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Prevalence of Systemic Infection among Chronic Hemodialysis Patients in Jeddah City, Saudi Arabia: A Retrospective Study

[1,2]*Samah O. Noor,* [1]*Shaima Alhazmi,* [3,4,5]*Majid Alshamrani,*
[3,4,5,6]*Fayssal Farahat,* [1,2]*Ahmed M. Al-Hejin and* [1,2]*Azhar Najjar*

[1]Faculty of Science, King Abdulaziz University, Jeddah, Saudi Arabia
[2]Microbiology Unit, King Fahd Medical Research Center,
King Abdulaziz University, Jeddah, Saudi Arabia
[3]King Saud bin Abdulaziz University for Health Sciences, Riyadh, Saudi Arabia
[4]King Abdullah International Medical Research Center, Riyadh, Saudi Arabia
[5]King Abdulaziz Medical City, Jeddah, Saudi Arabia
[6]Faculty of Medicine, Menoufia University, Egypt

Abstract: the susceptibility to infection among dialysis patients is, usually, associated with the dialysis procedure used. Hemodialysis (HD) patients require vascular access that can be punctured to remove and replace blood. These vascular accesses may serve as a major cause of infections. This study was aimed to estimate the prevalence of blood-stream infections (BSIs) and assess the associated factors among chronic HD outpatients at the National Guard Hospital in Jeddah, Saudi Arabia (SA). A retrospective review study was conducted between January 2014 and August 2016 at the HD unit at King Abdulaziz Medical City and King Abdullah HD Center in Jeddah, SA. Outpatients who had HD as first renal replacement therapy, aged between 18 to 60 years old and non-pregnant women were included. Data collection was done by reviewing the patient's medical records. Results showed that a total number of 160 outpatients on HD were included. Most patients were males (60.6%), with a mean age of 45.35 years. Most common co-morbid was hypertension (87.5%), followed by diabetes mellitus (47.5%). Most common vascular access in use was fistula (56.3%) followed by catheters (43.1%). The prevalence of BSI was 13.13%. Multivariate logistic regression revealed that the high risk for BSI was more likely to occur in patients who had catheters (OR: 10.088; *p*-value=0.001). Gram-negative bacteria were isolated in 54.6%, followed by Gram-positive (45.5%). Coagulase-negative *Staphylococcus* was the mostly found isolates (18.2%), followed by *Klebsiella pneumonia*e and *Enterobacteriaceae* family (15.2%, each). Antimicrobial susceptibility test showed that 36.4% of the isolates were multidrug resistant; 33.3% of which were resistant to ampicillin (45.5% were *Klebsiella pneumonia*e). Conclusions; vascular type access among HD patients is the main risk factor associated with BSI. A fistula is the best available option for HD patients and is associated with lower infection rates as compared to the use of catheters.

Key words: Hemodialysis · Bloodstream Infection · End-Stage Renal Disease · Risk Factors · Systemic Infections · Multidrug Resistance

INTRODUCTION

There are many complications that are associated with dialysis treatment. Some of those complications may lead to higher morbidity and mortality rates. The annual mortality rate among hemodialysis (HD) patients is 23% and infection is considered as the second most common cause of death, accounting for nearly 14% of the mortality cases [1]. According to the United States Renal Data System (USRDS) registry "Infection is the second leading cause of death in patients with end-stage renal disease (ESRD)" [2]. The susceptibility to infection among

Corresponding Author: Samah O. Noor, Faculty of Science, King Abdulaziz University, Jeddah, Saudi Arabia, Microbiology Unit, King Fahd Medical Research Center, King Abdulaziz University, Jeddah, Saudi Arabia.

dialysis patients is usually associated with the dialysis procedure used itself. Hemodialysis patients require vascular access that is introduced by a puncture to remove and replace blood, these vascular accesses are listed as a major cause of infections.

The rates of blood-stream infection (BSI) in patients undergoing HD appear to vary depending on the type of vascular access method that is used. According to the North American data, the rate of BSI among HD patients ranged from 0.5 to 27.1 per 100 patient-months [3]. The use of catheters is associated with a 10-fold increase in the risk of getting bacteremia in HD patients as compared to the use of fistula [4]. According to CDC data collected between 2008-2011, it has been estimated that 37,000 related BSIs to the central lines occurred among HD patients [5]. The Gram-positive *S. aureus* is considered as one of the most frequently isolated bacteria involved in such infections [6-10]. Other risk factors associated with infection include old age, the severity of illness, long-term hospital stay, repeated antimicrobial treatment and specific immune system defects associated with renal dysfunction [11].

Infection among HD patients results in major medical complications, long hospital stay and result in a high economic burden (Cost per infection has been estimated between $34,508 - $56,000 [2]. Intervention strategies are focused on infection prevention especially with increasing microorganism resistance and challenges of newly discovered antimicrobials.

The number of patients undergoing dialysis in Saudi Arabia is increasing each year. According to the Saudi Ministry of Health (MOH) [12] the total number of patients undergoing kidney dialysis in MOH-related centers in 20 governorates increased from 9,792 to 10,144 patients in 2015. This number represents approximately 66% of the total number of cases in all health governmental and non-governmental sectors in the kingdom [13]. More than 90% of those patients undergo HD [13]. The current study aimed to estimate the prevalence of BSIs and assess associated factors among chronic HD attending outpatients' clinics in the National Guard Hospital in Jeddah, Saudi Arabia.

MATERIALS AND METHODS

This retrospective review study was conducted between January 2014 and August 2016 at King Abdulaziz Medical City (KAMC) and King Abdullah HD center, Ministry of National Guard Health Affairs in Jeddah city, Saudi Arabia.

Adult patients (18 – 60 years old) and non-pregnant women who had HD as first renal replacement therapy were included in the study.

Data collection included information about the following: location of HD treatment (KAMC or King Abdullah HD center), demographic characteristics, comorbidities, type of current vascular access, the occurrence of BSI, type of vascular access during BSI, causative microorganisms and resistant profiles of antimicrobials.

Definition of Blood-stream Infection (BSI): Bloodstream infection was defined according to the National Healthcare Safety Networks (NHSN) Dialysis Event Surveillance Manual (CDC) [14] as any positive blood culture. Blood cultures were processed in accordance with standardized protocols in the hospital laboratory [14]. We considered BSI as a separate HD event when there was 21 days or more between positive blood cultures, even if organisms were different [14]. One of the following four suspected sources of positive blood culture is required to indicate BSI [14].

- Vascular access: if there is a local access infection (Pus, redness, swelling or pain at the access site), or a positive culture from the vascular access showing the same organism found in the blood.
- A source other than vascular access: if (1) a culture from another site shows the same organism found in the culture from the bloodstream (e.g., infected wound, urine), or (2) there is clinical evidence of infection at another site but was not sampled for culture.
- Contamination: if the isolated organism is a common commensal and it is isolated from only one of several blood cultures, the infection is more likely to be contamination and the source is thought by a physician and health care provider.
- Uncertain: if there is not enough evidence to decide among the three previous categories.

Ethical Considerations: The ethical approval was warranted by King Abdullah International Medical Research Center (KAIMRC) at the National Guard Hospital in Jeddah ethical committees.

Statistical Analysis: Data were presented using frequencies and percentages for categorical variables and mean ± standard deviation (SD) for continuous variables. The outcome was BSI. Associations between BSI and categorical variables were tested using Chi-square test.

The association between the continuous variables and the occurrence of BSI was examined using *t*-test. To compare the outcomes of patients who developed BSI and those who didn't, a bivariate analysis was applied.

Multiple logistic regression analysis was conducted to determine the independent variables that are associated with the presence of BSI among all studied variables. Odds ratios were calculated with 95% confidence interval. To evaluate the fit of the multivariate logistic regression model on our data we applied the Hosmer-Lemeshow goodness-of-fit test. The Hosmer-Lemeshow statistic indicates a poor fit if the *p*-value is less than 0.05. IBM SPSS version 24.0 for Windows was used for statistical analysis. Level of significance was determined at p-value ≤ 0.05. The prevalence analysis was calculated by dividing the number of patients with BSI to the total number of patients (Prevalence= Total number of patients with BSI/Total number of patients).

RESULTS

The total number of 167 outpatients with ESRD on HD was included in this study which was conducted between January 2014 and August 2016. Among all patients, 7 patients (4.2%) were excluded as one was a pregnant woman and 6 had previous treatment with HD. The final number of participants was reduced to 160 patients (95.8%) [42 (26.3%) from HD unit at KAMC and 118 (73.8%) from King Abdullah HD center] who met the inclusion criteria. Most patients were males (n= 97, 60.6%), while the rest were females (n= 63, 39.4%), with mean (±SD) age of 45.35 (±11.47) years. The youngest patient was 19 years old and the oldest was 60 years old. The most frequent age was 57 years old in 8% of patients. Co-morbidities were presented in 151 patients (94.4%). The most common co-morbid condition was hypertension, it was found in 140 patients (87.5%), followed by diabetes mellitus in 76 patients (47.5%). Also, 42 (26.3%) had heart disease, 18 (11.3%) had dyslipidemia and 19 (11.9%) had received organ transplantation. Serological tests revealed that 24 (15%) of HD patients were positive for anti-Hepatitis virus antibody, 20 (12.5%) were positive for anti-HCV and 4 (2.5%) were positive for HBsAg. None of the participants had HIV. At the time of the study, patients had been on HD for a mean duration of 875.25±1,359 days (2.397± 3.72 years), with the shortest period of 14 days and the longest period of 9,190 days (Equivalent to 25.178 years).

The most common vascular access in use was arteriovenous fistulas (AVF) in 90 patients (56.3%). One patient had arteriovenous graft (AVG) and the rest of the patients (n= 69, 43.1%) were treated by catheters. Most patients with AVF were males (n= 57, 63.33%), while 33 (36.7%) were females. Also, some patients with catheters were males 39 (56.5%), while 30 (43.5%) were females, with no significant differences (p-value=0.49). The characteristics of patients included in the study are presented in Table 1.

Table 1: Characteristics of the study population (N=160)

Characteristics	n	%	Mean (±SD)
Age (y)			45.35 ± 11.47
Gender			
Male	97	60.6%	
Female	63	39.4%	
Co-morbidities	151	94.4%	
Hypertension	140	87.5%	
Diabetes mellitus	76	47.5%	
Heart diseases	42	26.3%	
Dyslipidemia	18	11.3%	
Organ transplantation	19	11.9%	
Serological tests*			
HCV	20	12.5%	
HBV	4	2.5%	
HIV	0	0.00%	
Mean ± Days on HD (range)			875.25±1,359 (14-9,190)
Vascular access in use**			
AVF	90	56.3%	
AVG	1	0.63%	
CVC	69	43.1%	

*Serological tests: Hepatitis B Virus (HBV), Hepatitis C Virus (HCV) and Human Immunodeficiency Virus (HIV). **Vascular access type: Arteriovenous Fistula (AVF), Arteriovenous Graft (AVG), Central Venous Catheter (CVC). All values presented in the table are obtained by measured frequency, percent and mean (±SD).

Table 2: BSI and its relation to sample characteristics (n= 21)

		Blood-stream infection						
		Yes			No			
Characteristics	Level	n	%	Mean (±SD)	n	%	Mean (±SD)	*p*-value*
Age (y)				48.14±9.1			44.93 ± 11.76	0.232
Gender	Female	11	17.50%		52	82.50%		0.191
	Male	10	10.30%		87	89.70%		
Diabetes mellitus	Yes	13	17.10%		63	82.90%		0.156
	No	8	9.50%		76	90.50%		
Hypertension	Yes	21	15.00%		119	85.00%		0.063
	No	0	0.00%		20	100.00%		
Heart disease	Yes	8	19.00%		34	81.00%		0.186
	No	13	11.00%		105	89.00%		
Dyslipidemia	Yes	3	16.70%		15	83.30%		0.637
	No	18	12.70%		124	87.30%		
Organ transplantation	Yes	0	0.00%		19	100.00%		0.071
	No	21	14.90%		120	85.10%		
Hepatitis B	Yes	2	50.00%		2	50.00%		0.027
	No	19	12.20%		137	87.80%		
Hepatitis C	Yes	0	0.00%		20	100.00%		0.063
	No	21	15.00%		119	85.00%		
Duration of time on HD (d)				1141.38 ± 1272.65			835.04 ± 1371.54	0.337
Vascular access type**	AVF	3	3.60%		81	96.40%		0.001*
	CVC	18	24.00%		57	76.00%		
	AVG	0	0.00%		1	100.00%		

*$p \leq .05$ will be considered significant (95% confidence interval and 5% margin of error). **Vascular access type: Arteriovenous Fistula (AVF), Arteriovenous Graft (AVG), Central Venous Catheter (CVC). All values presented in the table are obtained by using the statistical tests: frequency, percent, mean (±SD), t-test and Chi-square test

The prevalence of BSI among our study population was 13.13% (95% CI: 8.31%-19.36%). There were 6 cases (28.6%) at HD unit at KAMC and 15 cases (71.4%) at King Abdullah HD center.

For the group of patients with BSI bivariate analysis showed that there were 11 females (17.5%) and 10 males (10.3%) with no statistically significant differences (p =0.19). The mean (±SD) age of the patients with BSIs was 48.14 (±9.1) years vs. 44.93 (±11.76) years for patients on HD without BSIs, with no statistically significant differences (p =0.23). BSIs were reported in 17.1% of patients with diabetes mellitus (n=13), 15% of patients with hypertension (n=21), 19% of patients with heart diseases (n=8), 16% of patients with dyslipidemia (n=3) and none among those with organ transplantation; differences were statistically not significant (p>0.05) (Table 2). In the meantime, 50% of patients with positive HBsAg had BSIs (n=2) (p=0.027) and no infection among patients with HCV (p= 0.06) (Table 2).

Patients with BSIs had been on HD for the mean (±SD) duration 1,141.38 ± 1,272.65 days (3.22 ± 3.58 years) vs. 835.04 ± 1,371.54 days (2.4 ± 3.9 years) for patients on HD without BSIs. The difference was not statistically significant (p=0.337). Blood-stream infections varied according to a type of vascular access employed, only 3 episodes of BSIs occurred in patients with AVFs (3.6%), compared to 18 episodes (24%) in patients with CVC and none in patients with AVG (p=0.001) (Table 2). Regarding the source of infection, contamination was reported in 8 (24.24%) episodes and other 2 episodes were classified as unknown.

Multivariate logistic regression revealed that there is a highly significant overall effect of type of vascular access on the prevalence rate of BSI (=0.004). The highest risk for BSI was in patients who have CVCs (OR= 10.088, 95% CI= 2.595-39.215; p=0.001) (Table 3).

No statistically significant association was reported between BSI and other studied variables.

Among 21 patients who had BSI, 29 episodes of infection were recorded. Some patients had repeated episodes, 2 of them (9.5%) had it twice and 3 others (14.3%) had it thrice in different events. Thirty-three (33) isolates were reported, different microorganisms with single infections were isolated in 26 episodes (89.65%), whereas in 3 episodes (10.34%) polymicrobial infections were reported.

Table 3: Multiple logistic regression showing factors associated with the occurrence of BSI

Factor	B	S.E.	*p*-value*	OR**	95% C.I. for OR	
					Lower	Upper
Age (y)	0.022	0.029	0.45	1.022	0.966	1.082
Female gender	0.679	0.527	0.198	1.971	0.702	5.535
Diabetes mellitus	0.300	0.662	0.65	1.350	0.369	4.940
Heart disease	-0.640-	0.630	0.31	0.528	0.153	1.813
Dyslipidemia	0.563	0.777	0.469	1.756	0.383	8.054
Hepatitis B	-1.632-	1.137	0.151	0.195	0.021	1.814
Duration on HD (days)	0.000	0.000	0.567	1.000	1.000	1.000
Vascular access type			0.004*			
CVC***	2.311	0.693	0.001*	10.088	2.595	39.215
Constant	-3.506-	2.125	0.099	0.030		

*$p \leq .05$ will be considered significant (95% confidence interval and 5% margin of error). **Odd Ratio (OR). ***Central Venous Catheter (CVC). All values presented in the table are obtained by using multiple logistic regression statistical test.

Table 4: Microorganisms isolated from blood culture

Causative microorganisms (N, %)	
Gram-negative	18 (54.54%)
Klebsiella pneumoniae	5 (15.15%)
Acinetobacter baumannii	3 (9.09%)
Pseudomonas aeruginosa	2 (6.06%)
Stenotrophomonas maltophilia	2 (6.06%)
Serratia marcescens	2 (6.06%)
Enterobacter cloacae	2 (6.06%)
Escherichia coli	1 (3.03%)
Achromobacter xylosoxidans	1 (3.03%)
Gram-positive	15 (45.45%)
Coagulase-negative *staphylococci*	6 (18.2%)
Staphylococcus aureus	3 (9.09%)
MRSA	3 (9.09%)
Corynebacterium spp.	2 (6.06%)
Alpha-haemolytic *Streptococcus*	1 (3.03%)

Table 5: Microorganisms isolated from blood culture by type of vascular access

	Catheter-associated BSI number (%)	Fistula-associated BSI number (%)
*Klebsiella pneumonia*e	3 (60%)	2 (40%)
Staphylococcus aureus	5 (83.3%)	1 (16.7%)
Common skin contaminants*	9 (100%)	0 (0%)
Other gram-negative	11 (84.62%)	0 (0%)

*Common skin contaminants included: *Corynebacterium* sp., coagulase-negative *Staphylococcus* and alpha-hemolytic *Streptococcus*.

Table 6: Antimicrobial susceptibility among isolated microorganisms

Antimicrobial	Resistant isolates (%)
Ampicillin	33.3%
Amoxicillin	21.2%
Cefazolin	18.2%
Oxacillin	15.2%
Trimethoprim	12.1%
Erythromycin	9.1%
Penicillin	9.1%
Ciprofloxacin	9.1%
Clindamycin	6.1%
Gentamicin	6.1%

The most prevalent microorganisms isolated from blood cultures were Gram-negative bacteria 18 (54.6%), followed by Gram-positive bacteria 15 (45.5%). Among the Gram-negative bacteria, non-fermenters were isolated in 38.9% of cases [*Acinetobacter baumanii* (9%); *Pseudomonas aeruginosa* and *Stenotrophomonas maltophilia* (6%, for each)], followed by 15.2% for each *Klebsiella pneumoniae* and *Enterobacteriaceae* family [*Serratia marcescens, Enterobacter cloacae* (6%, for each); and *Escherichia coli* (3%)]. Among the Gram-positive bacteria, coagulase-negative *Staphylococcus* (A common skin contaminant) and *Staphylococcus aureus* were isolated in 18.2% of blood cultures, for each. Thus, 50% of *S. aureus* (9.09%), were methicillin resistance *S. aureus* (MRSA). Other common skin contaminants were also found in 9% of isolates [*Corynebacterium* sp. (6%) and alpha-hemolytic *Streptococcus* (3%)] (Table 4).

Concerning all the microorganisms isolated, Coagulase-negative *Staphylococcus* and *S. aureus* were the most frequently isolated organisms from blood cultures of HD patients (18.2%, for each), followed by *Klebsiella pneumoniae* (15.2%) (Table 4). The data revealed a strong association between BSI in relation to the type of vascular access used. Table 5 represents the microorganisms isolated from blood culture versus the type of vascular access.

Vancomycin was used in the treatment of 55.2% of BSI cases, followed by ceftazidime (48.3%) and gentamicin (13.8%). Antimicrobial susceptibility showed that 12 out of the 33 isolated bacteria (36.4%) were multidrug resistant, 33.3% were resistant to ampicillin (45.5% of which was *Klebsiella pneumoniae*), 21.2% were resistant to amoxicillin, 18.2% were resistant to cefazolin, 15.2% were resistant to oxacillin and 12.1% were resistant to trimethoprim (Table 6).

DISCUSSION

Among HD patients, the annual mortality rate is 23% and infection is the second cause of death. It accounts for nearly 14% of the mortality cases [1]. In Saudi Arabia, it is estimated that 15,371 patients currently undergo HD treatment [13].

Prevalence of BSI in the current study was 13.13% (95% CI: 8.31%-19.36%) among 160 patients in two HD centers. Since a few patients undergoing HD in Saudi Arabia continues to increase [12, 13] the prevalence of BSI among them is expected to rise as well.

To the best of our knowledge, few studies were conducted in Saudi Arabia to estimate the prevalence rate of BSI among HD patients. In a prospective study in Al Qassim, Saudi Arabia, involving 57 patients undergoing HD via the use of temporary catheters, the prevalence of BSI was 19.3% [15]. Another prospective study in the Eastern region of Saudi Arabia, which included 209 HD patients showed that 40.6% had septicemia [16]. Such variations in BSI prevalence are possible because of differences in the characteristics of patients and vascular access management protocols that are applied at different HD units.

In recent years, the population of patients undergoing dialysis is changing, the mean age of HD patients is increasing [17, 18]. In the US during 2010, 26% of the HD population is mainly elderly patients [17, 19]. In the present study, the mean age of the studied population was 45.35±11.47 years. We did not observe a statistical significant association between age and occurrence of BSI (p =0.23) which may be due to the younger average age of our population. Similar results are reported in the literature. For instance, Gauna *et al.* [8] did not find a significant association between age and occurrence of BSI among 59 HD patients (p =0.83). These findings are contrary to those published by Fram *et al.* [20] who showed that the age of patients was associated with their morbidity and mortality due to BSI and estimated that for each additional year, the chance of death or hospitalization was increased by a factor of 1.05 times.

In the current study, males were the predominant gender (60.6%). Consistent with previous studies, our findings did not observe an association between gender and the occurrence of BSI (p =0.19). Gauna *et al.* [8] found that 54.2% of HD patients were females with no statistical association between gender and the occurrence of BSI (p =0.097).

Diabetes mellitus is a leading cause of renal disease [17]. In the U.S., diabetes accounts for 45% of ESRD compared to 20% in Europe [17]. In the current study, the most common co-morbid condition was hypertension (87.5%), diabetes mellitus was second (47.5%). However, we did not find a statistically significant association between hypertension or diabetes mellitus and the occurrence of BSI. However, Wang *et al.* found that patients with diabetes mellitus had more episodes of bacteremia [6]. The present study aligns with findings of Fram *et al.* who reported no relationships between diabetes mellitus, hypertension or cardiovascular diseases and occurrence of BSI in patients undergoing HD [20]. No available data in the literature on the possible relationship between HBV infection and the occurrence of BSI among HD patients, which is supported in the current study, in spite of the small number of HBV cases.

In the present study, the duration of HD treatment in both infected and non-infected groups did not show statistically significant differences, which is in accordance with what was reported by Gauna *et al.* [8] who found no association between the number of HD sessions and BSI (p- 0.64).

The type of vascular access is a known risk factor of BSI among HD patients. Several studies found that rates of BSI in patients undergoing HD appear to vary depending on the type of vascular access [6-10, 21-25]. In this study, all patients had tunneled (Long-duration). CVC and findings showed that the use of CVC was an independent risk factor for occurrence of BSI among HD Patients compared to AVF.

Multivariate logistic regression confirmed that use of CVC was associated with 10-fold increased risk of developing BSI among HD patients. This finding aligns well with the data obtained by Fram *et al*. [10] who reported an 11.2-fold increase in the chance of developing BSIs with use of CVC as compared to AVF (or: 11.2, 95% CI:5.17-24.29; p<0.001). IN another study by Fysaraki *et al*. [7] the absence of fistula was a risk factor for developing BSI (or: 2.933; p= 0.047).

The use of AFV is thought to be the most appropriate vascular access to reduce the risk of complications mainly due to infections [17]. Our findings emphasize the need to reduce the use of the catheter in HD patients as much as possible and replace with fistula instead. However, it is worth noting that using fistula has some limitations and it is not always possible especially in elderly and diabetic patients [20]. This should be taken into consideration where the mean age of dialysis patients is increasing and

diabetes mellitus is becoming the leading cause for ESRD [17]. The use of AVF in the current study was higher (56.3%) than catheters (43.1%). Also, Karkar *et al.* [26] found a significant increase in the use of AVF and reduction of CVC implantation associated with a decrease in infection rates.

Regarding the microorganisms, previous studies reported a high prevalence of Gram-positive organisms in patients undergoing HD treatment, mainly *S. aureus* [6-10, 19,20]. This differs from our data where we observed that Gram-negative organisms were the predominant organisms (54.6%). *Klebsiella pneumoniae* was the most frequently isolated with 100% resistance to ampicillin. Gram-positive organisms represented 45.5% of the isolated organisms from blood cultures and Coagulase-negative *staphylococcus* and *S. aureus* were the most frequent (18.2% each). Half of the *S. aureus* were methicillin resistance (MRSA) and all were isolated from blood cultures of patients with CVCs. *McCann et al.* [27] found that BSI with MRSA in dialysis patients is 100 times higher than in the general patient population and it is higher among HD patients dialyzed via CVCs (68.9%) than the dialysis patient population. Consistent with previous findings [3, 7 & 28] this study showed that common skin contaminants were the most frequently reported microorganisms among HD patients with catheters, no cases among patients with fistulas.

In our study, 38.9% of isolates were non-fermenters and included: 3 isolates of *Acinetobacter baumanii* (9%), 2 isolates for each of *Pseudomonas aeruginosa* and *Stenotrophomonas maltophilia* (6%). Blood-stream infections caused by non-fermenting Gram-negative rods, such as *Acinetobacter baumannii*, *Stenotrophomonas maltophilia* and *Pseudomonas aeruginosa* are highly resistant to antibiotics. Also, they can cause outbreaks of nosocomial infection and often associated with high mortality rates [8].

Infections among HD patients are often caused by resistant microorganisms, due to the frequent need for antimicrobial therapy and frequent hospitalizations [7]. Antimicrobial susceptibility in this study showed that more than a third of isolated bacteria were multiple resistant. According to the CDC, the rational use of antibiotics is an important measure for controlling the spread of multiple resistant microorganisms [14]. Fram *et al.* found that prior antimicrobial use was associated with a higher occurrence of BSI (OR: 2.53; p =0.013) [10]. It is remarkable that the proportion of microorganisms resistant to ampicillin in our study was very high, reflecting the problem of irrational use of antibiotics in this community. Healthcare providers should be aware of the resistant profiles in their units and restrict the use of antibiotics with high resistance rates. However, no vancomycin resistance has been reported although vancomycin was the first-line therapy used to treat 55.2% of the cases, followed by ceftazidime (48.3%) with no resistant isolates and gentamicin (13.8%) with only 2 resistant isolates, revealed that the strains remain susceptible to these antimicrobials.

This study had some limitations related to its retrospective nature and relatively small population size. Also, it was done in a single hospital, with separately distributed centers, within the same geographic location, thus representing single center experience. Based on that, the study should be extended to include more hospitals and healthcare centers from different locations in the kingdom to obtain a more meaningful representation of the situation in the whole kingdom of Saudi Arabia.

CONCLUSIONS

The data showed that the type of vascular access represents the main risk factor associated with BSI in patients undergoing HD and strongly influence the outcome of HD treatment. The use of fistula is the best available option for HD patients and has a much lower infection rate as compared to catheters. A longitudinal study with comparison of multiple units representing different healthcare sectors in the kingdom would improve our knowledge on risk factors and practices associated with BSIs among HD patients in Saudi Arabia.

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