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Identification of Bacterial Pathogens Isolated from Haemodialysis Patients using VITEK 2 Compact System and their Antibiotic Susceptibility

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ABSTRACT

This study was conducted to investigate catheter-related bloodstream infection (CRBI) of 201 chronic haemodialysis (HD) patients with temporary, or true permanent access (catheters) (PCs) who had fever, chills, or other symptoms suggesting systemic infection attended 17 dialysis units in Khartoum State during 12 month period. Blood infection is often the reason for hospitalization and the cause of mortality across the globe. In this study, patients with HD CRBSIs were identified. Their blood cultures were collected according to standard sterile technique. Specimens were sent to the microbiology lab for culture and primary identification of colonial morphology and Gram-stain. Isolates were then run on the semi automated Vitek 2 Compact System (bioMérieux, France). Sixty two patients ranged in age between 10 and 90 years were confirmed to have HD CRBSIs based on our study criteria. Fifty six (90.3%) patients had Gram-positive infections and six (9.7%) patients had Gram-negative infections. The antibiotic susceptibility results showed that only vancomycin, linezolid, tigecycline and nitrofuranation were fully efficacious against Gram-positive isolates, and were highly resistant to benzylpenicillin (92.9%) and oxacillin (83.9%). Susceptibility results of Gram-negative isolates showed fully resistance (100%) to ampicillin, ampicillin/sulbactam, cefazolin and cefoxitin and all isolates were susceptible to amikacin. Our study revealed that *Staphylococcus epidermidis* was the most common microorganism associated with HD CRBSIs. Antibiogram is an important tool in deciding empirical antibiotics for HD CRBSIs. Tailoring the antibiotics accordingly to the antibiogram can increase the chance of successful treatment and prevent the emergence of bacterial resistance.

INTRODUCTION

Dialysis is a mechanical process that performs the work of healthy kidneys. Haemodialysis (HD) uses a man-made membrane (dialyzer) to remove wastes and extra fluid from the blood. It also restores the proper balance of certain minerals in the blood (electrolytes). Haemodialysis is usually done in a hospital or dialysis center (Kumar and Clark, 2005; Rhodes, 2009). Kidney failure (also called end-stage renal disease) occurs when kidney damage is so severe that a person needs dialysis or a kidney transplant to maintain life. The spectrum of chronic kidney disease (CKD) (also called chronic kidney failure (CKF)) extends from the point at which there is slight kidney damage, but normal function, to the point at which a patient may require either a renal transplant or renal replacement therapy to survive (Kumar and Clark, 2005 ; Rhodes, 2009 and Peter *et al.,*2003).

Haemodialysis continues to be an important treatment option for persons with end-stage renal disease . Infection is a serious complication of hemodialysis, and infection arising from the percutaneous vascularaccess necessary to accomplish hemodialysis is the most common source of infection occurring in these patients (Taylor *et al.,*2004).

Vascular access sites may consist of fistulas (created from the patient's native vessels), grafts (created with synthetic materials), and cuffed (permanent) or noncuffed (temporary) catheters. Of these, the risk of infection is highest for catheters, intermediate for grafts, and lowest for fistulas (Saad, 1999, and Tokars *et al*., 2002).

The most serious problem of HD tunneled catheters is catheter-related bloodstream infection (CRBI) (Quarello and Forneris, 2002).

Catheter-associated bacteremia (CAB) is a serious complication of permanent catheter use and a common cause of catheter failure. Of the Gram-positive organisms, the causative agents for haemodialysis-associated infections are *Staphylococcus aureus* and coagulase-negative *staphylococci* (CoNS) which accounted for most infections, but *enterococcal* infections are also in high increase (Fitzgibbons *et al.,* 2011; Saad, 1999).

VITEK 2 compact system (bioMérieux, Marcy I'Etoile, France) as mentioned by Ligozzi *et al*., (2002) and Hackman *et al* .,(2013) is a semi-automated bacterial identification and susceptibility testing system enabling rapid determination of Minimum Inhibitory Concentrations (MICs) by analysis of bacterial growth kinetics with antimicrobials in sealed test cards and resistant mechanisms. This system allows kinetic analysis by reading each test every 15 min. The optical system combines multichannel fluorimeter and photometer readings to record fluorescence, turbidity, and colorimetric signals, which provide rapid and accurate identification as well as MIC evaluation for these pathogens has become increasingly important.

The goal of this study was to isolate and identify the causative agent from dialysis patients suspected to have bacteremia and investigate their antimicrobial susceptibility by VITEK 2 compact system.

MATERIALS AND METHODS

The study was conducted out in Khartoum State in the period from March 2013 to March 2014. Blood collection and patients' data were done in 17 Dialysis Units of Khartoum Teaching Hospital (KTH), Gaffer Iben

Auff Specialized Hospital for Children (GIASH), Omdurman Teaching Hospital, Mohamed Elamin Hospital for Children , AL academy Teaching Hospital , Al waledain dialysis centers, Giad hospital, El gamea Hospital for renal disease, Ahmed Gasim Hospital, El Safia Dialysis Center ,Military Medical Hospital, Ribat University Hospital ,Ibn Seina Hospital, Alamal Alwatani Hospital, Ompada Hospital, Sharg Elneel Hospital and Elban Gadead Hospital. It was a cross-sectional study which included 201 end stage renal disease (ESRD) patients with the diagnosis of HD CRBSIs. The diagnosis was made based on the clinical presentation of fever, chills or other symptoms suggesting systemic infection (eg, nausea, vomiting, malaise, or back pain) and laboratory confirmation. HD patients who presented with other source of infection were excluded from the study. Consents were taken from the patients and demographic data were taken via structural interviewing questionnaire. One set of blood culture (anaerobic and aerobic) was taken from a catheter by using clean technique with hand washing, non sterile gloves, masking of both nurse and patient, and a non sterile towel draped under the catheter, the nursing staff were disinfected the connection ports using two gauze sponges soaked with aqueous-based povidine-iodine solution for 5 minutes. The gauze was removed, and the solution was allowed to dry before the catheter was opened as mentioned by Landry *et al*., 2010. The blood cultures were then sent to the microbiology laboratory for culture, identification and antibiotic sensitivity tests. All culture isolates were identified based on their Gram stain reaction and biochemical reaction characteristics using VITEK 2 Compact System (bioMérieux, Marcy I'Etoile, France). The procedures recommended by the manufacturer were strictly followed.

Sterile identification (ID) and antibiotic susceptibility testing (AST) test tubes used to prepare inoculums were filled with 3ml of 0.45% saline water and placed in a cassette. The identification (ID) test tube was used to prepare inoculum from the pure colonies and mixed thoroughly using a vortex until a suspension of 0.5 – 0.63 McFarland was formed. The McFarland was determined using Densichek (bioMérieux, France). A volume of 145µl and 280µl of the inoculum from the ID test tube for Gram negative and Gram positive organisms respectively were pipetted into the AST test tube of 3.0 mL of sterile saline and mixed thoroughly.

The Gram negative (GN) ID test cards, Gram positive (GP) ID test cards and AST test cards were inserted in the respective test tubes and loaded into the Vitek instrument. The GP identification card is based on established biochemical methods and newly developed substrates which includes colorimetric tests for the following reactions: phosphatidylinositol phospholipase C, arginine dihydrolase (two tests), galactosidase,glucosidase, alanine-phenylalanine- proline arylamidase, L-aspartic acid arylamidase, galactosidase, mannosidase, alkaline phosphatase, L-leucine arylamidase, proline arylamidase-glucuronidase (two tests),galactosidase, L-pyroglutamic acid arylamidase, alanine arylamidase, tyrosine arylamidase, and urease. also tests acid production from the following substrates: amygdalin, xylose,cyclodextrin, sorbitol, galactose, ribose, lactate, lactose, *N*-acetylglucosamine, maltose, mannitol,

mannose, methyl-D-glucopyranoside, pullulan, raffinose, salicin, sucrose, and trehalose. Finally, growth in 6.5% NaCl and tests for resistance to polymyxin B, bacitracin, novobiocin, O129, and optochin were also included in the ID-GP identification card. The GN card was based on established biochemical methods and newly developed substrates measuring carbon source utilization, enzymatic activities, and resistance, there are 47 biochemical tests and one negative control well. Final identification results are available in approximately 10 hours or less, test substrates including 18 enzymatic tests for aminopeptidases and -osidases. Substrates used for detection of aminopeptidases are usually coupled with 7-amino-methylcoumarin (7AMC); substrates for detection of -osidases were usually coupled with 4-methylumbelliferone (4MU). The 18 test substrates were as follows: 4MU-a-arabinopyranoside, 4MU-a-D-galactoside, a-Lglutamic acid-7AMC, 4MU-b-D-cellobiopyranoside, 4MU-b-D-galactoside, 4MU-b- D-glucoside, 4MU-b-D-glucuronide, 4MU-b-D-mannopyranoside, 4MU-*N*-acetylb- D-glucosaminide, 4MU-*N*-acetyl-b-D-galactosaminide, 4MU-b-D-xyloside, glutaryl-glycyl-arginine-7AMC, g-L-glutamic acid-7AMC, 4MU-phosphate, L-proline-7AMC, L-pyroglutamic acid-7AMC, L-lysine-7AMC, and *Z*-arginine-7AMC. Furthermore, the ID-GNB card includes 18 fermentation tests (adonitol, L-arabinose,D-cellobiose, D-galacturonate, D-glucose, glucose-1-phosphate, D-glucuronate, inositol, 5-keto-gluconate, D-maltose, D-mannitol, D-melibiose, palatinose, D-raffinose, L-rhamnose, sucrose, D-sorbitol, and D-trehalose), 2 decarboxylase tests (ornithine and lysine), and 3 miscellaneous tests (urease, utilization of malonate, and tryptophane deaminase).

AST-GP 67 card were used for Gram positive cocci including *Staphylococcus spp*, *Enterococcus spp* and *S. agalactiae* contained benzylpenicillin, erythromycin, gentamicin, nitrofurantoin, oxacillin, rifampin, tetracycline, trimethoprim-sulfamethoxazole, tigecycline, linezolid, moxifloxacin, levofloxacin, clindamycin, ciprofloxacin, and vancomycin.

AST-GN 75 card was used for Gram negative bacilli contained ampicillin, gentamicin ampicillin-sulbactam, trimethoprim-sulfamethoxazole, nitrofurantoin, ciprofloxacin, cefoxitin, levofloxacin, ceftriaxone, amikacin, cefazolin cefepime, ceftazidime, meropenem, pipracillin and tobracillin,

While in the Vitek instrument, the cards were filled, sealed and incubated in the Vitek 2 compact system incubator until results were generated by the expert advanced system of the Vitek 2 compact system for the type of organism and antibiotic susceptibility,

Analysis of identification results: There are four possibilities for analysis of identification results: An unknown biopattern is compared to the database of reactions for each tax on, and a numerical probability calculation is performed. Various qualitative levels of identification are assigned based on the numerical probability calculation: excellent identification, very good identification, good identification, acceptable identification (each of these four categories shows only one identification result), low discrimination (more than one identification result is given, where upon the software suggests performing additional tests such as oxidase, hemolysis, pigmentation, indole, and motility tests in order to obtain the correct identification),

inconclusive identification, and unidentified.

Analysis of susceptibility testing: There are three possibilities for analysis of susceptibility testing. (i) Agreement. The VITEK 2 system and the reference method were considered to be in agreement when the species identification of the VITEK 2 system agreed exactly with the species identification of the reference method.(ii) Essential agreement. MICs obtained with the VITEK 2 system and by the reference methods were considered to be in essential agreement when the MIC obtained with the VITEK 2 system was within 1 twofold dilution of the reference MIC obtained by either the microdilution method or the agar dilution method. In the case of high-level resistance to aminoglycosides, "category agreement" occurred when the categorization of high-level resistance with the VITEK 2 system coincided with the results obtained by the reference methods and (iii) MIC discrepancies. MIC discrepancies were considered "very major" (the VITEK 2 system indicated susceptible and the reference method indicated resistant), "major" (the VITEK 2 system indicated resistant and the reference method indicated susceptible), and "minor" (the VITEK 2 system indicated intermediate and the reference method indicated susceptible or resistant, or the VITEK 2 system indicated susceptible or resistant and the reference method indicated intermediate).

RESULTS

During the study period, 201 patients with suspected Haemodialysis (HD) catheter-related blood stream infections (HD CRBSIs) were identified. The patients divided in to 115 (57.2%) males and 86 (42.8) females (Table 1). The patients attended different dialysis centers in Khartoum State, 85 (42.3%) were in Bahri, 69 (34.3%) were in Khartoum, and 47 (23.4%) were in Omdurman (Table 2).

Table 1: Distribution of specimens among enrolled patients according to gender

Gender	Frequency	Percent
Male	115	57.2
Female	86	42.8
Total	201	100

Table 2: Distribution of patients in dialysis centers in Khartoum state

State	Frequency	Percent
Khartoum	69	34.3
Bahri	85	42.3
Omdurman	47	23.4
Total	201	100

The patients ranged in age between 10 and 90 years. Most patients' ages were between 51-70 years ie 72(35.8%) patients (Table 3).

Table 3: Ditibution of patenl according to patient's age group

Age groups/years	Frequency	Percent
10- 30	59	29.4
31- 50	58	28.8
51- 70	72	35.8

71- 90	12	6.0
Total	201	100

The results revealed that out of 201 patients, 62 patients gave positive bacterial growth on blood culture 14(7.0%) though they were under antibiotic treatment and 48 (23.9%) not take antibiotics while 139 patients were negative for growth in blood culture and 31(15.4%) were under antibiotic treatment while 108 (53.7%) were not taking antibiotics (Table4).

Table 4: Association between patients' antibiotic status and growth pattern

Antibiotic status			Culture result		Total	Level of significance
			Growth	No growth		
Antibiotic	Yes	Count	14	31	45	0.965
		% of Total	7.0%	15.4%	22.4%	non-significant
	No	Count	48	108	156	
		% of Total	23.9%	53.7%	77.6%	
Total		Count	62	139	201	
		% of Total	30.8%	69.2%	100.0%	

Of the 201 patients, 147(73.1%) received hemodialysis through a permanent catheter and 54(26.9%) received hemodialysis through a temporary catheter. Permanent and temporary catheters showed 40(19.9%) and 22(10.9) bacterial growth respectivily (Table 5). The majority of the bacterial growth 107 (53.2%) occurred in the first 6 month insertion period of the catheter (Table 6).

Table 5: Association between type of catheter and growth pattern

Type of catheter			Culture result		Total	Level of significance
			growth	No growth		
	Permanent	Count	40	107	147	
		% of Total	19.9%	53.2%	73.1%	0.066
	Temporary	Count	22	32	54	non-significant
		% of Total	10.9%	15.9%	26.9%	
Total		Count	62	139	201	
		% of Total	30.8%	69.2%	100.0%	

Table 6: Association between days of catheter and growth pattern

Days of catheter/month			Culture result		Total	Level of significance
			Growth	No growth		
days of catheter	< 1M	Count	6	11	17	0.887
		% of Total	3.0%	5.5%	8.5%	
	1- 6 M	Count	30	77	107	non-significant
		% of Total	14.9%	38.3%	53.2%	
	7- 12 M	Count	18	38	56	
		% of Total	9.0%	18.9%	27.9%	
	13- 18 M	Count	4	7	11	
		% of Total	2.0%	3.5%	5.5%	
	>19 M	Count	4	6	10	
		% of Total	2.0%	3.0%	5.0%	
Total		Count	62	139	201	
		% of Total	30.8%	69.2%	100.0%	

Out of 201 cases, 62 cases gave positive growth blood cultures. Out of them, 56 (90.3%) patients revealed Gram-positive bacteria and 6 (9.7%) patients with Gram-negative bacteria. *Staphylococcus epidermidis* was the most common microorganism associated with HD CRBSIs, it involved 35 out of the 62 (56.5%) cases. Other prominent bacteria included *Enterococcus faecalis, Enterococcus faecium* each 6 (9.7%), *Staphylococcus aureus 4(*6.5%*),* *Pseudomonas aeruginosa* 3(4.8%), *Staphylococcus vitulinus, Staphylococcus hominis, Staphylococcus simulans, Streptococcus uberis*, *Enterobacter cloacae, Serratia marcescens,* and *Escherichia coli,* each once (1.6%) (Table 7).

Table 7: Bacterial isolates from 62 blood cultures

Type of bacteria	Count (%)	
Gram-positive organisms		
Staphylococcus epidermidis	35	(56.5)
Enterococcus faecalis	6	(9.7)
Enterococcus faecium	6	(9.7)
Staphylococcus aureus	4	(6.5)
Staphylococcus vitulinus	1	(1.6)
Staphylococcus hominis	1	(1.6)
Staphylococcus simulans	1	(1.6)
Streptococcus uberis	1	(1.6)
Total	56	(90.3)
Gram-negative organisms		
Pseudomonas aeruginosa	3	(4.8)
Enterobacter cloacae	1	(1.6)
Serratia marcescens	1	(1.6)
Escherichia coli	1	(1.6)
Total	6	(9.7)
Total for all organism	62	(100)

The antibiotic susceptibility results showed that only vancomycin, linezolid, tigecycline and Nitrofuranation were fully efficacious against Gram-positive isolates (0%), were highly resistant to Benzylpenicillin (92.9 %) and oxacillin (83.9 %).

Table 8: Minimum Inhibtory Concentrations (ICs) of the 56 Gram positive bacterial isolates

Strain No.*	MIC (µg/ ml)														
	P	OX	GM	CIP	LEV	MXF	E	CM	LNZ	VA	TE	TGC	FT	RA	SXT
1	0.5	4	8	0.5	0.12	1	8	0.25	1	1	1	0.12	16	0.5	80
2	0.5	0.25	0.5	0.5	0.12	0 .25	0 .25	0.25	2	1	16	0.12	16	0.5	10
3	0.5	4	0.5	0.5	0.12	0 .25	0 .25	0.25	1	1	1	0.12	16	0.5	10
4	0.25	0.25	0.5	0.5	0.5	0 .25	0.5	0.25	2	0.5	1	0.12	16	0.5	10
5	2	0.25	0.5	8	8	1	8	8	2	1	16	0.12	128	0.5	80
6	0.5	4	0.5	4	0.12	1	8	0.25	2	1	2	0.12	16	0.5	10
7	0.5	4	8	0.5	0.12	1	8	0.25	1	2	16	0 .25	16	32	320
8	0.5	4	0.5	0.5	0.12	0 .25	0 .25	0.25	1	1	1	0.12	16	0.5	20
9	0.5	0.25	4	8	4	2	0 .25	0.25	1	1	1	0.12	16	32	80
10	2	4	0.5	1	1	0.5	0.5	8	2	1	16	0.12	16	0.5	10
11	32	4	8	8	8	8	0 .25	0.25	2	0.5	16	0.12	16	0.5	80
12	2	4	0.5	1	0.5	0.25	0 .25	8	2	1	1	0.12	16	0.5	10
13	0.5	4	16	4	4	1	8	0.25	1	1	1	0.12	16	0.5	160
14	0.5	4	16	8	4	1	0.25	8	1	0.5	1	0.12	16	0.5	20
15	0.5	0.5	1	8	8	2	8	0.25	2	0.5	1	0.12	16	0.5	80
16	0.5	0.25	0.5	0.5	0.25	0.25	0.25	0.25	2	1	16	0.12	16	0.5	10
17	0.5	4	16	1	0.5	0.25	8	8	1	2	16	0.5	16	0.5	20
18	0.25	4	0.5	4	4	1	0.25	0.25	1	2	2	0.25	16	0.5	10
19	0.5	4	0.5	0.5	0.25	0.25	0.25	0.25	2	1	16	0.12	16	0.5	10
20	0.5	4	0.5	0.5	0.5	0.25	8	0.25	1	1	1	0.12	16	0.5	10
21	4	4	0.5	0.5	1	0.25	0.5	8	2	1	16	0.12	16	0.5	10
22	0.5	4	0.5	0.5	0.5	0.25	8	0.25	1	1	1	0.12	16	0.5	80
23	0.5	4	16	0.5	0.12	0.25	8	0.25	1	1	16	0.5	16	0.5	160
24	0.5	4	0.5	0.5	0.5	0.25	0.25	0.25	2	0.5	16	0.12	16	0.5	320
25	0.12	4	4	0.5	0.12	0.25	8	0.25	1	2	2	0.12	16	0.5	10
26	0.5	4	0.5	0.5	0.12	0.25	0.25	0.25	1	1	16	0.12	16	0.5	10
27	2	4	0.5	1	1	0.25	0. 25	8	2	1	1	0.12	16	0.5	10
28	4	4	0.5	8	4	2	8	8	1	2	16	0.12	16	0.5	10
29	1	4	0.5	1	2	0.5	0.25	8	2	0.5	1	0.12	32	0.5	10
30	0.5	4	0.5	0.5	0.12	0.25	8	0.25	1	2	1	0.12	16	0.5	10
31	1	4	0.5	1	2	1	0.25	0.25	2	0.5	1	0.12	16	0.5	10
32	0.5	4	0.5	0.5	0.12	0.25	8	0.25	1	1	16	0.12	16	0.5	160
33	0.5	4	16	1	4	1	0.25	0.25	1	2	16	0.5	16	0.5	80
34	0.5	4	0.5	8	8	2	8	0.25	1	2	2	0.25	16	0.5	10
35	0.5	4	0.5	0.5	0.12	0.25	0.25	0.25	1	1	1	0.12	16	0.5	160
36	0.5	4	16	0.5	0.12	0.25	8	0.25	1	1	1	0.12	16	0.5	160
37	1	4	0.5	0.5	2	0.25	0.25	8	2	0.5	1	0.12	64	0.5	10
38	0.5	4	0.5	8	4	2	8	0.25	1	2	16	0.5	16	0.5	10
39	0.5	4	0.5	4	4	1	8	0.25	1	2	16	0.5	16	0.5	10
40	0.5	4	8	1	0.5	0.25	8	0.25	1	1	2	0.12	16	0.5	10
41	0.5	4	0.5	4	4	8	8	0.25	1	2	2	0.12	16	0.5	160
42	0.25	0.25	0.5	0.5	0.12	0.25	0.25	0.25	1	1	1	0.12	16	0.5	160
43	0.5	0.25	0.5	0.5	0.12	0.25	8	0.25	1	0.5	16	0.12	16	0.5	10
44	0.5	4	0.5	0.5	0.12	0.25	0.25	0.25	1	2	1	0.12	16	0.5	10
45	0.5	4	0.5	0.5	0.12	0.25	0.25	0.25	1	2	1	0.12	16	0.5	80
46	0.5	4	0.5	4	4	1	8	0.25	1	1	1	0.12	16	0.5	10
47	0.5	4	0.5	1	0.5	0.25	8	0.25	1	1	2	0.12	16	32	160
48	0.5	0.25	0.5	0.5	0.12	0.25	8	8	1	1	1	0.12	16	0.5	10
49	0.5	4	0.5	0.5	0.12	0.25	8	8	1	2	1	0.12	16	0.5	10
50	0.5	4	0.5	0.5	0.12	0.25	8	8	1	2	1	0.12	16	0.5	10
51	0.5	4	0.5	0.5	0.12	0.25	8	8	2	1	16	0.12	16	0.5	10
52	0.5	4	0.5	0.5	0.12	0.25	8	0.25	1	1	1	0.12	16	0.5	160
53	0.5	4	0.5	0.5	0.12	0.25	0.25	0.25	1	1	1	0.12	16	0.5	160
54	0.5	4	0.5	0.5	0.12	0.25	0.25	0.25	1	1	16	0.25	16	0.5	10
55	0.5	4	0.5	8	0.12	0.25	8	8	1	2	1	0.12	16	0.5	160
56	0.5	4	0.5	0.5	0.12	0.25	0.25	8	1	2	1	0.12	16	0.5	10
BP	≥0.5	≥4	≥ 16	≥ 8	≥ 8	≥ 8	≥ 8	≥ 8	≥ 8	≥ 32	≥ 16	≥ 2	≥ 512	≥ 32	≥ 32
RS	52/56	47/56	6/56	9/56	4/56	2/56	29/56	16/56	0/56	0/56	20/56	0/56	0/56	3/56	21/56
%	92.9	83.9	10.7	16.1	7.2	3.6	51.8	28.6	0	0	35.7	0	0	5.4	37

P Benzylpenicillin OX Oxacillin GM Gentamicin CIP Ciprofloxacin LEV Levofloxacin MXF Moxifloxacin E Erythromycin
CM Clindamycin LNZLinozolid VA Vancomycin TE Tetracycline TGC Tigecycline
FT Nitrofuranation RA Rifampicin SXT Trimethoprim/Sulfamethoxazole

Resistance rate to other antibiotics were: erythromycin (51.8%), trimethoprim/sulfamethoxazole (37.5%), tetracycline (35.7%), clindamycin

(28.6%), ciprofloxacin (16.1%), gentamicin (10.7%), levofloxacin (7.2%), rifampicin (5.4 %) and moxifloxacin (3.6%).

Susceptibility results of Gram-negative isolates showed fully resistance (100%) to ampicillin, ampicillin/sulbactam, cefazolin and cefoxitin. Followed by piperacillin, nitrofuranation, trimethoprim/Sulfamethoxazole all (50%), cefepime (33.3%), meropenem, gentamicin, tobramycin, ciprofloxacin levofloxacin all (16.7%). All isolates were susceptible to amikacin (Tables 8 and 9) were the MICs and resistance rate of Gram-positive and Gram-negative bacterial sensitivity testing.

Table 9: Minimum Inhibitory Concentrations **(**MICs) of the 6 Gram negative bacterial isolates

Strain No.*	MIC (mg ml"1)														
	AM	SAM	PIP	CZ	FOX	CAZ	CRO	FEP	MEM	AN	GM	TM	CIP	LEV	FT SXT
1	32	32	4	64	64	2	64	1	0.25	2	1	1	0.25	0.25	512 320
2	32	32	128	64	64	2	64	1	0.25	2	16	16	4	8	16 320
3	32	32	4	64	64	1	1	1	0.25	2	1	1	0.25	0.12	16 20
4	32	32	4	64	64	64	6	64	16	2	1	1	0.25	0.25	512 20
5	32	32	128	64	64	2	1	64	0.25	2	1	1	0.25	0.25	512 20
6	32	32	128	64	64	2	64	1	0.25	2	1	1	0.25	0.25	16 320
BP	≥32	≥32	≥128	≥64	≥64	≥64	≥64	≥64	≥16	≥64	≥16	≥16	≥4	≥8	≥512 ≥320
RS	6/6	6/6	3/6	6/6	6/6	1/6	3/6	2/6	1/6	0/6	1/6	1/6	1/6	1/6	3/6 3/6
%	100	100	50	100	100	16.7	50	33.3	16.7	0	16.7	16.7	16.7	16.7	50 50

AM= Ampicillin SAM= Ampicillin/Sulbactam PIP= Piperacillin CZ = Cefazolin FOX= Cefoxitin
CAZ=Ceftazidime CRO= Ceftriaxone FEP= Cefepime MEM= Meropenem AN= Amikacin
GM= Gentamicin TM= Tobramycin CIP= Ciprofloxacin LEV= Levofloxacin FT=Nitrofuranation
SXT= Trimethoprim/Sulfamethoxazole

DISCUSSION

This study confirms that bacteremia is a frequent occurrence in the chronic HD patients with long-term, permanent and temporary venous catheter access. In this study most infections (73.1%) occur in permenent catheters. This result is similar to the result shown by Taylor *et al*., (2004) who found the most infections (57%) were for permenent catheters. Our rate of median catheter duration of use for 1-6 month was (53.5%) this is with in the range obtained by Abdul Gafor *et al,* (2014) who reported that the median catheter duration was three months.

Our results showed that the average patient age was from 51-70 years. This result is in line with the results obtained by Abdul Gafor *et al,* (2014) who reported that the average patient age was 61 years.

This study diagnosed CAB based on blood cultures drawn directly from the PC port or from the dialysis blood tubing coming from the PC. This technique is similar to that of Saad,(1999).

The present study also reported a predominance of Gram-positive organisms (90.3%) which is contrasts with Saad (1999). The wide variety of both Gram-positive and Gram-negative infections seen, is similar to the spectrum of organisms reported by landry *et al*., (2010) who found that a predominance of Gram-positive organisms (87.7%). Also this study reported a predominance of Gram-

positive coagulase- negative staphylococci (59.7%). This result goes in line with the result reported by Taylor *et al*., (2004) who found the most microbial etiology of CAB in hemodialysis patients was coagulase-negative staphylococci (45%).

CONCLUSION

Coagulase-negative *Staphylococcus* was the most common microorganism associated with HD CRBSIs, they were sensitive to vancomycin, and most their infections (73.1%) occured in permenent catheters. Vitek 2 compact system was a reliable semi-automated microbiology system which may be used for routine, accurate and rapid detection of bacterial strains in health facilities in our settings. Gram-positive isolates were highly resistant to benzylpenicillin and oxacillin while Gram-negative isolates showed fully resistance to ampicillin, ampicillin/sulbactam, cefazolin and cefoxitin and all isolates were susceptible to amikacin.

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