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Frequency of Tunneled Central Venous Catheters Infection in Adults on Haemodialysis at Ibn Sina Hospital -Khartoum, Sudan: A cross-sectional study

Mustafa Yasseen Hamid Yasseen[1,2], Fatima Jadalmola Siralkhatim Mohammed[3]

[1]Assistant Professor at the University of Bakht Elruda, Faculty of Medicine and Health Sciences, Department of Internal Medicine.
[2]University of Khartoum, Faculty of Dentistry, Department of General Medicine.
[3]Specialist in Internal Medicine, University of Ibn Sina and Atbra Teaching

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ABSTRACT

Background: Global initiatives for the study of the outcomes in patients on dialysis consider the presence of catheter-related infections as a potentially devastating complication, being the most common cause of morbidity and the second of mortality. The risk of sepsis attributable to this condition is one hundred-fold greater than that of the general population. In the same way, it is considered that haemodialysis catheters represent the greatest risk of bacteraemia, sepsis and death compared with other vascular accesses types. **Objectives:** To measure the frequency of tunneled central venous catheter infection among adults undergoing haemodialysis. **Methods:** This is a cross sectional, descriptive, analytical hospital-based study, included 81 adult patients with known history of end-stage renal disease (ESRD), using tunneled central venous catheters as access to haemodialysis at Ibn Sina Hospital-Khartoum Sudan. **Results:** The predominant gender in this study was female gender 66.7% (n=54), as for age group, 58% (n= 47) of the study group were between 40-65 years old. 67.9% (n=55) had end stage renal disease for 1-10 years. most of the study group 96.3% (n=78) underwent two sessions of dialysis per week and the main site of tunneled central venous catheter among the patients was Internal jugular vein. Tunneled central venous catheter infection was present in 48.1% (n=39) of the study group. 86.4% (n=70) were known case of systemic hypertension, and 17.3% (n=14) had diabetes mellitus. 57% (n=46) of the study group were received prophylactic antibiotics at the time of catheter insertion. 37% (n=30) of the patients had tunneled central venous catheter for 3-6 months, 34.6% for 6 months to 2 years. old patients were more prone to catheter infection than younger groups, patients who had tunneled central venous catheter duration for 6 months and above (>2 years) were frequently infected compared to the group with less duration "<6 months". There was a significant association with prophylactic antibiotics use at the time of insertion. **Conclusion:** Long duration of tunneled central venous catheter, hypertension, diabetes mellitus and old age were major risk factors related to infection in haemodialysis patients. Promotion of the infection control precautions through education and training the health providers is needed.

Keywords: End Stage Renal Disease, Haemodialysis, Central Venous Catheter Infections, CLABSI, Sudan,

Corresponding Author e-mail: mustafayasseen@uofb.edu.sd

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NTRODUCTION

Annually, in the United States, approximately 150 million intravascular devices are used for multiple purposes, mainly including the administration of fluids, medications and blood products; haemodynamic monitoring and renal replacement therapies [1]. End-stage chronic kidney disease, with a growing prevalence worldwide, and the need for haemodialysis as a treatment constitute the main indication for the insertion of central venous catheters [2]. This is an important risk factor for the development of infectious complications, given that it negatively impacts the quality of life of patients and increases mortality rates up to threefold, when compared with the hospital population [3].

Patients with end-stage renal disease (ESRD) treated by maintenance dialysis in the United States, approximately 90% are on maintenance haemodialysis and 10% are on peritoneal dialysis, because uraemia is known to make patients more susceptible to infectious agents through defects in cellular immunity, neutrophils function, and complement activation [4,5]. So permanent haemodialysis patients are at high risk for infection. Long term permanent central haemodialysis catheter is frequently used as vascular access in such patients and common complication is infection with severe morbidity like endocarditis, osteomyelitis, spinal epidural abscess, septic arthritis and septic pulmonary embolism and high-risk mortality. Bloodstream infection in this context is considered one of the main reasons for hospital admission, prolonged stay, and adverse outcomes among users of these devices [4].

Global initiatives for the study of the outcomes in patients on dialysis consider the presence of catheter-related infections to be a potentially devastating complication, as they are the most common cause of morbidity and the second leading cause of mortality. The risk of sepsis attributable to this condition is one hundred-fold greater than that of the general population. In the same way, it is considered that haemodialysis catheters represent the greatest risk of bacteraemia, sepsis and death compared with other vascular access types [6].

The common causative organism are gram positive bacteria with staphylococcus aureus which present 40% to 80% and polymicrobial infections 10% to 20% and fungal infection <5% [7]. Caring for adults individuals with end-stage kidney disease (ESKD) involves complex medical decisions, including the choice of optimal haemodialysis (HD) vascular access, and the consideration of all potential access should be given when presenting with non-maturing arterio-venous fistula or poorly functioning graft. Knowledge of age-specific risk of catheter related blood stream infections (CRBSIs) could aid the decision-making process regarding choice of dialysis vascular access, balancing likelihood of prolonged access function with complications [5].

Objectives

General Objectives

To measure the frequency of tunneled central venous catheter infection among adult undergoing haemodialysis.

Specific objectives

1. To assess the clinical presentation of tunneled central venous catheter infection.
2. To assess the link between number of dialysis sessions and risk of infection.
3. To assess comorbidities as risk factors for infection.
4. To compare the rate of tunneled central venous catheter infection between elderly and younger patients.

MATERIAL AND METHODS

Study design and setting

This is a cross sectional, descriptive, analytical, hospital-based study. The study was conducted at Haemodialysis Centre in Ibn Sina Specialized Hospital.

Study duration:

The study was conducted during the period from March to June 2021.

Study Population:

All patients with ESRD attending to haemodialysis centre at Ibn Sina Specialized Hospital.

Inclusion Criteria

All patient age more than 18 years who are attended haemodialysis centre in IBN SINA specialised hospital

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use tunneled central venous catheter as access of haemodialysis

Exclusion Criteria:

1. Patients age less than 18 years old.
2. Patients used other access for dialysis rather than tunneled central venous catheter

Sampling Technique:

Total coverage of patients having end-stage renal disease receiving haemodialysis through tunneled central venous catheter during the study period were included; as the nephrology centre at Ibn Sina hospital is specialized centre with limited beds capacity. The sample size in this study was 81 patients.

Data collection methods and techniques

This was a cross-sectional study included patients with known history of end-stage renal disease use tunneled central venous catheter as access of haemodialysis; patients younger than 18 years were excluded. The data was collected using interviewing questionnaire and was filled by the researcher. Age, gender, history of diabetes mellitus, immunosuppressive, malignancy, and other comorbidity were obtained from medical records.

Patients' presentation including fever, vomiting, confusion and temperature chart respiratory rate, pulse rate, O2 saturation, blood pressure and number of systemic inflammatory response syndrome criteria were collected at initial presentation to the hospital. Site of infection, presence of discharge, tenderness, redness, at site of infection causative microorganism and presence of bacteraemia were detected as well as complete blood count, electrolytes, blood culture, coagulation profile, was noted.

All the necessary precautions against the spread of Corona virus and infection control were considered. The data were conducted in an unrestricted time and comfortable place for patients.

Plan for data analysis

Data entry, analysis and presentation

Data were entered, cleaned, and analysed using SPSS version 22.0. Descriptive statistics in terms of frequency tables with percentages and graphs were presented with relevant graphical representation for quantitative data. Bivariable analysis, Chi-square test (for categorical variables), and t-test (for quantitative variables) were performed to determine the associations between the study variables. Data were represented after analysis in the form of univariable tables, cross-tabulation (bivariable tables), figures, and narrative illustration.

Ethical considerations

Written informed consent was insured from the participants with confidentiality and autonomy ensured. Ethical clearance was obtained from, ethics committee and research unit at educational development Centre of Sudan Medical Specialization Board (SMSB). Permission was granted by the hospital involved.

RESULTS

The 81 patients over 18 years old who were attending Ibn Sina Specialized Hospital from Mars/2021 to June/2021 were included. The predominant gender in this study was females 66.7% (n=54), as for age group, 58% (n=47) of the study group were 40-65 years old, while 27.2% (n=22) were 18-39 years old. **(Table 1)**

Table 1 shows the characteristics of the participants

Variable	Frequency	%
Age		
18-39	22	27.2%
40-65	47	58%
>65	12	14.8%
Gender		
Male	27	33.3%
Female	54	66.7%

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67.9% (n=55) had end-stage renal disease for 1-10 years, 24.7% (n=20) were less than 1 year. Less than half of the study group, 43.2% (n=35) started haemodialysis before 6 months to 12 years. (Table 2)

Table 2 Duration of end-stage renal disease and onset of haemodialysis

Variable	Frequency	%
Duration of ESRD		
< 1 year	20	24.7%
1-10 years	55	67.9%
> 10 years	6	7.4%
Duration of starting haemodialysis		
< month	3	3.7%
1-3 months	12	14.8%
3-6 months	14	17.3%
6 months-2 years	35	43.2%
> 2 years	17	21.0%

Almost all the study group, 96.3% (n=78) underwent two sessions of dialysis per week and the main site of tunneled central venous catheter among the patients was internal jugular vein. (Table 3)

Table 3 Number of dialysis sessions plus site of tunneled central venous catheter

Variable	Frequency	%
Number of dialysis sessions/weak		
2 sessions	78	96.3
3 sessions	3	3.7
Site of haemodialysis tunneled central venous catheter		
Internal jugular vien	81	100

Tunneled central venous catheter infection was present in 48.1% (n=39), among those, 76.9% (n=30) had catheter infection for the first time, 20.5% (n=8) had a recurrent infection for the second time. (Table 4)

Table 4 Frequency tunneled central venous catheter infection

Presence of tunneled central venous catheter infection	Frequency	%
Yes	39	48.1%
No	42	51.9%
if, yes:		
First time	30	76.9%
Recurrent twice	8	20.5%
Recurrent 4 times	1	2.6%

The most common comorbidity associated with catheter infection were systemic hypertension 86.4% (n=70), diabetes mellitus 17.3% (n=14). Regarding clinical presentation, 50.6% (n=41) presented with shivering or rigors, 48.1% (n=39) had fever, vomiting 22.2% (n=18) and only 2 cases presented with confusion. Regarding the

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clinical signs; 43.2% had blood pressure above 120/80 mmHg, 42% had heart rate above 100 beats/minute and 39.5% had body temperature ≥ 38 C°. Only 4% (n=3) presented with discharge and pain at the catheter exit site. **(Table 5, 6, Figure 2)**

Table 5 shows the Associated comorbidity.

Variable	Frequency	%
Diabetes Mellitus	14	17.3%
Systemic Hypertension	70	86.4%
Immunosuppressive	1	1.2%
Others	16	19.8%

Table 6 shows the clinical symptoms

Variable	Frequency	%
No symptoms	22	27.2%
Fever	39	48.1%
Confusion	2	2.5%
Vomiting	18	22.2%
Shivering or rigors	41	50.6%

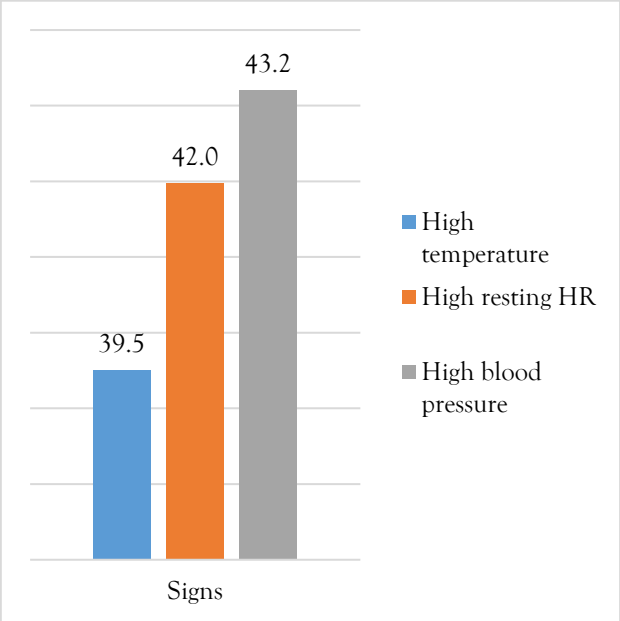

Figure 1 shows the clinical presentation signs

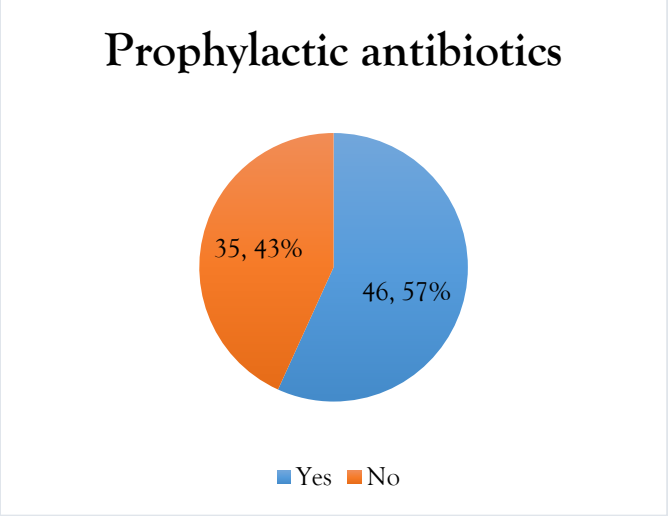

Figure 2 shows the use of prophylactic antibiotics

57% (n=46) of the study group were received prophylactic antibiotics during catheter insertion. Regarding the laboratory investigations; the entire study group presented with high creatinine levels, low haemoglobin levels 75.3%, high CRP 48.1%, High TWBCs 40.78% and high differential neutrophil count 37%. **(Figure 2, 3, 4)**

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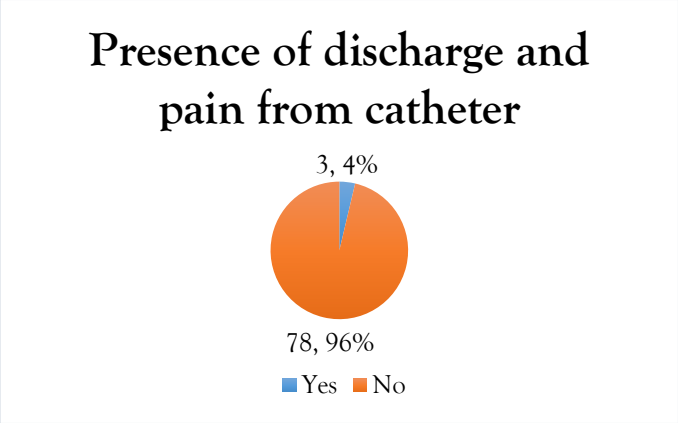

Figure 3 Pain and discharge at catheter exit site

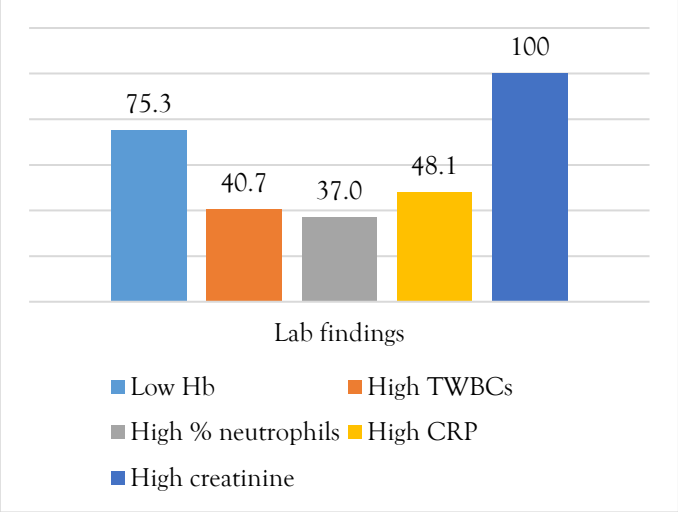

Figure 4 shows the Laboratory investigations

37% (n=30) of the patients had tunneled central venous catheter duration of 3-6 months, 34.6% (n=28) had duration of 6 months to 2 years, 16% (n=13) had duration of 1-3 months and 12.3% (n=10) had tunneled central venous catheter duration of two years. **(Table 7)**

Older patients were more prone to tunneled central venous catheter infection than younger groups; the difference was statistically significant (p value < 0.05). Moreover, patients who had tunneled central venous catheter for 6 months and above (> 2 years) were frequently infected compared to the group with less duration "< 6 months", (p value < 0.05). Furthermore, there was a significant association between prophylactic antibiotics use at the time of insertion and prevention of catheter infection (p value < 0.05). However, there is no association between numbers of dialysis sessions and the rate of catheter infection (p value > 0.05). **(Table 8)**

Table 7 shows the time duration of Tunneled central venous catheter since insertion.

Duration of tunneled central venous catheter since insertion	Frequency	%
1-3 months	13	16.0%
3-6 months	30	37.0%
6 months-2 years	28	34.6%
> 2 years	10	12.3%

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Table 8 shows the association between catheter infections and the age of the participants. Fisher's exact test

Variables		Catheter infection		Total	P value
		Yes	No		
Age groups	18-39	12	10	22	0.001
	40-65	16	31	47	
	>65	11	1	12	
Number of dialysis sessions/week	2 sessions	36	42	78	0.107
	3 sessions	3	0	3	
Duration of tunneled central venous catheter	1-3 months	0	13	13	0.000
	3-6 months	4	26	30	
	6 months-2 years	25	3	28	
	> 2 years	10	0	10	
Prophylactic antibiotics	Yes	6	40	46	0.000
	No	33	2	35	
Total		39	42	81	

DISCUSSION

Global initiatives for the study of the outcomes in patients on dialysis consider the presence of catheter-related infections to be a potentially devastating complication, as they are the most common cause of morbidity and the second leading cause of mortality. The risk of sepsis attributable to this condition is one hundred-fold greater than that of the general population. In the same way, it is considered that haemodialysis catheters represent the greatest risk of bacteraemia, sepsis and death compared with other vascular access types [6].

The catheters continued to be the primary method of acute haemodialysis access [57, 58]. The incidence and risk of infection varied significantly over time and according to the site of insertion. This concept was reflected in the National Kidney Foundation Guidelines on vascular access, which recommended removal of femoral catheters after five days of use and internal jugular catheters after three weeks of use [59]. These guidelines were based on expert opinion.

In this study, the incidence of tunneled central venous catheter infection was 48.1 %. This was in agreement with previously reported studies [60-64], however, Farida S. et al. [65] and Mattous et al. [66] both reported a higher incidence rate of CVC infection. A higher rate of CVC infection can be explained by a low compliance with hygiene measures. Deficiencies in hygiene measures during either CVC insertion or CVC maintenance.

In the present study, old patients were more prone to tunneled central venous catheter infection than younger groups, the difference was statistically significant. There was a predominance of females compared to male groups. These findings were similar to a previous report by Farida S. et al, [65] were they had a predominance of female and

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old patients. However, our findings were in contrast with Murea M. et al, [53] who stated that elderly patients on haemodialysis using central venous catheter (CVC) are at lower risk of catheter-related bloodstream infection than their younger counterparts.

In this study, prolonged duration of tunneled central venous catheter (up to two years) significantly associated with the risk of central venous catheter infection. Our findings were in agreement with Poinen K. et al, [55] who stated that, approximately one-third of haemodialysis patients who used CVCs during 1 to 2 years experienced complications. Bacteraemia occurred in ~9% of patients at 1 year and was the most common cause of CVC-related hospitalizations.

The study confirmed that hypertension, diabetes and longer duration of tunneled central venous catheter use were significantly associated with risk of infection. These findings were in agreement with Farida S. et al, [65] and Lemaire et al, [67] both identified hypertension, diabetes and prolonged duration of CVC usage as a risk factor of CVC infection. Moreover, previously, it has been described as major risk factors related to infection in haemodialysis patients. [68, 69] The reason behind prolonged duration of CVC usage maybe due to difficulty of performing an arteriovenous fistula.

In our study, all patients tunneled central venous catheter. Farida S. et al. [65] reported, CVC location was not an independent risk factor for CVC infection in their study. However, this was in contrast to Lemaire et al. report [67] but in accordance to other previous reports. [70, 71]

Our study had some limitations; we had not identified the causative organisms. Farida S. et al. reported Klebsiella pneumoniae, Coagulase-negative Staphylococci and Staphylococcus aureus as the most common causative organisms in their study. Moreover, previous reports stated that, CVC infection was caused essentially by S. aureus. Considering all Gram-negative micro-organisms, they were responsible for a significant proportion of CVC infection. [66, 67, 70, 72-75]

CONCLUSION

Long duration of tunneled central venous catheter and hypertension, diabetes and older age are major risk factors related to infection in haemodialysis patients. Promotion of the infection control precautions by educating and training the health providers is needed.

Recommendations:
Promotion of clear clinical guidelines and continuing staff education for improvements of practice are needed. Improving hand hygiene is needed but attention must be made for using protective clothes: mask and sterile gown. Applying aseptic techniques during the insertion, care and manipulation of intravascular catheters are known to be effective precautions against CVC infection.

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Competing Interests:
The authors declare no competing interests.

Author Contributions:
Conception/design: MYH, FJM.

Provision of study material/patients: Collection and/or assembly of data: (FJM, MYH).

Data analysis and interpretation: FJM, MYH

Manuscript writing: MYH,FJM

Final Approval of manuscript: All authors.

Data Availability Statement: The data underlying this article will be shared upon request to the corresponding author.

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