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Original Article

Frequency of Catheter-Related Bacterial Infection in End Stage Renal Disease Patients on Hemodialysis

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ABSTRACT

Objective: To determine the frequency of catheter related bacterial infections among the patients on hemodialysis due to end stage renal disease.

Study Design: Cross sectional study

Place and Duration of Study: Department of Nephrology, Sharif Medical City Hospital, Lahore Pakistan, from 6 Months i.e., Jun 2021 to Oct 2021.

Methodology: After meeting the inclusion and exclusion criteria 171 patients were enrolled. Tips of the catheters were removed by the surgeon and transferred to laboratory in a sterile container, while at least two blood culture samples were taken before removing the catheter. Catheter related bacterial infections were noted.

Results: In this study the most common catheter related bacterial infection in ESRD cases on hemodialysis was blood stream tunnel infection noted in 48.5% patients followed by, infective endocarditis noted in 28.1%, echo vegetation in 26.3% patients, tunnel infection in 25.1% and exit site infection in 23.4% patients.

Conclusion: The most common catheter related bacterial infection in ESRD cases on hemodialysis was blood stream tunnel infection followed by, infective endocarditis, echo vegetation, tunnel infection and exit site infection patients.

Keywords: Catheter Related Bacterial Infection, Hemodialysis, End stage renal disease

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INTRODUCTION

Achieving proper access for hemodialysis among the ESRD cases is a difficult step. Its success depends on many factors like anatomic factors, patient's hesitation and long maturation time of AV fistula.[1] According to previous data overall prevalence of catheter used in ESRD cases is 29%, while frequency is much higher as 69% in first six months and 41% after one year of dialysis.[2] Due to long maturation time required by AV fistula duration of catheter use is increased causing its complications.[3] ESRD cases admitted in hospitals have higher chances of acquiring nosocomial infections. Those on repeated hemodialysis are more prone to nosocomial infections than those admitted cases not on hemodialysis yet.[4] Pathogens responsible in such cases include Staphylococcus aureus, Pseudomonas, Enterococcus and Klebsiella.[5] A Canadian study stated that decreased GFR causes increase in blood stream infection rate so showing that it is an independent risk factor or bacterial infection other than vascular access.[6] There are three types of access for hemodialysis as CV catheter, AV fistula and AV graft.[7] Patients with ESRD are more prone to infections. Patients with AV fistula have lesser chance of infection than intravascular catheters.[8] About 75% deaths in ESRD occur due to septicemia. Other risk factors of infections in ESRD cases with CV catheters include old age, prolong catheter use, diabetes mellitus, low serum level of albumen and anemia.[9] Staphylococcus aureus contribute 80% catheter related infections in such cases.[10]

Practical Implication

This study will help us to understand frequency of catheter related infections among the cases with ESRD and to increase awareness among health professionals treating such patients to understand disease burden so that this condition may be avoided by taking proper preventive measures

METHODOLOGY

This is a cross sectional study. Conducted in department of Nephrology, Sharif Medical City Hospital, Lahore. It was completed in six months after approval of synopsis i.e., June 2021 to December 2021. WHO calculator for sample size was used and 171 sample size calculated taking 95% confidence interval and 4% margin of error and expected prevalence of Tunnel infection by 7.7% in end stage renal disease

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patients on hemodialysis. Non-probability consecutive sampling.

Inclusion Criteria: Age 30 to 70 years, Both gender, End stage renal disease as per operational definition

On hemodialysis for >30 days duration.

Exclusion Criteria: Undergoing dialysis using arterio venous fistula, Taking antibiotics in last one month

Refused informed consent.

Data Collection Procedure

Patients falling into inclusion criteria admitted in the Department of Nephrology, Sharif Medical City Hospital, Lahore were included in this study. Approval was taken from the institutional ethical board. Consent was taken from all the study cases in written. Basic variables like, gender, age, body weight, height and duration of dialysis were noted.

Tips of the catheters were removed by the surgeon and transferred to laboratory in a sterile container, while at least two blood culture samples were taken before removing the catheter (from peripheral vein and catheter line or hub). All patients were also be referred to cardiology department for echocardiography. Catheter related bacterial infections were documented on a self-made proforma. .

Data Analysis

SPSS software (version 20) was used for data analysis. For age, duration of dialysis and weight Means±SD were calculated. Frequency with percentages were determined for qualitative variables like infective endocarditis, tunnel infection etc. Catheter related bacterial infections were stratified among age, gender, duration of dialysis and weight. Chi square test was applied on the data, $p \leq 0.05$ was considered significant and more than this as non significant.

RESULTS

In this study 70 patients were enrolled. The mean age was 52±09.81 years with the range of 30-70 years of age. In this study male patients were 112(65.5%) and female patients were 59(34.5%). Male to female ratio in study group was 1.8:1.

According to the results mean duration of dialysis was 8.32±5.63 months with the range of 2-36 months. According to this study the mean weight of the patients was 66.22±9.23 kg with minimum weight of 42 kg and maximum weight of 86 kg. According to this study the exit site infection was noted in 40(23.4%) cases. Tunnel infection was noted in 43(25.1%) cases. The blood stream infection was found in 83(48.5%) patients. In this study the infective endocarditis was found in 48(28.1%) patients. In this study the echo vegetation was found in 45(26.3%) patients.

Figure-1: Frequency distribution of gender

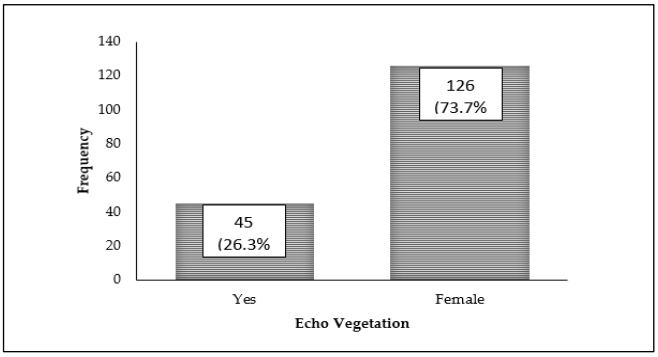

Figure-2: Frequency distribution of echo vegetations

In patients having age ≤50 years the exit site infection was found in 20(28.2%) patients and in patients having age >50 years the exit site infection was found in 20(20.0%) patients (p-value=0.214). In male patients the exit site infection was found in 26(23.2%) patients and in female patients the exit site infection was found in 14(23.7%) patients (p-value=0.940).

Table-I: Comparison of exit site infection between age group, gender, duration of dialysis and weight of the patients

		Exit site Infection		Total	*p*-value
		Yes	No		
Age groups	≤50	20	51	71	0.214
		28.2%	71.8%	100.0%	
	>50	20	80	100	
		20.0%	80.0%	100.0%	
Gender	Male	26	86	112	0.940
		23.2%	76.8%	100.0%	
	Female	14	45	59	
		23.7%	76.3%	100.0%	
Duration of dialysis (Months)	≤12	30	108	138	0.296
		21.7%	78.3%	100.0%	
	>12	10	23	33	
		30.3%	69.7%	100.0%	
Weight (Kg)	≤60	14	37	51	0.414
		27.5%	72.5%	100.0%	
	>60	26	94	120	
		21.7%	78.3%	100.0%	

In patients having duration of dialysis ≤12 months the exit site infection was found in 30(21.7%) patients and in patients having duration of dialysis age >12 months the exit site infection was found in 10(30.3%) patients (*p*-value=0.296). In patients having weight ≤60 kg the exit site infection was found in 14(27.5%) patients and in patients having weight >60 kg the exit site infection was found in 26(21.7%) patients (*p*-value=0.414).

Table-II: Comparison of tunnel infection between age group, gender, duration of dialysis and weight of the patients

		Tunnel Infection		Total	*p*-value
		Yes	No		
Age groups	≤50	19	52	71	0.682
		26.8%	73.2%	100.0%	
	>50	24	76	100	
		24.0%	76.0%	100.0%	
Gender	Male	30	82	112	0.496
		26.8%	73.2%	100.0%	
	Female	13	46	59	
		22.0%	78.0%	100.0%	
Duration of dialysis (Months)	≤ 12	29	109	138	0.011
		21.0%	79.0%	100.0%	
	>12	14	19	33	
		42.4%	57.6%	100.0%	
Weight (Kg)	≤60	15	36	51	0.402
		29.4%	70.6%	100.0%	
	>60	28	92	120	
		23.3%	76.7%	100.0%	

Table-III: Comparison of blood stream infection between age group, gender, duration of dialysis and weight of the patients

		Blood stream Infection		Total	*p*-value
		Yes	No		
Age groups	≤50	31	40	71	0.282
		43.7%	56.3%	100.0%	
	>50	52	48	100	
		52.0%	48.0%	100.0%	
Gender	Male	51	61	112	0.279
		45.5%	54.5%	100.0%	
	Female	32	27	59	
		54.2%	45.8%	100.0%	
Duration of dialysis (Months)	≤12	70	68	138	0.242
		50.7%	49.3%	100.0%	
	>12	13	20	33	
		39.4%	60.6%	100.0%	
Weight (Kg)	≤60	16	35	51	0.003
		31.4%	68.6%	100.0%	
	>60	67	53	120	
		55.8%	44.2%	100.0%	

In patients having age ≤50 years the tunnel infection was found in 19(26.8%) patients and in patients having age >50 years the tunnel infection was found in 24(24.0%) patients (*p*-value=0.682). In male patients the tunnel infection was found in 30(26.8%) patients and in female patients the tunnel infection was found in 13(22%) patients (*p*-value=0.496). In patients having duration of dialysis ≤12 months the tunnel infection was found in 29(21.0%) patients and in patients having duration of dialysis >12 months the tunnel infection was found in 14(42.4%) patients (*p*-value=0.011). In patients having weight ≤60 kg the tunnel infection was found in 15(29.4%) patients and in patients having weight >60 kg the tunnel infection was found in 28(23.3%) patients (*p*-value=0.402).

Table-IV: Comparison of blood infective endocarditis between age group, gender, duration of dialysis and weight of the patients

		Infective endocarditis		Total	*p*-value
		Yes	No		
Age groups	≤50	15	56	71	0.089
		21.1%	78.9%	100.0%	
	>50	33	67	100	
		33.0%	67.0%	100.0%	
Gender	Male	31	81	112	0.875
		27.7%	72.3%	100.0%	
	Female	17	42	59	
		28.8%	71.2%	100.0%	
Duration of dialysis (Months)	≤12	29	109	138	<0.001
		21.0%	79.0%	100.0%	
	>12	19	14	33	
		57.6%	42.4%	100.0%	
Weight (Kg)	≤60	17	34	51	0.318
		33.3%	66.7%	100.0%	
	>60	31	89	120	
		25.8%	74.2%	100.0%	

Table-V: Comparison of blood eacho vegitation between age group, gender, duration of dialysis and weight of the patients

		Echo vegitations		Total	*p*-value
		Yes	No		
Age groups	≤50	13	58	71	0.045
		18.3%	81.7%	100.0%	
	>50	32	68	100	
		32.0%	68.0%	100.0%	
Gender	Male	28	84	112	0.590
		25.0%	75.0%	100.0%	
	Female	17	42	59	
		28.8%	71.2%	100.0%	
Duration of dialysis (Months)	≤12	29	109	138	0.001
		21.0%	79.0%	100.0%	
	>12	16	17	33	
		48.5%	51.5%	100.0%	
Weight (Kg)	≤60	17	34	51	0.174
		33.3%	66.7%	100.0%	
	>60	28	92	120	
		23.3%	76.7%	100.0%	

There is statistically insignificant difference was found between blood stream infection and age group, gender and duration of dialysis of the patients. i.e., *p*-value>0.05. There is statistically insignificant difference was found between the blood infective endocarditis and age group, gender, weight of the patients. i.e., *p*-

value >0.05. In patients having age ≤50 years the echo vegitation was found in 13(18.3%) patients and in patients having age >50 years the echo vegitation was found in 32(32.0%) patients (*p*-value=0.045). In male patients the echo vegitation was found in 28(25.0%) patients and in female patients the echo vegitation was found in 17(28.8%) patients (*p*-value=0.590). In patients having duration of dialysis ≤12 months the echo vegitation was found in 29(21.0%) patients and in patients having duration of dialysis age >12 months the echo vegitation was found in 16(48.5%) patients (*p*-value=0.001). In patients having weight ≤60kg the echo vegitation was found in 17(33.3%) patients and in patients having weight >60kg the echo vegitation was found in 28(23.3%) patients (*p*-value=0.174).

DISCUSSION

According to the literature in UK more than 23000 cases underwent renal transplant surgery in the year of 2001.[11] About 50% of them continued receiving dialysis while remaining 50% had functional transplant.[12] Hemodialysis is a common form of dialysis which is received by 37% cases after renal transplantation.[13] According to a European study hemodialysis is received by 24.5% cases in hospitals and by 1.7% cases in home.[14]

In this study the most common catheter related bacterial infection in ESRD cases having hemodialysis was blood stream tunnel infection noted in 48.5% patients followed by, infective endocarditis noted in 28.1%, echo vegetation in 26.3% patients, tunnel infection in 25.1% and exit site infection in 23.4% patients. Some of the studies are discussed below showing their results as.

Mahmood *et al.,* stated that staphylococcus aureus are predominantly responsible for catheter related blood stream infections (CRBSI).[15] In Brazil prevalence of CRBSI among the patients with ESRD is very high about 62% while in Pakistan its prevalence is 25% according to recent literature.[16] Another study reported that central venous catheters in Jugular vein are more prone to infection with the frequency of 56% than the catheter in subclavian vein.[17] Javeid *et al*, reported 22% prevalence of CRBSI in their study conducted on 210 patients with ESRD. Data showed that 23% deaths of patients with ESRD occur due to blood stream infections. According to a systemic review study mean 19.2 to 29.8 episodes of CRBSI occur per 1000 patients. Infection rate is 9% in AV fistula and 23.9% in long term catheter placemen.[18]

Javeid *et al.* documented in their study that Catheter-related bloodstream infections, exit-site infections, and tunnel infections are common complications related to hemodialysis central venous catheter use.[18]

Gul *et al*. demonstrated in their study that non cuffed non tunneled double lumen catheters are designed for short-term emergency use and should be used in the same context. Although pathogenesis of catheter related infection is multifactorial the transcutaneous migration of organisms colonizing the skin remains the most important route.[19,20]

Studies showed that fever or chills are the most sensitive clinical features, associated with positive blood cultures in 60% to 80% of patients.[21] Only 5% of patients with CRBSIs will have a concurrent exit-site or tunnel infection. Other clinical manifestations of CRBSIs include hemodynamic instability, altered mental status, catheter dysfunction, hypothermia, nausea/vomiting, and generalized malaise.[22]

A recent prospective study of 178 suspected CRBSIs in hemodialysis patients showed that blood culture results are the most sensitive, specific, and accurate for diagnosis when taken from the hemodialysis circuit and the venous catheter hub, compared with any combination with peripheral vein cultures.38 Broad-spectrum antibiotics should be initiated to cover both gram-positive and gram-negative organisms.[23]

In future further studies should be done to evaluate the findings of our study with larger sample size. As it was single center study so it is suggested that in future studies should be done in multicenter setting to control bias.

CONLCUSION

This study concluded that the most common catheter related bacterial infection in ESRD cases having hemodialysis was blood stream tunnel infection followed by, infective endocarditis, echo vegetation, tunnel infection and exit site infection patients.

Conflict of Interest: None.

Author's Contribution

Following authors have made substantial contributions to the manuscript as under:

FS: & IA: Study design, drafting the manuscript, data interpretation, critical review, approval of the final version to be published.

STS: & SA: Critical review, concept, drafting the manuscript, appro-val of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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