

# Patency and outcomes of tunneled hemodialysis catheter via femoral versus jugular vein access

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## ABSTRACT

The design of a suitable catheter to achieve a permanent, economical, and efficient vascular pathway for hemodialysis has been always accompanied by difficult and potential complications. Various strategies have been adopted to minimize the use of tunneled catheters that are used for dialysis. Regarding this, the present study aimed to assess the success, patency, as well as early and late complications of cuffed femoral and jugular hemodialysis catheters. This case-control study was performed on 145 hemodialysis patients who were candidates for the insertion of tunneled hemodialysis catheters at Rasool-e-Akram Hospital in Tehran, Iran, during 2015–2016. The data were collected retrospectively by reviewing the patients' medical records. The participants were divided into two groups of femoral and jugular accesses, based on the type of catheter they had. To determine the procedure-related outcomes, they were assessed 1 week, 1 month, and 6 months after catheterization. According to the results, the mean times of catheter efficacy (patency) were  $4.43 \pm 3.11$  and  $5.65 \pm 4.57$  months in the femoral and jugular access groups, respectively, showing no significant difference between the two groups ( $P = 0.095$ ). Furthermore, the femoral and jugular access groups had the infection prevalence of 23.2% and 16.2%, thrombosis prevalence of 28.6% and 20.9%, and mortality rates of 3.5% and 1.4%, respectively. According to the multivariable linear regression model, the history of catheterization could predict reduced catheter patency. In addition, catheter-related infection could be predicted among females based on the multivariate logistic regression analysis. As the findings indicated, femoral and jugular hemodialysis catheter insertions showed no significant difference in terms of the mean patency, complications (e.g., infection and thrombosis), and mortality rate.

**Key words:** Catheter, jugular, patency

## INTRODUCTION

The installation and preparation of a permanent vascular pathway for hemodialysis is an important challenge for

surgeons. This challenge is mainly due to the increased number of dialysis patients, such as the elderly and diabetic patients, especially those who are considered and candidates for kidney transplantation, as well as patients requiring long-term dialysis.<sup>[1,2]</sup>

The guidelines to improve the outcomes of kidney disease have offered and provided standards for optimal access

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and maintenance of the route for dialysis.<sup>[3]</sup> The autologous arteriovenous fistula turns as a selective vascular access in patients requiring long-term dialysis. The use of this type of access results in a long-term patency and also a few potential complications.<sup>[4,5]</sup> However, these benefits may be accompanied by a high failure rate (up to about 30%).<sup>[6,7]</sup>

The arterial/venous grafts are more favorable, compared to the autologous arteriovenous fistulas, because they have more short-term outcomes and fewer deficits; moreover, they can be used immediately for hemodialysis if needed.<sup>[8]</sup> However, this tool is also associated with low patency, leading to increased morbidity and high hospital costs.<sup>[9]</sup>

The application of autogenous arteriovenous fistulas has been increasingly considered today as a temporary access using tunneled catheters. However, the employment of this method is associated with a high degree of morbidity, slight patency, and limited need for hospitalization.<sup>[10-12]</sup> Accordingly, the design of a suitable catheter to achieve a permanent, economical, and efficient vascular pathway for hemodialysis has been always accompanied by difficult and potential complications.

Various strategies have been adopted to minimize the use of tunneled catheters.<sup>[13]</sup> The tunneled catheters are used for dialysis in form of cuffs or noncuffs and antigradient or retrograde. The cuffed tunneled hemodialysis catheters have significant advantages over the noncuffed varieties. These types of catheters have a simple insertion, reduce intravascular coagulation, and are potential to be planted on various sites; moreover, they are soft, thereby decreasing vascular endothelial damage. Nonetheless, the benefits and limitations of the cuffed tunneled catheters remain uncertain. With this background in mind, the present study was conducted to assess the success, patency, as well as early and late complications of cuffed femoral and jugular hemodialysis catheters.

## MATERIALS AND METHODS

This case-control study was conducted on 145 hemodialysis patients who were candidates for the insertion of tunneled hemodialysis catheters (i.e., 74 cases with femoral access and 71 cases with jugular access) referring to Rasoul-e-Akram Hospital in Tehran, Iran, within 2015–2016. The data were collected retrospectively by reviewing the patients' medical records. The collected data included demographic characteristics, medical history, consumption of medications, previous catheter insertion, duration of catheter use, duration of end-stage renal disease and hemodialysis, and sites of catheter access.

Femoral and jugular catheters were used in the present study. Therefore, the participants were assigned into two groups, namely femoral and jugular accesses, based on the type

of catheter they had. To determine the procedure-related outcomes, the evidence of catheter-induced infection, catheter malfunction, and existence of any clot in the site of catheter were assessed 1 week, 1 month, and 6 months after catheterization.

## Statistical analysis

The quantitative variables were presented as mean and standard deviation. Furthermore, the categorical variables were summarized by absolute frequency and percentage. The normality of data was analyzed using the Kolmogorov–Smirnov test. Furthermore, the categorical variables were compared by means of Chi-square or Fisher's exact tests when >20% of the cells with expected count of <5 were observed. All statistical analyses were performed in the statistical software SPSS, version 16.0 (SPSS Inc., Chicago, IL, USA).  $P \leq 0.05$  was considered statistically significant.

## RESULTS

Regarding the baseline characteristics, the femoral access group had a significantly higher in female gender (66.2% vs. 46.5%,  $P = 0.017$ ) and mean age (59.29 vs. 50.20 years,  $P = 0.010$ ), compared to the jugular access group. However, no significant difference was observed between the two groups considering other variables, including age at disease onset, duration of dialysis, and previous history of catheter insertion [Table 1]. The femoral and jugular access groups had the mean catheter efficacy time (patency) of  $4.43 \pm 3.11$  and  $5.65 \pm 4.57$  months, respectively, indicating no significant difference between the two groups ( $P = 0.095$ ).

Furthermore, 14.1% and 7.1% of the patients with femoral and jugular catheters required to use anticoagulant, respectively. The results revealed no significant difference between the two groups in this regard ( $P = 0.181$ ). Likewise, as shown in Table 2, there was no significant difference between the femoral and jugular access groups regarding the rate of catheter-related infection, thrombosis, or mortality ( $P = 0.324$ ,  $P = 0.316$ , and  $P = 0.368$ , respectively).

According to the multivariable linear regression model [Table 3], only the history of catheterization could predict reduced catheter patency (beta =  $-2.032$ ,  $P = 0.015$ ). Based on the multivariate logistic regression analysis, catheter-related infection could be predicted among the females [Table 4]. In this regard, the rates of infection in women and men were 29.2% and 5.8%, respectively (odds ratio = 9.034,  $P = 0.003$ ). A similar regression model could not discover any baseline factor predicting catheter-related thrombosis.

## DISCUSSION

Few studies have been conducted mainly in the form of case report or cross-sectional report on the success rate

**Table 1: Baseline characteristics in the groups with femoral and jugular catheters**

Item	Femoral access	Jugular access	P
Female gender	49 (66.2)	33 (46.5)	0.017
Mean age (year)	59.29±19.13	50.20±22.94	0.010
Age at end-stage renal disease onset (year)	55.48±21.31	49.77±23.21	0.126
Dialysis duration (month)	20.48±6.16	5.27±9.26	0.001
Previous catheterization	62 (82.7)	44 (62.9)	0.159

**Table 2: Outcomes of femoral and jugular hemodialysis catheters**

Item	Femoral access	Jugular access	P
Mean patency (month)	4.43±3.11	5.65±4.57	0.095
Needing coagulation therapy	10 (14.1)	5 (7.1)	0.181
Infection	13 (23.2)	11 (16.2)	0.324
Thrombosis	16 (28.6)	14 (20.9)	0.316
Mortality	4 (5.3)	1 (1.4)	0.368

**Table 3: Multivariable linear regression model to assess the predictors of patency**

Item	$\beta$	SE	P
Catheter site	1.660	0.752	0.096
Age	-0.053	0.172	0.760
Female gender	0.487	0.956	0.612
End-stage renal disease duration	-0.086	0.170	0.614
Time of dialysis	0.009	0.028	0.755
History of catheter insertion	-2.032	0.819	0.015

SE: Standard deviation

**Table 4: Multivariable logistic regression model to assess the predictors of infection**

Item	$\beta$	OR	P
Catheter site	0.036	1.036	0.953
Age	0.141	0.199	0.479
Female gender	2.201	9.034	0.003
End-stage renal disease duration	-0.199	0.819	0.316
Time of dialysis	-0.017	0.983	0.558
History of catheter insertion	-0.366	0.694	0.585

OR: Odds ratio

or complications of catheterization for hemodialysis, particularly through the femoral or jugular vein. Accordingly, limited comparisons have been made between two or more pathways for catheter implantation in terms of patency or complications. Moreover, based on a review, no studies have been performed to identify the relevant factors or predictors of the patency and complications associated with catheter implantation.

In the present study, a comparison was performed between the patency and frequency of mortality and morbidity

related to the two types of catheterization for hemodialysis, namely femoral and internal jugular catheterizations. This study also included the investigation of the predictors of the associated outcomes. The results of the current study indicated no difference between the two catheterization methods in terms of the patency rate and complications of catheter implantation.

The findings of the current study are supported by some studies; however, they are inconsistent with those of others. In a study conducted by Maya and Allon,<sup>[14]</sup> the initial patency of the femoral catheters was far lower than that of the jugular catheters, which is completely inconsistent with our results. Nevertheless, in line with our findings, in the mentioned study, the two groups were comparable in terms of infection-free survival. Accordingly, in the present research, in case of femoral catheters, 28.6% of the patients had deep venous thrombosis, which is quite similar to the results reported in the mentioned study.

In another study carried out by Schillinger *et al.*,<sup>[15]</sup> the infection and venous sinus incidence rates were reported as 6% and 42%, respectively. However, these rates were significantly higher in our study (16.2% and 20.9%, respectively), compared to those in the mentioned study. In addition, in a study conducted by Ervo *et al.*, the prevalence of catheter-related infection was determined as 2.5% in the jugular catheterization group, which is lower than the rate obtained in our study (56).

In the present research, the investigation of patency-related factors revealed that the previous history of catheterization was the only factor associated with the mean patency of the catheter. However, the experience of a surgeon or specialist, along with the patient's comorbidity, such as diabetes, hypertension, and peripheral vascular disorders, seems to have potential implications for this degree of patency.

In the current study, the incidence of catheter-induced infection in women was significantly higher than that in men. In the previous studies, no evidence was presented regarding the role of patients' gender, history of diabetes, and duration of catheter insertion in catheter-induced infection. Therefore, more studies are needed to assess the role of gender in increasing the risk of infection and determine the relevant risk factors for thrombosis.

## CONCLUSION

As the findings of the present study indicated, there was no difference between the two hemodialysis catheterization procedures, namely femoral and jugular catheter implantations, in terms of the mean patency and complications, such as infection, thrombosis, and mortality. Accordingly, the femoral and jugular access groups had the mean patency of 4.45 and 6.6 months, infection prevalence

of 23.2% and 16.2%, thrombosis prevalence of 28.6% and 20.9%, and mortality rates of 3.5% and 1.4%, respectively. Furthermore, the history of catheter implantation and female gender were obtained as the predictors of reduced patency and catheter-related infection risk, respectively.

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### Conflicts of interest

There are no conflicts of interest.

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