

Table 2: Mean efficacy durations in 16 cm and 20 cm catheter groups

Type of catheter	Number	Mean	Standard deviation	Mann-Whitney test		
				Mean rank	statistic	P-value
20	20	13.10	1.744	22.28	-1.129	0.259
16	20	12.45	2.625			

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Discussion

Given the high number of dialysis patients in Iran and unavailability of kidney transplantation for all the patients, permcaths are being increasingly used. However, a major complication of permcaths is jugular veins' thrombosis, and it is not possible to use jugular veins in these patients for catheter placement [12]. In several of the patients admitted into ICUs, catheter placement in jugular vein is an impossible choice making the femoral vein as the unavoidable option for these patients [13]. On the other hand, considering the high incidence rate of venous thrombosis in permanent catheterization, it is necessary for patients with limited possibility of using arteriovenous fistula to apply temporary catheters up until permcaths are available to them [14].

At present, the presupposition is that temporary catheters can have wider applicability in light of the current socioeconomic circumstances, their lower costs, and easier accessibility.

When an inadequate amount of heparin is injected into the catheter after dialysis, the blood will enter into the catheter leaving clot in the lumen whereby the catheter gets blocked [15].

In the current study, comparison of the prevalence of infection in the two groups showed that in the 16 cm catheter group, 10% of the patients had infections, while 90% had no infections. Infection rate in the 20 cm catheter group was 15%, and 85% were not infected. The two groups had no significant differences in terms of infection frequency.

Comparison of the mean efficacy duration of catheters showed no significant differences in the two groups.

Beigi et al studied the complications and performance of central vein permanent and temporary catheters. They reported a 15.3% infection rate as for temporary catheters, a finding which is similar to the 10% and 15% rates in our study [6].

In Al Homrani et al's report in 2000, femoral catheterization was described as a safe procedure for hemodialysis but accompanied with acceptable, rare life-threatening complications [16]. They also recommend this procedure for acute dialysis patients and caution against inaccuracy at the time of placement with an aim to prevent from complications. This, to their belief, plays a vital role in incidence of complications. These hygienic and sterilization considerations as well as surgical skills were regarded for in the current study whereby infection rate was limited and close to those of other studies.

Kjellstrand et al investigated 5 common complications of femoral catheter among 700 dialysis patients over a period of 5 years. Their results indicated that extensive bleeding occurred in three cases of thrombolysis, one case of pulmonary embolism, and two cases of inferior vena cava perforation. They reported that these complications can be prevented through early removal of the catheter after dialysis and continuous manipulation of the guidewire in the presence of resistance when placement is being performed. Finally, they recommend this method due to few complications associated with it (upon observing the aforementioned guidelines) [17]. In our study, serious complications were not reported and not included in statistics consequently. Only, the most common complications including inefficacy and infection were examined. In both groups, the inefficacy was found similar and indifferent.

Dialysis catheter is among catheters used in emergency cases and in hospitals only up until the patient is prepared for permanent vascular access involving permcaths or arteriovenous fistulas. Therefore, it is recommended to observe all sterilization and nursing care principles as well as to educate the patient to self-care of groin area which can contribute to optimized efficiency of femoral catheter.

Conclusions

According to the findings of the current study, the 16 cm and 20 cm catheters do not differ in terms of efficacy and infection rates. In the clinic, a set of factors affect the preference of one over the other including physical characteristics of the patient (height and weight), clinical view and surgeon's experience, accessibility and type and size of the available catheters for placement.

Implications

Since there is no difference between the types of catheters, the findings of the current study suggest, the type of catheter should best be selected according to the physicians' clinical view and the patient's conditions. Given the limited sample size and patient follow-up time in the current study and the few studies conducted in this regard, it is proposed to perform multi-center research with bigger sample sizes to find more exactly any efficacy differences between the two types of catheters.

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