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Original Article

Characteristics of Chronic Kidney Disease Patient Undergoing Regular Hemodialysis with Tunneled Cuffed Catheter Dialysis Access

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ABSTRACT

Background: Chronic kidney disease (CKD) is one of the leading contributors to morbidity and mortality rates worldwide, where end-stage patients require dialysis. Dialysis requires access, and tunneled cuffed catheters (TCCs) are considered a viable option.
Objective: This study aims to describe the characteristics of the CKD patients with TCCs dialysis access at Rasyida Kidney Hospital.
Methods: This descriptive study with a cross-sectional design was conducted based on patients' medical records. Total sampling was used as the sampling technique.
Results: A total of 96 patients with TCC dialysis access were identified at Rasyida Kidney Hospital from January 2021 to 2024. Most patients were aged 61-75 years (39.6%), female (63.7%), and had hypertension as a comorbidity (53.8%). Additionally, 67% had a history of non-tunneled cuffed catheter access, 70.3% had the right internal jugular vein as the insertion site, and 53.8% had the indication of failed AV fistula. The duration of TCC use was more than 12 months for 65.9% of patients, and catheter thrombosis occurred in 13.2% of cases.
Conclusion: The characteristics of CKD patients with TCC dialysis access at Rasyida Kidney Hospital in Medan include individuals aged 61-75 years, female, with a history of hypertension and non-tunneled cuffed catheter access, an insertion site at the right internal jugular vein, failed AV fistula as the primary indication, catheter usage for more than 12 months, and the most occurred complication is catheter thrombosis.
Keywords: Characteristic, Chronic Kidney Disease, Dialysis Access, Tunneled Cuffed Catheter.

Introduction

Chronic kidney disease (CKD) is one of the leading contributors to morbidity and mortality rates worldwide.[1,2] In Indonesia itself, the number of CKD patients is rising significantly. According to the Indonesian Health Survey in 2023, the prevalence of CKD patients reached the number 638,178.[3] End-stage renal disease (ESRD) patients will experience more serious complications, requiring renal replacement therapy such as hemodialysis.[4] To ensure effective hemodialysis, a vascular access is essential, as patients typically need this therapy over an extended period.[5] Among the various types of dialysis access, AVF is the most recommended access for hemodialysis patients.[6] Although AVF is the primary method for dialysis access, tunneled cuffed catheters (TCCs), remain

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a reliable option due to their use in emergencies, safety for patients with multiple comorbidities, patients with limited life expectancy, and for patients with needle phobia.[7,8]

In Indonesia, research on TCCs is still very limited. This study aims to describe the characteristics of CKD patients who have TCCs as their hemodialysis vascular access. We hope that the information obtained can serve as a data foundation to improve management and prevent unwanted complications related to TCCs.

Methods

Design and participants

This study uses a descriptive cross-sectional research method on patient medical records to describe the characteristics of CKD patients with TCC dialysis access. This study was conducted from February to August 2024 at Rasyida Kidney Hospital, Medan. The target population in this study were adult CKD patients (aged ≥ 18 years) who underwent regular hemodialysis with permanent TCC dialysis access at Rasyida Kidney Hospital, Medan. The accessible population was all adult CKD patients with TCC dialysis access at Rasyida Kidney Hospital Medan from January 2021 to August 2024. Patients with missing data in the medical records and those who underwent repeat catheterization in the same vein without any complications were excluded from this study. The samples were selected using a total sampling method. The variables were age, gender, comorbidities, previous history of non-tunneled cuffed catheter (NTCC) access, site of TCC insertion, indications for TCC use, duration of TCC use, and complication of TCCs.

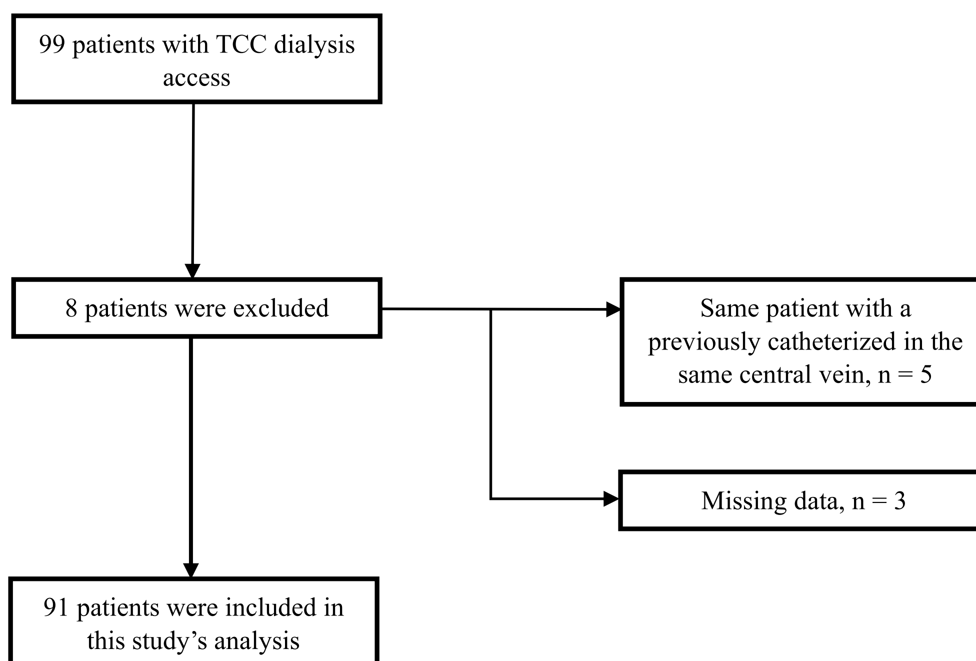

Figure 1. A flowchart of patient selection in our study

Statistical analysis

Data collected from medical records were analyzed using SPSS (Statistical Package for the Social Sciences) version 26, IBM. Univariate analysis was used to describe the baseline clinical characteristics of the research subjects. Data obtained from patient medical records were interpreted using distribution tables and percentages through data processing. This study has received ethical approval from the Health Research Ethics Committee of Rasyida Kidney Hospital, Medan.

Results

From 99 patients undergoing regular hemodialysis with TCC dialysis access found in the hospital database, a total of 91 patients were included in this study. The reasons for the exclusion of the subjects were patients who previously catheterized with a permanent TCC in the same central vein and patients with incomplete or missing data in the medical record.

Table 1 below shows the baseline characteristics of the patients in this study. Overall, the included subjects had a mean age of 62.67 years, 33 were males, and 58 were females. Comorbid conditions such as hypertension were found in 53.8% patients, diabetes in 6.6% patients, and 23.1% patients had both hypertension and diabetes. In this study, we found that 67% had a previous history of NTCC access and only 33% of the patients were catheter naive. Catheter was inserted in the right internal jugular vein in in 70.3% of patients, the left internal jugular vein for 17.6% of patients, the left femoral vein for 8.8% of and the left femoral vein for 3.3% of patients. Most of the patients (65.9%) use the TCCs for more than 12 months. The indications for TCC use were a failed AVF for 53.8% of patients, as a last access option for 40.7% of patients, an immature AVF for 4.4% of patients, and 1 as an access for a patient preparing for kidney transplantation. Some patients experienced both immediate and long-term complications of TCC usage, including bleeding in 1 case, infection in 5 cases, catheter thrombosis in 12 cases, catheter malposition in 4 cases, and central vein stenosis in 7 cases.

Table 1. Baseline characteristics of the study population

CHARACTERISTICS	N (%)
Age	
<45	11(12.1)
45-60	23(25.3)
61-75	36(39.6)
>75	21(23.1)
Mean ± SD	62.67±14.9
Gender	
Male	33(36.3)
Female	58(63.7)
Comorbidities	
Hypertension	49(53.8)
Diabetes Mellitus	6(6.6)
HTN + DM	21(23.1)
None	15(16.5)
Previous NTCC Access	
Yes	61(67)
No	30(33)
Site of insertion	
Right Internal Jugular Vein	64(70.3)
Left Internal Jugular Vein	16(17.6)
Right Femoral Vein	8(8.8)
Left Femoral Vein	3(3.3)
Indication of TCC use	
Immature AVF	4(4.4)
Failed AVF	49(53.8)
Last Access Option	37(40.7)
Preparing for kidney transplantation	1(1.1)
Duration of TCC	
<12 Months	31(34.1)
≥ 12 Months	60(65.9)

Table 1 (cont.)

Complication	
Bleeding	1(1.1)
Infection	5(5.5)
Catheter thrombosis	12(13.2)
Catheter Malposition/Kinking	4(4.4)
Central Vein Stenosis	7(7.7)

Discussion

Arteriovenous fistulas (AVFs) are the most preferred method for hemodialysis vascular access.[8] However, their benefits may be less evident in elderly patients with multiple comorbidities. Therefore, it is essential to consider the range of comorbidities when selecting and managing the appropriate vascular access type for elderly patients undergoing hemodialysis.[9] TCCs plays an important role as a permanent access because it can be used immediately after insertion, offers the potential for long-term use, and prove a relatively painless method for dialysis access.[10]

The use of TCC has been increasing worldwide, particularly among elderly patients.[11] This study shows that most patients with TCC access were in the age group of 61-75 years, where the study conducted by Shreshtha et al. yielded similar results, with 51 out of 103 patients (49.52%) in that age group.[12] The reason for this is the high incidence of end-stage renal disease in this age group. Additionally, TCC is a more reasonable option for vascular access in elderly patients, as advanced age is linked with difficulties in fistula maturation, and patients might prefer simpler dialysis access.[12,13]

This study shows that the population using TCC access is predominantly female, with 62 patients (64.6%). The results of this study differ from other studies and literature. For example, a 2021 study by Sadukhan et al. found that most hemodialysis patients with TCC access were male (65.8%).[14] The results of this study can be explained by the theory proposed by Shin Mei Chan et al., which suggests that females may have lower AVF patency due to differences in vascular response and platelet aggregation between genders.[15] Additionally, it has been suggested that aesthetic considerations may also play a role in female's decisions, prompting them to choose TCC access to minimize needle use and visible surgical scars.[16]

Due to the high prevalence of patients with multiple comorbidities, creating AV access has become a challenge. So, TCC has become the preferred option for patients with multiple comorbidities.[17] This study shows that hypertension (53.8%) is the most dominant comorbidity in the population; diabetes mellitus is present in 6 patients (6.6%), and 21 patients (23.1%) suffer from both hypertension and diabetes mellitus. The findings of this study are supported by data from the Indonesian Renal Registry, where the dominant etiology of CKD patients undergoing regular hemodialysis in Indonesia is hypertensive nephropathy (42%), followed by diabetic nephropathy (22%).[18] The high prevalence of these comorbid conditions in this population is due to hypertension and diabetes being the leading causes of CKD.

TCCs are usually inserted through the internal jugular, external jugular, subclavian, or femoral vein.[19] In our population, the preferred insertion site is the right internal jugular vein (70.3%), similar to the study by Banerjee et al., where 66.7% of the population used the internal jugular vein.[20] This is due to its anatomical direct connection to the superior vena cava and the right atrium, which results in lower infection rates and a reduced risk of central vein stenosis, making it an advantageous choice.[21] The other preferred site besides the right internal jugular vein is by the left internal jugular vein (17.6%). A total of 11 patients used femoral access, with 8 patients having right femoral access (8.8%) and 3 patients having left femoral access (3.3%). The femoral vein can be an alternative option for patients whose upper extremity venous structures

were exhausted or deemed unsuitable.[22] In this current study, access via the subclavian vein was not performed; as Clark et al. indicate, subclavian veins should be avoided due to their higher risk of venous stenosis, which could jeopardize future arteriovenous access options.[10]

The leading indication for the use of TCCs in our study was failed AV fistula access (53.8%), followed by a last access option (40.7%). This finding was similar to the research conducted by Hu et al., where among 316 patients with vascular access via TCC, 156 patients were indicated for failed AV (49.4%), and 111 patients were indicated because there is no other access option (35.1%).[23] The other indications are immature AVF and preparing for kidney transplantation. This is in line with the theory that TCCs can be used in various indications as a permanent access option.[24]

A total of 67% of patients in this study had a history of temporary central venous catheter access before transitioning to a TCC. A study conducted in 2021 by Yaqub et al. showed similar results, with 90 out of 116 patients (77.6%) having a history of central venous access.[21]

This study also highlights the potential of TCC as a long-term or permanent vascular access solution. The findings show that 62.5% of patients used the catheter for more than 12 months. Similarly, a 2020 study by Shrestha et al., which involved 103 patients, showed that 72 catheters (61.54%) remained patent after 1 year of use.[12] Regarding complication, bleeding occurred in 1 case during the insertion procedure, leading to the intravenous administration of vitamin K and tranexamic acid to the patient. A study by Yardımcı et al. found that bleeding occurred in 0.88% of patients. The likely cause of these cases is a coagulation disorder in the patients.[22]

TCC infection occurred in 5.5% of populations in this study. Vaidya et al. reported that infection occurred in 6.25% of patients similar to our study.[25] The rate of infection was very low due to most insertions being made in the internal jugular vein, which carries a lower risk of infection. The management approach in this study included the application of antibiotics to the exit site or the use of systemic antibiotics in several cases.

Shreshtha et al. reported catheter thrombosis in 27.18% of their subjects.[12] In our study, catheter thrombosis was the most found complication, but it occurred in only 13.2% of cases, leading to a decrease in catheter flow and dysfunction. To address this issue, an anticoagulant flush was implemented as a solution.

In our study, the rate of catheter kinking or malposition was 4.4%. Hamid et al. reported that catheter malposition was observed in 4.9% of subjects.[26] This problem can be prevented by ensuring that the catheter tip is properly positioned at the junction of the superior vena cava and right atrium.[27] Al-Balas et al. reported central vein stenosis in 13% of their patients.[28] In our study, central vein stenosis was observed in only 7.7% of cases, leading to re-catheterization at a different site.

Conclusion

Based on this study, it can be concluded that the characteristics of chronic kidney disease patients undergoing regular hemodialysis with TCC dialysis access at Rasyida Kidney Hospital in Medan are predominantly individuals aged 61-75 years, female, with a comorbidity of hypertension. The preferred insertion site is the right internal jugular vein, with the indication being failed AV fistula. The majority of patients had a history of NTCC access, and most used TCCs for more than 12 months. Catheter thrombosis was the most common complication that occurred.

Limitations of the Study

The limitations of this study are that it was based on medical record data, which means the findings may not completely reflect the patient's condition if there was incorrect documentation in the records and the study was

conducted using a single-center design at Rasyida Hospital, because it is the only hospital providing TCC placement services in the North Sumatra region; as a result, the findings may only represent a limited sample size and the recorded complications were based solely on patient follow-up visits for repairs. The authors recommend using the study results as a reference for further research development, such as survival analysis and factors influencing TCC outcomes.

Declarations

Ethics approval and consent to participate

This study adhered to the guidelines and received approval from the Ethics Committee of the Faculty of Medicine, Universitas Sumatera Utara under reference number No. 4194/UN5.2.1.1.D1/SPB/2024.

Competing interests

There are no conflicts of interest in writing this article.

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None.

Author's Contribution

Idea/concept: BRN, NMIS. Design: NMIS. Control/supervision: BRN. Data collection/processing: NMIS. Analysis/ interpretation: NMIS. Literature review: NMIS, BRN. Writing the article: NMIS, BRN. Critical review: BRN. All authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript.

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