Prevalence of dialysis catheter-related complication and associated risk factors in patients on chronic hemodialysis in eight dialysis centers in Addis Ababa 2023-2024

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A thesis submitted in partial fulfillment of the requirements for the award of a nephrology subspecialty certificate.

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DECLARATION

I, Helen G/medhin, hereby declare that the research project entitled ‘Prevalence of dialysis catheter-related complication and associated risk factors in patients on chronic hemodialysis in dialysis centers in Addis Ababa,2023-2024” for nephrology subspecialty training is a result of the works of my own, has never been submitted for any prior academic award or qualification in this Institution.

Helen G/medhin G/Egziabhier

Signed: _____

Date: _____

Department of Internal Medicine approval

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ACRONYMS AND ABBREVIATIONS

AV	Arteriovenous
AVF	Arteriovenous fistula
CKD	chronic kidney disease
CRBSI	Catheter-related bloodstream infection
CVC	Central venous catheter
ESKD	End-stage kidney disease
RRT	Renal replacement therapy
HD	Hemodialysis

Contents

List of Tables and Figures

Abstract

Background

Central venous catheters are widely used to initiate hemodialysis despite recommendations for arteriovenous access use from the Dialysis Outcomes. Catheter-related complications are notable in patients on chronic hemodialysis. However, data on the prevalence is lacking. This study determined the prevalence and risk factors associated with catheter-related complications among patients receiving chronic hemodialysis in eight hemodialysis centers in Addis Ababa.

Objective

Assessed the prevalence of dialysis catheter-related complications among patients on chronic hemodialysis and the associated risk factors in patients on chronic dialysis in dialysis centers in Addis Ababa.

Methodology

A multi-center cross-sectional study involving 239 chronic hemodialysis patients using dialysis catheters for access was conducted at eight dialysis centers in Addis Ababa.

Result

In the study, it was found that complications related to catheters occurred in 48.1% of all patients. The proportion of patients who experienced catheter-related infections was 45.2%. The overall incidence of catheter infections was 11.07 per 1,000 catheter days. Notably, catheter-related bloodstream infections accounted for 86.1% of all catheter-related infections. Additionally, factors such as catheter reinsertion, the presence of underlying diabetes, and the duration of the catheter on day 30 were associated with an increased risk of infection.

Conclusion

This study found a high rate of dialysis catheter-related complications. Measures to minimize catheter-related complications should be implemented.

Key words

Central venous catheter, chronic hemodialysis, arteriovenous access

Introduction

End-stage kidney disease (ESKD) which is an advanced stage of chronic kidney disease (CKD) is a common global health challenge that is rapidly increasing the burden and need for renal replacement therapy(1,2). The prevalence of CKD among patients with chronic illnesses in Ethiopia is 21.71% (3). Worldwide, the most common form of renal replacement therapy (RRT) is hemodialysis(4).

Hemodialysis is a transient treatment for those patients who are candidates for kidney transplantation and a permanent treatment for end-stage renal disease patients with no chance of transplantation. Efficient hemodialysis requires a well-functioning intravascular access which includes a native arteriovenous fistula (AVF), an arteriovenous graft, or a central venous catheter.(1,5)

Patients with end-stage renal disease (ESRD) on dialysis who are using an AVF for permanent vascular access should be higher than 65% and the percentage of patients using a dialysis catheter for permanent vascular access should be lower than 10%. However, using a dialysis catheter is still very common.(1)

Vascular access is a crucial factor in the treatment of hemodialysis patients. Catheters play an important role in providing reliable vascular access in some patients. However, the use of catheters is associated with increased all-cause mortality. Catheters have been associated with as much as a threefold increase in mortality rate compared to fistulas.(6,7).

Two types of central vein catheters (CVC) are used: non-tunneled CVC for short-term use, and tunneled cuffed CVC, which can be used for several weeks to months or as permanent access in patients without AV access options. Non-tunneled CVCs are associated with higher infectious complications and should be limited to less than 2 weeks duration of use.

Dialysis catheter usages are associated with complications that occur during catheter insertion, throughout the catheter dwell period, and at the time of removal. Complications like clots and emboli, exit-site and tunnel inflammation/infection, bacteremia, and sepsis may all occur, increasing mortality risk. Identification and prevention of catheter-related complications is critical to improving patient care.(1,8)

Literature review

Hemodialysis (HD) is the commonest form of kidney replacement therapy in the world, accounting for approximately 69% of all kidney replacement therapy. Whereas hemodialysis is the only type of dialysis being offered to ESRD patients in Ethiopia as peritoneal dialysis is not available(4,9)

Despite widespread recognition of poor outcomes and the availability of international guidelines to inform clinical practice, CVC usage at HD commencement remains high(10).

Compared with arteriovenous fistulas (AVF) and arteriovenous grafts (AVG), central venous catheters (CVC) are typically associated with the highest risks of all-cause mortality, fatal infections and cardiovascular death (CVD)(9,11).

In Ethiopia arteriovenous fistula is the most commonly utilized vascular access, accounting for 72% maintenance HD patients. A sizable proportion (16%) of patients use temporary hemodialysis catheters at the beginning , whereas 10% use tunneled hemodialysis catheters in Ethiopia(12).

Vascular access-related complications and interventions account for almost one-third of hospital admissions among patients receiving HD(11).

In many studies the most common catheter related complication is catheter related infection the incidence ranges from 3.7 to 7.7/1000 catheter days. The prevalence of catheter related infection ranges 10 to 38 %(1,13,14).

Catheter-related bloodstream infection (CRBSI) is one of the most feared consequences of hemodialysis catheter use due to its associated increased risk of morbidity and mortality(13).

Serious metastatic infectious complications occur in 3–44% of episodes, and include endocarditis, osteomyelitis, thrombophlebitis, septic arthritis, spinal epidural abscess, and large atrial thrombi(15).

The level of evidence for other catheter related complications are limited. Incidence of central vein stenosis was 0.68/1000 catheter-days, affecting 8.79% of patients(1).

Study done in Cameroon showed the main non-tunneled catheter-related complications were infections (62.9%) and bleeding (22.2%), which were associated with unemployment and longer duration of catheter(16).

Other study done in Ghana showed prevalence of CRBSI was 34.2%, Of these, 53.9% had Possible CRBSI while 11.5% had Definite CRBSI. Sex, duration of maintenance dialysis, underlying cause of End-stage kidney disease were significantly predictive of CRBSI status(5).

Data from Ethiopia is scarce one retrospective study showed 38.2% CRBSIs documented with an incidence rate of 7.74 episodes per 1000 catheter days(7).

Risk factors for CRB that have been identified include poor patient hygiene, previous CRB, recent hospitalization, longer duration of catheter use, inadequate dialysis, hypoalbuminemia, *S. aureus* nasal carriage, diabetes mellitus, immunocompromised status, atherosclerosis, and hypertension(17).

Compared with patients younger than 60 years, patients aged 70 to 79 and those 80 years or older experienced lower rates of CVC complications which is different from the study done in China which showed increased risk as age increases(1,15).

Underlying diabetic was found to be a risk factor for development of catheter related infection whereas patients with higher educational levels had a lower catheter infection risk(1).

In a Filipino study CRBSI were found to be most frequent with a left sided, non-tunneled, femoral CVC. Autoimmune disease, HD frequency of >3x per week, use of CVC for blood transfusion or IV medications, drug induced nephropathy and hypertensive kidney disease were all significantly associated with CRBSI development whereas the risk of CRBSI was reduced by 24% for every in 1mg/dl increase in Serum albumin(18).

Ethiopian study identified the following associated factors for non-tunneled dialysis CRBSI duration of a catheter, previous CVC infection, high white blood cell count, urban residence and low hemoglobin(14).

Justification of the study

Many ESKD patients start hemodialysis using tunneled or non-tunneled hemodialysis catheters. The use of dialysis catheters is associated with many complications. This study shows the complications of HD catheters and associated risk factors in both tunneled and non-tunneled hemodialysis catheters.

Given the higher number of chronic hemodialysis patients using dialysis catheters as an access knowing the prevalence and risk factors of complications is useful for taking proper measures and improving health care.

There are limited studies assessing the prevalence of catheter-related complication and associated risk factors in Ethiopia

Objective

GENERAL OBJECTIVES

To investigate the prevalence and risk factors for catheter-related complications in patients on chronic hemodialysis

Specific objectives

- Assess the prevalence of catheter-related infection
- Assess the prevalence dialysis catheter-related thrombosis
- Assess the prevalence of central vein thrombosis
- To identify the risk factors for the development of dialysis catheter-related complication

Method and material

Ethical clearance

Ethical clearance was obtained from Addis Ababa University, College of Health Science's ethical review board. The ethical clearance form was submitted to each hospital and clearance was obtained to access patients' records. Consent was obtained from patients prior to conducting interviews.

Study design and period

A retrospective cross-sectional study was done at hemodialysis units in six general hospitals, one surgical and medical center, and one dialysis center in Addis Ababa from August 10/2024 to September 17/2024.

General practitioners of the hemodialysis centers were trained on the details of the questionnaire and operational definitions of these studies before data collection was initiated.

Data was retrieved from the patient's registry. Patients who began chronic hemodialysis between August 10, 2023, and August 10, 2024, were included. Data were collected from patient's medical records and through interviews with patients and dialysis staff.

Eligibility Criteria

Inclusion criteria

- All adult patients (age >18 years) on hemodialysis greater than one month
- All patients on chronic hemodialysis with either tunneled or non-tunneled dialysis catheter

Exclusion Criteria

- Patients who had incomplete clinical and laboratory records or determination
- Patient on hemodialysis with dialysis catheter less than one month
- Patients on chronic hemodialysis with fistula or AV graft
- Dialysis centers which are not willing to participate in the study

Sampling procedure

All patients who began hemodialysis using a dialysis catheter during the study period were included in the analysis. The selection of dialysis centers was done based on convenience.

Study variables

The dependent variable

Catheter-related complication

Catheter exit-site infection, Catheter tunnel infection

Catheter-related bloodstream infection, Catheter dysfunction

Catheter related central vein thrombosis, Central vein stenosis

Independent variables

socio-demographic factors

Age, sex, BMI, marital status, and living address

Comorbidities Diabetes, hypertension, HIV infection, heart failure, cirrhosis, stroke, malignancy

Catheter and dialysis-related

site of catheter insertion, site of catheter insertion, type of dialysis catheter, frequency of dialysis

Operational definitions

Definitions of dialysis catheter-related complications

- Catheter exit-site infection will be diagnosed if pus, redness, induration, or tenderness within 2 cm around the catheter exit site is present, or pus secretion
- Catheter tunnel infection will be diagnosed if pus, redness, tenderness, and/or induration (>2 cm) along the catheter tunnel is present, with a positive bacteria culture from secretions.
- Definitive
    - will be diagnosed if the same microorganism was grown from peripheral blood culture and catheter tip culture at least once
- Probable
    - Defervescence of symptoms after antibiotic therapy with or without removal of the catheter, in the setting where blood culture confirms infection, but catheter tip does not (or catheter tip does, but blood does not) in a symptomatic patient with no other apparent source of infection.

Possible

- Defervescence of symptoms after antibiotic treatment or after removal of the catheter in the absence of laboratory confirmation of BSI in a symptomatic patient with no other apparent source of infection

Metastatic infection

- In the presence of distant infection in a patient with dialysis catheter and the decision of the physician to treat it as metastatic infection

Catheter dysfunction

- Catheter dysfunction was identified when at least one of the following criteria was met:
  (1) peak blood flow <200 mL/min for at least 30 min
  (2) mean blood flow <250 mL/min during two consecutive dialysis sessions
  (3) unable to initiate dialysis due to inadequate blood flow

Thrombosis

- Intrinsic catheter thrombosis occurs when a thrombus is formed and attaches to the inner or outer surface of the catheter (including thrombi in the lumen or at the tip of the catheter)
- Extrinsic catheter thrombosis occurs when a thrombus is caused by the presence of a catheter in the atrium or central vein.

Catheter malposition or kinking

- Catheter malposition or kinking occurs when the position of the catheter tip is in the wrong place or moves after being placed, or the catheter is curved or folded.

Central vein stenosis

- Damage caused by the dialysis catheter after insertion, thus causes obstruction syndrome, which results in symptoms and signs including swelling of the limbs, head, and neck after stenosis of the vena cava system
- The presence of clinical symptoms or Doppler ultrasound examinations

Chronic dialysis - a patient who has been on hemodialysis for over a month

Statical analysis

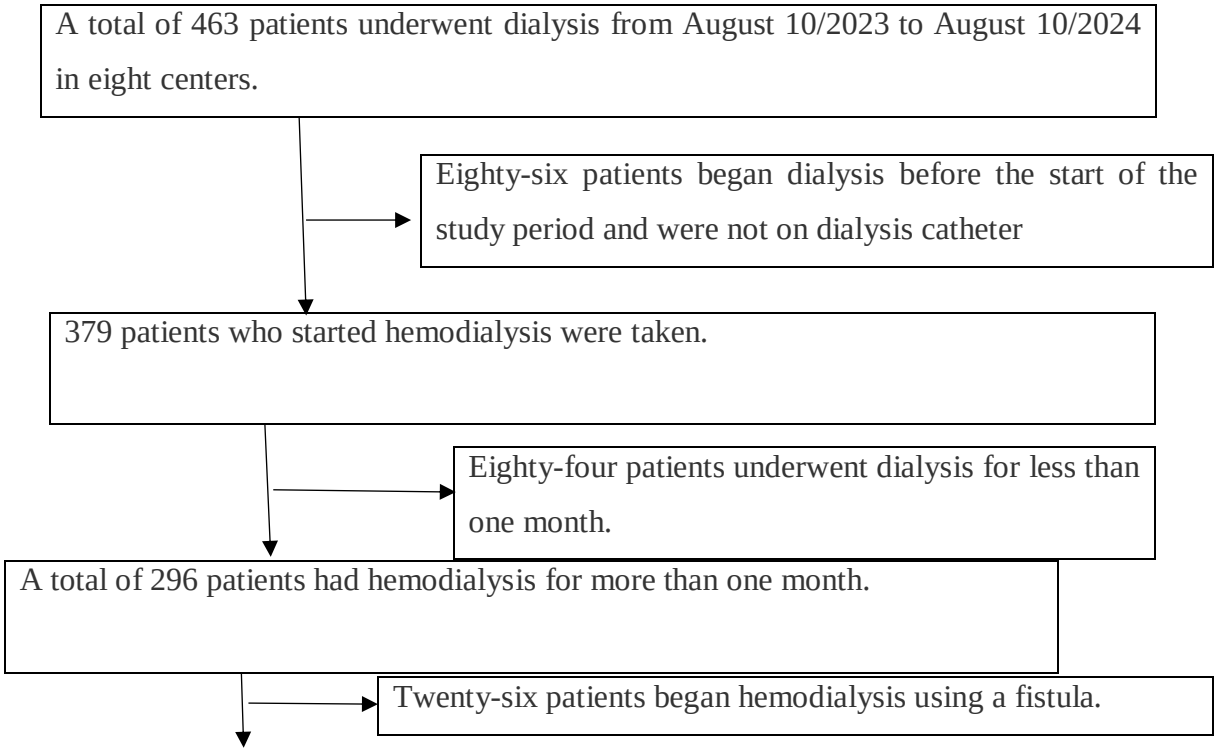
STATA V.17 was used for data management and analysis. The general characteristics of the patients are presented as means and standard deviations or frequencies and percentages.

Logistic regression was used to investigate the risk factors influencing the outcomes of catheter infection, catheter dysfunction, and central vein stenosis, which were the dependent variables. The independent variables investigated were age (18–44, ≥60 years), gender (female vs male), residency (from Addis Ababa and outside of Addis Ababa), marital status (married, single, and divorce/widowed), primary disease (non-diabetes vs diabetes), and level of education (higher education, secondary, primary school or below).

Results

This cross-sectional study includes 239 patients using dialysis catheters for more than one month in eight different dialysis centers found in Addis Ababa. Six centers were found in general hospitals, one center in surgical and medical centers and one was specifically a dialysis center.

A total of 463 patients underwent hemodialysis in this study period, out of which 239 patients were included in the study.



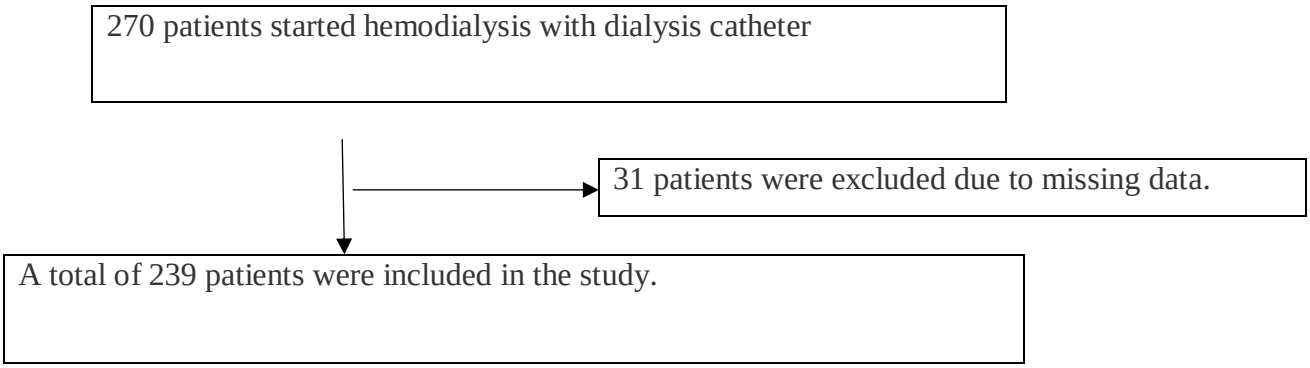


Figure1. Flow chart of patient selection

Proportion of patients for each center

The largest number of participants came from Centre F, representing 29.7% (N=71) of the total. This was followed by Centre B at 17.9% (N=43), Centre H at 14.2% (N=34), and Centre A at 12.5% (N=30). Centre D had 25 participants, while Centre C contributed 6.7% (N=16). Both Centre E and G Clinic each had 10 participants, making up 4.1% of the study participants.

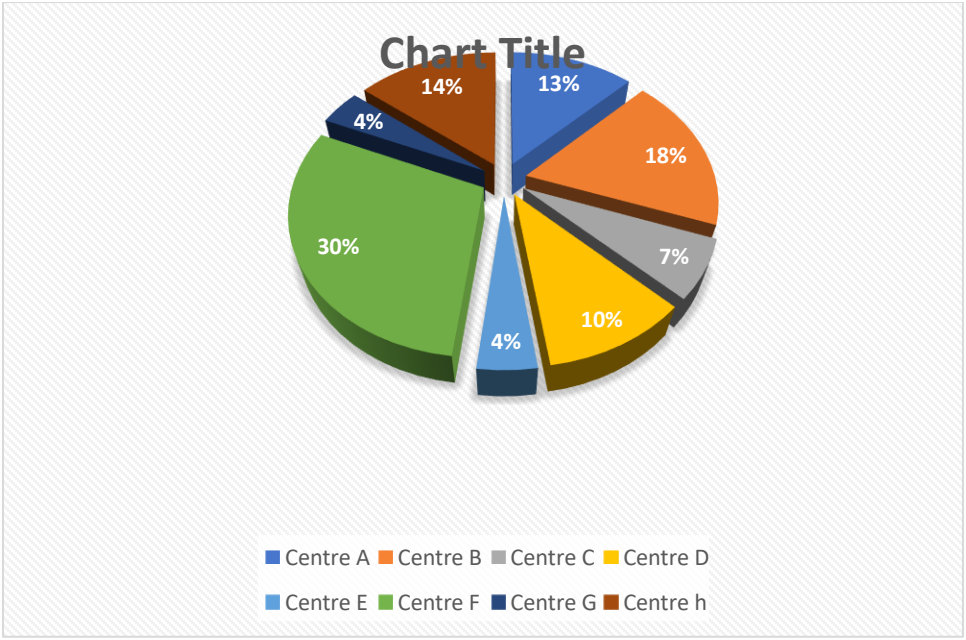


Figure 2. Patient distribution from each dialysis center

Socio-demographic variables

The mean age was 51.5(±15.2), and 69 % of the patients were male. 78% (209) of patients were from Addis Ababa, the rest were from outside the capital (Addis Ababa). As for the marital status of the participants, 73.6% (176) were married, 17.9% (43) were single and 8.3% (20) were divorced. The educational level of the participants was 47.7% (144) attended higher education, 35 % (86) attended secondary school and 16.3% (39) attended primary school and below.

Comorbidities and duration of CKD

Most patients had hypertension 86.1%, half (49.7%) of participants had diabetes and 20 % had heart failure. Only 6.2 % of participant patients had underlying HIV infection, 5% of the participants had a history of stroke, and only 4 patients had underlying malignancy.

The mean duration of CKD diagnosis before dialysis initiation was 27 months the mean was slightly higher in female participants which was 31 months.

Characteristics	**Frequency**	**Percent**
Sex (n=239)		
Female	73	30.54
Male	166	69.46
Marital Status(n=239)		
Single	43	17.99
Married	176	73.64
Widowed/Divorced	20	8.37
Mean Age (n=239)	51.5	-
	14.97	

The mean duration of dialysis in months (n=239)		
Educational Status (n=239)		
Higher education	144	47.70
Primary and below	39	16.32
Secondary	86	35.98
Dialysis Centre (n=239)		
Centre A	30	12.55
Centre B	43	17.99
Centre C	16	6.69
Centre D	25	10.46
Centre E	10	4.18
Centre F	71	29.71
Centre G	10	4.18
Centre H	34	14.23
Patient's residence(n=239)		
Addis Ababa	184	76.49
Outside Addis Ababa	55	23.01
Type of catheter dialysis used (n=239)		
Tunneled	41	17.51
Non-tunneled	198	82.85

Comorbidity status of the patient		
Hypertension	206	50
Diabetes mellitus	119	29
Heart failure	48	12
Cirrhosis	0	0
Stroke	12	3
Asthma	6	1
HIV-status	15	4
Malignancy	4	1

Table 1 sociodemographic characteristics of patients

Type of dialysis catheter and duration of catheter

The temporary right jugular catheter is the most commonly used type, accounting for 68.62% of the total (N=164). This is followed by tunneled jugular catheters, which make up 17.1% (41). Among insertion sites, the right-side tunnel is the most frequently used, comprising 16.3%. The right femoral site accounts for 8.79%. The left femoral and subclavian sites are used less frequently, representing only a small percentage of the total.

The average duration of catheter use was 92 days for both tunneled and non-tunneled catheters. Specifically, the average duration for tunneled catheters was 215 days, while for non-tunneled catheters, it was 67 days.

Type of catheter based on the dialysis center

Dialysis Center	**Tunneled**	**Temporary**
Centre A	11	19
Centre B	6	37
Centre C	5	11
Centre D	8	17
Centre E	2	8

Centre F	1	70
Centre G	1	9
Centre H	7	27

Table 2 Types of dialysis catheter on each dialysis center

Rate of catheter reinsertion

In this study total percentage of reinsertion across all centers is 50.6%, indicating that more than half of the patients required the reinsertion of catheters.

dialysis center	NO	YES	Total	Percentage of reinsertion
Centre A	14	16	30	53.3%
Centre B	17	26	43	60.5%
Centre C	6	10	16	62.5%
Centre D	17	8	25	32.0%
Centre E	6	4	10	40.0%
Centre F	46	25	71	35.2%
Centre G	2	8	10	80.0%

Centre H	10	24	34	70.6%

Table 3 Rate of dialysis catheter reinsertion in each center

The percentage of patients requiring catheter reinsertion varies across centers: Centre F has the highest percentage of reinsertion at 29.7%, it is also a center with the highest number of patients in the study.

Prevalence complication

Catheter-related complication

The prevalence of catheter-related complications is 48.1% of all patients in the study. The proportion of catheter infections is 45.2% **(**95% CI: 38.8,51.7). The overall rate of catheter infection was 11.07/1000 catheter days This indicates that out of the total population included in this study, nearly half experienced a catheter infection. The most common catheter-related infection was catheter-associated bloodstream infection which accounted for 86 % (N=93) of the infection followed by exit site infection at 8.3%(N=9) and metastatic infection at 5.5% (N=6).

Patients experience their first catheter-related infection on average around 70 days after catheter insertion, with a confidence interval suggesting that this average could reasonably fall between approximately 43 and 97 days. The standard error indicates some variability in this estimate, but overall, these results provide useful insights into the timing of infections related to catheter use.

The prevalence of catheter-related infection was 48.78 % for those using tunneled catheters and 44.44 % for non-tunneled catheters, respectively. The incidence rate for tunneled catheters was 1.79 for 1000 catheter days, and the incidence rate for temporary catheters was 20.97 for 1000 catheter days.

Twenty percent of patients had multiple infections, with 14.8% (N=16) suffering from second infections and 5.5% (N=6) from third infections. Among the patients who experienced catheter-related infections, 73% required hospitalization.

Blood culture was sent for 52.7%(N=57) of patients with catheter-related infections. The result is as follows 56.2% (N=27) had growth on blood cultures and 43.7% (N=21) had no growth, about 15.7% (9) patients' blood culture results couldn’t be traced.

dialysis center	NO	YES	Total	Catheter infection rate
Centre A	18	12	30	40.0%
Centre B	20	23	43	53.5%
Centre C	13	3	16	18.8%
Centre D	12	13	25	52.0%
Centre E	2	8	10	80.0%
Centre F	57	14	71	19.7%
Centre G	3	7	10	70.0%
Centre H	6	28	34	82.4%

Table 4 dialysis catheter infection rate on each dialysis center

Types microorganisms detected

Microorganism	Frequency	Percent
Klebsiella pneumoniae	11	22.9%
Acinetobacter	2	4.1%
Coagulase Negative Staphylococcus	3	6.2%

E. coli	2	4.1%
Enterococcus spp.	1	2%
K. pneumoniae, Pseudomonas aeruginosa	1	2%
No Growth	21	43.7%
Staphylococcus aureus	6	12.5%
Staphylococcus epidermidis	1	2%

Table 5 Types of microorganisms detected in culture.

The most commonly identified pathogen was Klebsiella pneumoniae accounting for 22.9% (N=11), followed by Staphylococcus aureus contributing 12.5% (N=6), One culture grew both K. pneumoniae and Pseudomonas aeruginosa.

Type of catheter-related infection	**Freq.**	**Percent**
Bloodstream infection definitive	18	19.35%
Bloodstream infection is probable	10	10.75%
Bloodstream infection possible	65	69.89%

Table 6 type of catheter related infection

Catheter infection rate per dialysis center

Highest Infection Rates:

- The highest catheter infection rates were observed at:
    - Centre H (82.4%)
    - Centre E (80.0%)
    - Centre G (70.0%)
- Lowest Infection Rate:
    - The lowest infection rate was found at the Centre C (18.8%).

Catheter-related infection and catheter outcome

The catheter-related infection led to catheter removal in 60% of cases during the first infection, 57% during the second, and 100% in the third. In our study 98.1% of patients survived the first infection,86.3% survived the second infection, and 83.1% survived the third infection.

Association with the use of antibiotic lock and catheter outcome

Patient-Related Outcome for First Catheter Infection	Use of Antibiotic Lock	Frequency	Percent
Deceased	NO	2	1.85%
	YES	2	1.85%
Survived	NO	49	45.37%
	YES	57	52.78%

Table 7 Antibiotic lock and patient-related outcomes

The data shows that of those who survived, a slightly higher percentage (52.78%) received antibiotic locks compared to those who did not.

Risk factors for the development of dialysis catheter-related infection

Risk factors assessed: Age, Sex, Educational Level, Hypertension Complication, Diabetes Mellitus Complication, HIV Status, Catheter Reinsertion, Residence (Outside Addis Ababa), BMI

Univariate Analysis

Characteristics	Frequency (n=239)	Catheter infection		Crude Odds Ratio (COR) (95% CI)
		Yes(n=108)	No(131)	
Age (Mean)	**50.5**	49.7	52.9	0.98 (0.96,1.00)*
Sex				
Female	73	32	41	0.92 (0.53,1.60)
Male	166	76	90	1.0
Educational Status				
Primary and below	39	18	21	1.0
Secondary and above	200	90	110	0.95(0.47,1.9)
Hypertension comorbidity				
Yes	206	89	117	0.56(0.26,1.17)*
No	33	19	14	1.0
Diabetes Mellitus comorbidity				
Yes	119	56	63	1.16(0.67,1.93)
No	120	52	68	1.0
HIV status				
Reactive	15	5	10	0.59 (0.19,1.77)*
Non-reactive	224	103	121	1.0
Duration of CKD in months (mean)	27.19	30.21	24.69	1.00(0.99,1.01)

Total duration of dialysis in months (mean)	14.97	17.63	12.77	1.00 (0.99,1.02)
Duration of catheter used in days (mean)	92.6	84.27	99.48	0.998 (0.996,1.001)
Reinsertion of catheter				
Yes	121	77	44	4.91(2.82,8.53)***
No	118	31	87	1.0
Patients' residence				
Outside Addis Ababa	55	30	25	1.63(0.88,2.98)*
Addis Ababa	184	78	106	1.0

Table 8 univariate analysis of variables

2.**Multivariate Analysis**

Characteristics	**Frequency (n=239)**	**Catheter infection**		**Adjusted Odds Ratio (AOR) (95% CI)**
		Yes(n=108)	**No(131)**	
Age (Mean)	**50.5**	49.7	52.9	0.98 (0.96,1.00)
Sex				
Female	73	32	41	0.88 (0.45,1.70)
Male	166	76	90	1.0

Educational Status				
Primary and below	39	18	21	1.0
Secondary and above	200	90	110	0.89(0.39,2.07)
Hypertension comorbidity				
Yes	206	89	117	0.56(0.23,1.30)
No	33	19	14	1.0
Diabetes Mellitus comorbidity				
Yes	119	56	63	1.77(0.92,3.37)*
No	120	52	68	1.0
HIV status				
Reactive	15	5	10	0.63 (0.18,2.17)
Non-reactive	224	103	121	1.0
Duration of CKD in months (mean)	27.19	30.21	24.69	1.001(0.99,1.01)
Total duration of dialysis in months (mean)	14.97	17.63	12.77	1.0001 (0.99,1.02)
Duration of catheter used in days (mean)	92.6	84.27	99.48	0.998 (0.997,1.002)
Duration of catheter 30 days	239	108	131	1.822 (0.64,1.7) *****
Reinsertion of catheter				
Yes	121	77	44	4.84(2.66,8.84)****

No	118	31	87	1.0
Patients' residence				
Outside Addis Ababa	55	30	25	1.29(0.64,2.58)
Addis Ababa	184	78	106	1.0

Table 9 multivariate analysis

Multivariate analysis of factors for catheter-related infection

Patients who underwent catheter reinsertion have significantly higher odds—approximately 413% greater—of developing complications compared to those who did not undergo reinsertion. This finding is highly significant, with a p-value of less than 0.001. This suggests that catheter reinsertion is a strong risk factor for complications.

Patients with diabetes have about 82.9% higher odds of experiencing catheter infections, approaching statistical significance ($p = 0.076$). This also suggests a potential risk factor.

The risk of infection approaches to statical significance as the duration of the catheter increases to 30 days with a p-value of 0.088.

The logistic regression analysis indicates that while several variables were assessed for their association with catheter infections, only catheter reinsertion showed a statistically significant and patients with diabetes and catheter duration on 30 days were approaching a statistically significant relationship with a high odds ratio indicating increased risk for infection.

Assessment of the prevalence of other dialysis-related complications

The prevalence of dialysis catheter-related thrombosis was reported at 2.64% **(**95% CI: 1.07,5.37)

The prevalence of dialysis catheter central vein stenosis was reported at 0.38% **(**95% CI: 0.01,2.08)

Discussion

The objective of this study was to investigate the prevalence and risk factors for catheter-related complications in different dialysis centers in Addis Ababa. The prevalence of catheter-related complications was 48.1%, and catheter-related infection was 45.2% resulting catheter infection rate of 11.07/1000 catheter days. Catheter-related bloodstream infection comprises 86.1% of catheter-related infections. Most patients were diagnosed with possible catheter-related bloodstream infections.

In other studies, the most common catheter-related complication is catheter-related infection the incidence ranges from 3.7 to 7.7/1000 catheter days. The prevalence of catheter-related infection ranges from 10 to 38 %.(1,19).

The most common catheter-related complication in this study is catheter-related infection, like the other studies. A retrospective study in Ethiopia found a prevalence rate of 38.2% of CRBSIs documented with an incidence rate of 7.74(7). The prevalence of catheter-related infection was found to be higher (45.2%) compared to the other studies. This could be due to 82.8% of patients in our study using non-tunneled catheters compared to 17.5 % who were on tunneled. It is shown in different studies overall infection rate in the non-tunneled dialysis catheter group was significantly higher than in the TVC(1,20). A significant number of patients had possible catheter-related bloodstream infections; this might have increased the prevalence in our study. Most patients were using non-tunneled dialysis catheters. Based on the KDOQI guideline, the use of a double-lumen temporary catheter for more than 14 days is not recommended. (21)

The variation in infection rates among different dialysis centers indicates that several factors may influence the prevalence of catheter-related infections. These factors include hospital protocols, staff training, patient management practices, and possibly the overall health status of the patient population.

Centers E and H should consider reviewing their practices, as their high infection rates suggest potential issues with catheter management or infection control. In contrast, the low infection rate at Centre C could serve as a model for best practices in catheter care and infection prevention.

Blood cultures were sent to 52.7% of patients with catheter-related infections. This indicates a low level of blood culture utilization for patients with dialysis catheter infections. Implementing routine blood culture practices will be essential for improving patient care.

The most commonly identified pathogen was gram-negative, with Klebsiella pneumoniae accounting for 22.9%. This was also observed in a study conducted in Algeria and Ethiopia(7,22), followed by Staphylococcus aureus, which contributed 12.5%.

Approximately 15.7% of patients' blood culture results could not be traced. Factors contributing to this issue can be; that many centers outsource bacteriology culture services, which can lead to lost culture results. Improved documentation practices could help resolve this problem.

The logistic regression analysis indicates that while several variables were assessed for their association with catheter infections, only catheter reinsertion showed a statistically significant and patients with diabetes and duration of catheter at day 30 approached a statistically significance relationship with a high odds ratio indicating increased risk for infection.

In other studies, having underlying diabetes was found to be a risk factor for the development of catheter-related infections(1,22).

In our study, the rate risk of catheter-related infection approaches statical significance as the duration of the catheter approaches 30 days. This was seen in several studies, the risk of infection increases as the duration of the catheter increases(1,7,22)

Catheter reinsertions have significantly higher odds of developing complications, approximately 413% more than those who do not undergo reinsertion. This finding is highly significant ($p < 0.001$). To minimize the risk of catheter-related infections, measures must be taken to reduce catheter reinsertion. One effective approach is the early creation of an arteriovenous (AV) fistula or graft.

The prevalence of dialysis catheter-related thrombosis was reported at 2.64%. In different studies, the prevalence ranges from 10 to 14%(23,24). Our study shows a low prevalence rate.

The prevalence of dialysis catheter-related central vein stenosis was reported at 0.38%. In other studies, central vein stenosis ranges as high as 10–40%(1,25) . The low incidence in our study could be due to the clinal diagnosis of central vein thrombosis with no standard imaging.

Given the low number of catheter-related thrombosis and central vein stenosis, no analysis of the associated factors was done.

Limitations

This study has several limitations. The retrospective design made data collection challenging, leading to the exclusion of many patients and resulting in a smaller sample size. Additionally, differences in clinical practices across the various centers made it difficult to gather uniform data.

The number of participants varied significantly between centers, which had a considerable impact on the outcomes. Conducting a prospective study would be beneficial to obtain accurate data in practice, and this study can serve as useful input for future research.

Conclusion

In our study, we found that patients undergoing hemodialysis had a high rate of infections related to dialysis catheters. We also observed that non-tunneled dialysis catheters were being used for longer durations than those recommended by the KDOQI guidelines. Additionally, our study recorded an increased number of hospital admissions due to complications associated with these catheters.

These issues are likely to result in higher morbidity and costs for patients. It is essential for healthcare providers to identify patients who require chronic dialysis early on and transition them to permanent vascular access. Furthermore, standard infection prevention procedures should be strictly adhered to in order to minimize infection rates.

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Annexes

The following document is the questionnaire that is used to collect data for this study , prevalence of hemodialysis catheter related complication and associated risk factors in patients on chronic hemodialysis in eight dialysis centers in Addis Ababa 2023- 2024

Questionnaire for dialysis catheter-related complication

Date…… ...

SITE …….. EMRN…….

1. Socio-demographic data

A. Age in yrs …….

B. Sex MALE ☐ FEMALE ☐

C. marital status Married ☐ Single ☐ widowed /divorced ☐

D. Address ……..

E. Education level primary school and below ☐ secondary ☐

Higher education ☐

f. BMI weight ……. Height …….

2. Co morbid condition

A. Hypertension Yes ☐ No ☐

B. DM Yes ☐ No ☐ unknown ☐

C. Heart failure Yes ☐ No ☐

D. Cirrhosis Yes ☐ No ☐

E. Stroke Yes ☐ No ☐

F. Asthma/ COPD Yes ☐ No ☐

G.HIV Yes ☐ No ☐

H. Malignancy SPECIFY IF ANY ……..

I. Presumed cause of CKD …… …….

J. duration of CKD diagnosis in months /years ……..

4.Type of dialysis catheter during dialysis initiation

a. Tunneled jugular left ☐ right ☐

b. Temporary jugular left ☐ right ☐

femoral left ☐ right ☐

subclavian left ☐ right ☐

5. Duration of catheter

Date of insertion …….. Date of removal …….. or Duration of catheter in weeks …….

6. catheter reinsertion yes ☐ No ☐

If yes .. 1st ☐ 2nd ☐ 3rd ☐ others specify……

7. Site of catheter reinsertion F☐ral ☐eft ☐ght

Jugular ☐ left ☐ right ☐

8.Reason for removal

a. Dialysis access created Fistula ☐ Graft ☐

b. catheter slipped at home ☐

C. Development of complication ☐

1. Infection Yes☐ No☐

If yes

Exit site infection ☐

Tunnel infection ☐

Metastatic infection ☐

Catheter related blood stream infection ☐

Definitive ☐ probable ☐ possible ☐

Is blood culture taken? Yes ☐ No ☐

If yes, blood culture result……..

I. Is there multiple times treatment for infection Yes ☐ No ☐

If yes for the above question, how many time patient treated ……

Date of first infection ……

Date of second infection …….

II. Antibiotics used for treatment of infection

Type of antibiotics ……

Duration of antibiotics……

III. infection related out come

Catheter … Removed ☐ kept ☐

Outpatient treatment ☐

Admission required if yes ward ☐ ICU ☐

IV. Patient-related outcome - Survived ☐ Deceased ☐

2. Thrombosis Yes ☐ No ☐

3. Malfunction

I. Kinking ☐ II. Inadequate flow ☐

4.Central vein stenosis Yes ☐ No ☐

5. Catheter malposition Yes ☐ No ☐

6. Discontinuation of dialysis a. death ☐ b . financial reasons ☐

9. Antiseptic procedures used during catheter manipulation

a. iodine ☐

b. alcohol ☐

c. none ☐

10. Use of heparin lock on dialysis catheter Yes ☐ No ☐

11. Use of antibiotic lock Yes ☐ No ☐

12. if the answer for question number 11 is yes please specify type of antibiotic used

……

13. Follow up with nephrologist Yes ☐ No ☐

14. Use of anticoagulation Yes ☐ No ☐

If yes - Type of anticoagulation used …….

15. Number of dialysis sessions per week

a. once ☐ b. twice ☐ c. three times ☐ d. others……