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Long-term outcome of permanent hemodialysis catheters: a single center experience

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ABSTRACT

Aim: Tunneled dialysis catheters are generally not used as a primary dialysis access but as bridging therapy until a permanent dialysis access is available. However, it has been stated that long-term use may be appropriate if needed. In our study, we aimed to reveal the long-term patency rates of tunneled dialysis catheters and the frequency of catheter-related diseases in a large patient group.

Material and Method: Patients who referred to our center for tunneled dialysis catheter insertion procedure between 2017 and 2022 were retrospectively analyzed with respect of catheter patency durations. The duration between the patients' repetitive admissions to our center due to catheter dysfunction, the cause of the dysfunction and the procedure applied to achieve the patency were noted. Kaplan- Meier survival analysis was used to calculate patency rates of catheters.

Results: 1010 procedures were performed on 464 patients who applied to our center for tunneled dialysis catheter creation or dysfunction. 309 patients were excluded from the study due to short-term follow-up or lack of data. Of the remaining 155 patients with 211 catheter sites included to the study and 467 interventional procedures data analyzed. The mean primary patency duration of the tunneled dialysis catheters was 10.50±10.25 months and the secondary patency duration was 18.00±13.77 months. The 6, 12, and 24-month patency rates of the overall tunneled dialysis catheters were 91.1 %, 83.9 % and 77.9% respectively

Conclusion: Although permanent dialysis catheters, which should not be the first choice for arteriovenous access, have associated comorbidities, they are a method with satisfactory patency rates when other access types are not suitable.

Keywords: Dialysis, tunneled catheter, arteriovenous fistula, complications

INTRODUCTION

Tunneled dialysis catheters are generally not used as the primary dialysis access method, but as bridging therapy until a permanent dialysis access is reached (1). However, tunneled dialysis catheters may be the patient's only dialysis access option in some cases. It is stated that long-term use of tunneled dialysis catheters may be the only way in cases where there is no suitable vascular access, the patient's rejection of other treatment options, the patient's life expectancy is short, and there is a history of multiple unsuccessful arteriovenous fistula creation (2).

One of the factors that determine the type of dialysis access is whether pre-dialysis planning is made by a clinician. An inverse correlation was found between nephrology follow-up and tunneled dialysis catheter placement rate for the first dialysis session of patients (3). It is possible to start dialysis directly through a permanent arteriovenous fistula by planning the dialysis access route in the pre-dialysis phase before the patients start the dialysis process.

Although tunneled dialysis catheters are easier to create than surgical methods, they cause some associated comorbidities in long-term use (4-6). These include catheter site infection, central stenosis, thrombosis, and sepsis. Although it increases morbidity and hospitalization, there is not enough data about mortality (7).

In our study, we aimed to reveal the long-term patency rates of tunneled dialysis catheters and the frequency of catheter-related comorbidities in a large patient group.

MATERIAL AND METHOD

Population

The retrospective study was carried out with the permission of Bolu Abant İzzet Baysal University Hospital, Local Ethics Committee (Date: 2023/01, Decision No: 41) All procedures were carried out in accordance with the Declaration of Helsinki.

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Patients who referred to our center for tunneled dialysis catheter insertion procedure between 2017 and 2022 included to the study. In order to analyze the results of long-term use, patients with a follow-up period of less than 180 days were excluded from the study.

The duration between the of the patients' repetitive admissions to our center due to catheter dysfunction, the cause of the dysfunction and the procedure applied to achieve the patency were noted.

Primary patency was defined as the time between the catheter creation and the first catheter failure.

Secondary patency was defined as the time from the creation of the catheter to the moment that the catheter patency could no longer be achieved with interventional procedures.

Procedure

After the local anesthesia injection, the central vein, whose patency was confirmed by ultrasound, was entered with a 17 G venous needle and the guide wire was extended into the vein. After measuring the distance between the atriocaval junction and the puncture cite, the tunnel was created. The catheter was first passed through the tunnel, then passed through the properly dilated tract and placed at the level of the atriocaval junction. It was tested that the catheter would provide sufficient flow for the dialysis with a syringe. During the replacement of the dysfunctional catheter, an angiogram was obtained by first injecting opaque material through the catheter lumen. After the pathology was detected and treated appropriately, the new catheter was advanced to its proper position via the guide wire (**Figure 1**). In patients with rapid and frequent fibrin sleeve formation, 2 mg/hour t-PA infusion was performed from both lumens of the catheter regularly once a month.

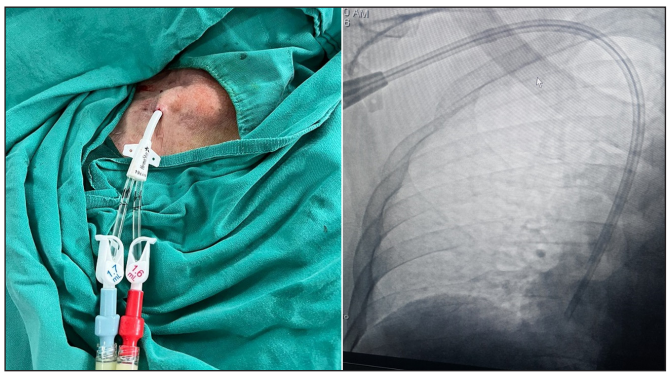

Figure 1. Tunneled catheter inserted via right internal jugular vein is seen (A), Angiographic image of the same tunneled catheter, the tip of the catheter placed at the level of atriocaval junction (B)

Statistical Analysis

Age, gender and catheter cite data analyzed with descriptive statistic methods. Mean patency durations of the dialysis catheters with different locations calculated with student's t test. The primary and secondary patency rates were calculated by the Kaplan-Meier survival analysis. SPSS ver. 26 program was used (IBM corp., Armonk, NY, USA) for statistical analysis.

RESULTS

1010 procedures were performed on 464 patients who applied to our center for tunneled dialysis catheter creation or dysfunction. 309 patients were excluded from the study due to short-term follow-up or lack of data. Of the remaining 155 patients with 211 catheter sites included to the study and 467 interventional procedures data analyzed. The demographic characteristics of the patients and their catheter locations are summarized in **Table 1**. The mean primary patency duration of the tunneled dialysis catheters was 10.50±10.25 months and the secondary patency duration was 18.00±13.77 months. The mean primary and secondary patency durations and patency rates with the aspect of the catheter locations are shown in **Table 2**. There was a significant difference in patency rates of tunneled dialysis catheters between inserted via right jugular vein and left jugular vein (p= 0.002). The 6, 12, and 24-month patency rates of the overall tunneled dialysis catheters were 91.1 %, 83.9 % and 77.9 % respectively (**Figure 2**).

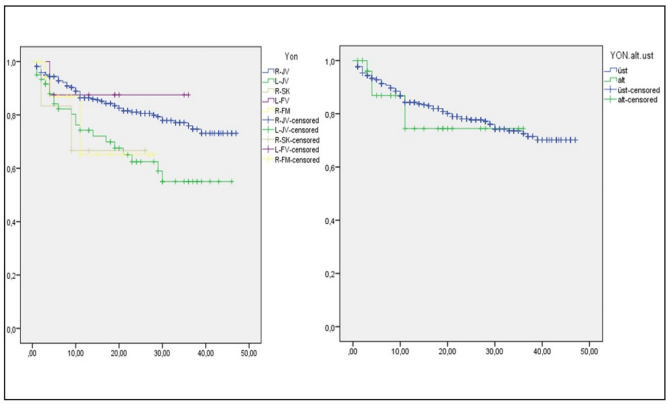

Figure 2. Kaplan–Meier survival curve presenting the patency results of catheters. There is a significant difference in access survival between right jugular and left jugular site catheters (p = 0.002) (A), Kaplan–Meier survival curve presenting the patency results of upper and lower extremity catheters (p=0.648) (B).

Table 1. Patients' characteristics and catheter locations

	Catheter Location						Overall
	RJV	LJV	RSV	LSV	LFV	RFV	
Number of Patients	142	9	2	-	1	1	155
Age	63.12	55.77	54.50	-	58.00	56.00	62,50 (20-93)
Gender (M/F)	81/61	1/8	1/1	-	1/-	1/-	85 (54.8 %)/ 70 (45.2 %)

RJV: Right Jugular Vein; LJV: Left Jugular Vein; RSV: Right Subclavian Vein; LSV: Left Subclavian Vein; LFV: Left Femoral Vein; RFV: Right Femoral Vein; M: Male; F: Female

Table 2. The mean primary and secondary patency durations and patency rates

	Primary Patency	Secondary Patency	6 Months Patency	12 Months Patency	24 Months Patency	P value
RJV	10.48±10.29	20.34±13.99	92.9 %	86.0 %	80.7 %	0.002
LJV	11.65±10.70	18.48±13.29	82.3 %	73.1 %	60.5 %	
RSV	14.16±9.82	14.16±9.82	83.3 %	66.7 %	61.3 %	
LFV	12.12±11.84	18.87±11.96	87.5 %	70.4 %	65.7 %	
RFV	5.65±6.01	9.70±8.24	86.9 %	65.2 %	60.7 %	
Upper extremity	10.69±10.33	20.00±13.86	91.3 %	84.3 %	77.7 %	0.648
Lower extremity	7.50±8.41	12.32±10.13	86.9 %	74.4	69.7 %	
Overall	10.50±10.25	18.00±13.77	91.1 %	83.9 %	77.9 %	

RJV: Right Jugular Vein; LJV: Left Jugular Vein; RSV: Right Subclavian Vein; LSV: Left Subclavian Vein; LFV: Left Femoral Vein; RFV: Right Femoral Vein

Fibrin sleeve developed in 31 (20%) patients, central venous stenosis developed in 22 (14.1%) patients, and central venous thrombosis in 20 (12.9%) patients as the causes of catheter dysfunction. t-PA injection or balloon dilatation was applied to the fibrin sleeve to assess the patency of the catheter. Balloon dilatation was performed for central venous stenosis. No complications were observed procedural and within the 24 hours post procedural period, except in 56 procedures with catheter tract bleeding as leakage. No major complications or mortality related to the procedure were observed.

DISCUSSION

Tunneled dialysis catheters are life-saving equipment when there is no alternative for dialysis access. However, complications such as thrombosis, infection and central stenosis are among its biggest disadvantages. For this reason, it should not be preferred in the first place for long-term use, but should be preferred when other options are not possible.

Despite all efforts to ensure that the permanent dialysis access method is native arteriovenous fistulas, the rate of performing the first dialysis session with a catheter was 65% (8). This condition is observed in fewer patients who receive nephrology treatment and is referred by a nephrologist before dialysis, and it is more advantageous in terms of cost-effectiveness (9). For this reason, the permanent dialysis access made before the dialysis period has a great contribution to the patient during the chronic dialysis decision-making phase.

Despite all efforts, tunneled dialysis catheters may be the only option in cases where there is no suitable arteriovenous fistulae creation site or surgery cannot be performed. In this case, tunneled dialysis catheters can achieve satisfactory patency rates by performing appropriate interventional procedures (10,11). In our study, the average primary patency duration was 10.50±10.25 and secondary patency rate was 18.00±13.77 determined as months. In addition, patency rates of 6, 12 and 24 months were determined 91.1 %, 83.9 % and 77.9 % respectively.

In our study, the rate of catheter-related infection was 12.9% and the number of procedures per patient was 3.01, which emphasizes the importance of creating a native AV fistula. Over time, the catheter causes a complication such as stenosis, especially in the central veins, apart from its own dysfunction. It limits the use of the central catheters and causes comorbidities such as swelling in the face and arms (12-15). In our study, central stenosis developed in 20 patients (14.1%) and balloon dilatation was performed to achieve optimal patency. In cases with central stenosis, stenosis not only disrupts the flow of the catheter, but also causes loss of access in the future and may necessitate insertion of a new catheter from another access site.

In our study, no significant difference was found between the catheters placed in the lower extremity and the catheters placed in the upper extremity in terms of patency rates. It has been reported in the literature that lower extremity catheters have poorer outcomes compared to upper extremity catheters (16, 17). In our study, only 28 patients were followed with lower extremity catheter and different result with the literature might be due to the low number of patients. However, for patients who have access problems in the upper extremity veins, lower extremity veins can be used for catheterization.

Fibrin sleeve formation, described by Motin et al. (18) in 1964, is another cause of catheter dysfunction. In our study, the incidence of fibrin sleeve was found to be 14.1%. In the literature, catheter dysfunction due to the fibrin sleeve is seen with a frequency reaching 76% (11). The reason for the relatively low incidence of fibrin sleeves in our study may be that we regularly inject tissue plasminogen activator through the catheter once a month in patients with catheter dysfunction due to rapid and frequent fibrin formation around the catheter.

The retrospective nature of the study, low number of catheters placed in the lower extremity veins, the inability to analyze the results with the aspect of tunneled catheter types, and lack of data obtained from patients' records might be stated among the limitations of the study.

CONCLUSION

Although permanent dialysis catheters, which should not be the first choice for arteriovenous access, have associated comorbidities, they are a method with satisfactory patency rates when other access types are not suitable.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of Bolu Abant İzzet Baysal University Hospital, Local Ethics Committee (Date: 2023/01, Decision No: 41)

Informed Consent: Because the study was designed retrospectively, no written informed consent form was obtained from patients**.**

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

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