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Assessing the Frequency and Antibiotic Susceptibility Pattern of Isolated Bacteria from Septicemic Hemodialysis Patients

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Abstract

Introduction: Septicemia is one of the main causes of morbidity and mortality worldwide that increases the hospitalization time and also raises the cost for patients. The current study aimed to evaluate the frequency and antimicrobial susceptibility profiles of blood culture isolates from the hemodialysis patients referred to Hasheminejad Hospital in Tehran, Iran.

Methods: In this retrospective cross-sectional study the records of 1090 patients who undergone hemodialysis in Hasheminejad Hospital Urinary Tract and Kidney Center between 2012 and 2013 were evaluated. At least two Blood samples from each patients were collected under sterile conditions and was injected into blood culture bottles. After 1, 3, 5 and 7 days, samples were cultured in sheep blood agar (BA), chocolate agar and eosin methylene blue agar (EMB). Disc diffusion on Muller Hinton Agar (HIMEDIA, India) was performed to define the susceptibility. Spss software version 20 was used to analyze the data.

Results: From 1090 patients 186 subjects had positive blood culture from them 121 were male and 65 were female. The most frequent isolated species are as follow respectively: coagulase positive *Staphylococcus* 68 (37%), *Escherichia coli* 47 (26%), *Pseudomonas aeruginosa* 25 (14%), *Streptococcus* Group D 22 (12%), Coagulase-negative *Staphylococcus* 13 (7%), *Streptococcus* group A 4 (2%), *Klebsiella* 2 (1%), and *Bacillus* 1 (1%). Gram negative bacteria were mostly sensitive to nitrofurantoin, amikacin, and ciprofloxacin. In addition, gram positive bacteria were mostly sensitive to vancomycin, amikacin, cefotaxime, ciprofloxacin, imidazole, colistin, erythromycin, and oflatoxin.

Conclusion: The result of the current study determined the most prevalent bacteria that are responsible for septicemia in Tehran, Iran, and the most effective antimicrobials for treatment of septicemia in this area which could help physicians to select a proper antibiotics for initial antimicrobial therapy.

INTRODUCTION

Septicemia is one of the main causes of morbidity and mortality worldwide that increases the hospitalization time and also raises the cost for patients. Annually, almost 200,000 cases of septicemia happen throughout the world with 20 to 50% mortality rates [1]. The most common sources of septicemia are respiratory tract, genitourinary tract, and intra-abdominal foci [2].

A wide range of bacteria are responsible for septicemia in patients including *Escherichia coli*, *Pseudomonas aeroginosa*, *Klebsiella* species, *Neisseria meningitidis*, *Haemophilus influenza* as gram negative bacteria and coagulase negative *staphylococci* (CONS), *Staphylococcus aureus*, *Streptococcus pneumoniae*, *Streptococcus pyogenes*, *Streptococcus agalactiae*, and *Enterococcus faecium* as gram positive bacteria [3]. Preceding studies have reported that *Staphylococcus aureus* and *Escherichia coli* are the two most common causes of septicemia in patients in the United States and Europe [4-7] and that 6 to 18% of bacteremia are poly-microbial [4, 5].

The occurrence of septicemia in hospitalized patients has been reported to associate with increasing use of central venous catheters, patient illness such as oncology and burn/trauma, and some other disposing factors, including staying in intensive-care unit (ICU), microorganism, and staffs' hand washing practices [8-10].

Primary initiation of proper antimicrobial treatment is vital in diminishing morbidity and mortality among patients with septicemia [11]. Antibiotic resistance is one of the major problems that physicians face with it during the treatment of septicemia. Therefore, having knowledge about the frequency of the isolated bacteria and their antibiotic

susceptibility patterns in each area is helpful for initial antimicrobial therapy. The current study aimed to evaluate the frequency and antimicrobial susceptibility profiles of blood culture isolates from the hemodialysis patients referred to Hasheminejad Hospital in Tehran, Iran.

METHODS

In this retrospective cross-sectional study the records of 1090 patients who undergone hemodialysis in Hasheminejad Hospital Urinary Tract and Kidney Center between 2012 and 2013 were evaluated. At least two Blood samples from each patients were collected under sterile conditions and was injected into blood culture bottles (Trypticase Soy broth/ Brain Heart Infusion broth) (Darvash, Iran) and incubated in 37oC for a week. After 1, 3, 5 and 7 days, samples were cultured in sheep blood agar (BA), chocolate agar and eosin methylene blue agar (EMB) and then incubated at 37oC for 24-48 hours. Biochemical test including catalase, coagulase, novobiocin and optochin disk for gram positive and triple sugar iron (TSI), indole, citrate, urea, Lysine decarboxylase (LDC), MR-VP and motility were for Gram negative bacteria was performed to define the species of bacteria using standard procedures [12]. Disc diffusion on Muller Hinton Agar (HIMEDIA, India) was performed to define the susiptibility. The anitibiotic for disc diffusion were as follow: ofloxacin (OFX), ampicillin (AMP), Imidazole (IMD), ceftriaxone (CRO), ciprofloxacin (CIP), amoxicillin (AMX), cephalothin (CF), gentamicin (GM), cefazolin (CZ), ceftazidime (CAZ), trimethoprim-sulphamethoxazole (SXT), cefotaxime (CTX), nitrofurantoin (FM), amikacin (AK), colistin (CT), vancomycin (VAN), imipenem (IPM), erythromycin (E), and cefuroxime (CXM) (Padtan teb company, Iran). The National Committee for Clinical Laboratory Standards guideline was used to interpret the susceptibility [12].

Statistical Analysis

Spss software version 20 (BM Corp. Released 2011. IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp.) was used to analyze the data.

RESULTS

1090 patients were evaluated in this study from which 613 subjects were male and 477 were female. 186 subjects had positive blood culture from them 121 were male and 65 were female. The most frequent isolated species are as follow respectively: Coagulase positive *Staphylococcus* 68 (37%), *Escherichia coli* 47 (26%), *Pseudomonas aeruginosa* 25 (14%), *Streptococcus* Group D 22 (12%), Coagulase-negative *Staphylococcus* 13 (7%), *Streptococcus* group A 4 (2%), *Klebsiella* 2 (1%), and *Bacillus* 1 (1%). The frequency of isolated species are shown in Fig 1.

The sensitivity of species to antibiotics is demonstrated in Table 1. As shown coagulase positive *Staphylococcus* was mostly sensitive to the Vancomycin (20%). Escherichia coli was frequently susceptible to nitrofurantoin (15%), ciprofloxacin (14%), and amikacin (12%). Amikacin (23%) and nitrofurantoin (19%) were the most effective antibiotic for *Pseudomonas aeruginosa*. Vancomycin (16%) and imidazole (12%) were the most effective antimicrobials for *Streptococcus group* D and coagulase-Negative *Staphylococcus*, respectively. *Klebsiella* and *Bacillus* were mostly sensitive to nitrofurantoin and amikacin.

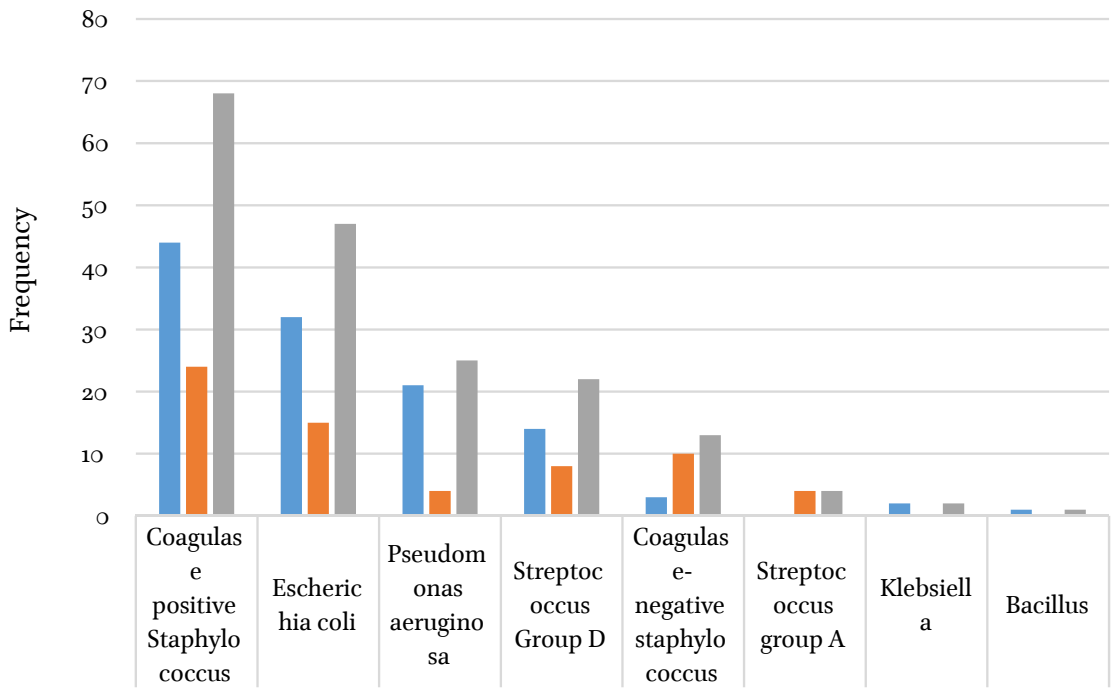

Figure 1: The Frequency of Isolated Species and its Frequency in Different Sexes

Table 1: The Antibiotic Susceptibility of the Isolated Species

Antibiotics	Species, No. (%)						
	Gram Positive				Gram Negative		
	Coagulase Positive *Staphylococcus*	*Streptococcus* Group D	Coagulase-Negative *Staphylococcus*	*Bacillus*	*Escherichia coli*	*Pseudomonas aeruginosa*	*Klebsiella*
OFX	4 (5)	5 (5)	23 (9)	0 (0)	16 (9)	3 (6)	0 (0)
AMP	0 (0)	6 (6)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
IMD	0 (0)	4 (4)	30 (12)	0 (0)	16 (9)	1 (2)	0 (0)
CRO	0 (0)	7 (7)	21 (8)	0 (0)	6 (3)	1 (2)	0 (0)
CIP	10 (12)	6 (6)	20 (8)	2 (20)	26 (14)	6 (13)	0 (0)
AMX	0 (0)	5 (5)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
CF	11 (13)	5 (5)	7 (3)	0 (0)	0 (0)	0 (0)	0 (0)
GM	0 (0)	3 (3)	14 (5)	0 (0)	4 (2)	1 (2)	0 (0)
CZ	0 (0)	2 (2)	10 (4)	0 (0)	3 (2)	0 (0)	0 (0)
CAZ	2 (2)	2 (2)	9 (4)	0 (0)	8 (4)	3 (6)	0 (0)
SXT	0 (0)	1 (1)	6 (2)	0 (0)	16 (9)	1 (2)	0 (0)
CTX	8 (9)	10 (10)	23 (9)	0 (0)	7 (4)	1 (2)	0 (0)
FM	0 (0)	0 (0)	2 (1)	4 (40)	28 (15)	9 (19)	2 (50)
AK	7 (8)	10 (10)	21 (8)	4 (40)	23 (12)	11 (23)	2 (50)
CT	9 (11)	7 (7)	18 (7)	0 (0)	15 (8)	3 (6)	0 (0)
VA	17 (20)	16 (16)	23 (9)	0 (0)	0 (0)	0 (0)	0 (0)
IPM	0 (0)	6 (6)	3 (1)	0 (0)	3 (2)	6 (13)	0 (0)
E	11 (13)	7 (7)	16 (6)	0 (0)	0 (0)	0 (0)	0 (0)
CXM	5 (6)	1 (1)	10 (5)	0 (0)	0 (0)	0 (0)	0 (0)
NA	1 (1)	0 (0)	0 (0)	0 (0)	15 (8)	2 (4)	0 (0)

OFX: ofloxacin; AMP: ampicillin; IMD: imidazole, CRO: ceftriaxone; CIP: ciprofloxacin; AMX; amoxicillin; CF: cephalothin; GM: gentamicin; CZ: Cefazolin; CAZ: ceftazidime; SXT: trimethoprim-sulphamethoxazole; CTX: cefotaxime; FM: nitrofurantoin; AK: amikacin; CT: colistin; VA: vancomycin; IPM: imipenem; E: erythromycin; NA: nalidixic acid, and CXM: cefuroxime.

DISCUSSION

The present study evaluate the frequency and antimicrobial susceptibility profiles of blood culture isolates from the hemodialysis patients of Hasheminejad Hospital. Since antibiotic resistance is one of the main issues that physicians face with it during the treatment of septicemia, having knowledge about the frequency of the isolated bacteria and their antibiotic susceptibility patterns in each area for initial antimicrobial therapy.

In current study the rate of isolation of bacteria from blood culture of patients with septicemia was 17.04% which was almost similar to the Dagnew et al. [13] and Nwadioha et al. [14] which they mentioned that the rate was 18.2%. Although in Obi et al. [15] and Aletayeb et al. [16] study the rate was dramatically higher (37.1) and lower (4.1%) than the present study. The diversity in the results could be due to different methods of the studies.

In this study gram positive bacteria were responsible for 58% of the infections and gram negative bacteria were responsible for 42% of infections. The result is consistent with some other studies which showed that most of the infections cause by gram positive bacteria such as Zenebe et al. which showed that the frequency of gram positive and negative bacteria were 60.9% and 39.1% [17]. Moreover, in study by Shitaye et al. the frequency were 62.6% and 37.4% respectively for gram positive and negative bacteria [18]. On the other in some other studies gram negative bacteria were mostly responsible for septicemia as demonstrated in Nwadioha and Meremo and their colleagues studies [14, 19].

In present study the most frequent isolated species were as follow respectively: Coagulase positive *Staphylococcus 37%, Escherichia coli 26%, Pseudomonas aeruginosa 14%, Streptococcus* Group D 12%, Coagulase-negative *Staphylococcus* 7%, *Streptococcus* group A 2%, *Klebsiella* 1%, and *Bacillus* 1%. The results revealed that the Coagulase positive *Staphylococcus* was the most gram positive bacteria and *Escherichia coli* was the main gram negative bacteria which cause infection. Many studies revealed that coagulase negative *Staphylococci* are the most prevalent septicemic cause with various rates ranging from 27.3-54.3% [13, 20, 21]. In Asghar study similar to the present study the most frequent isolated gram negative bacteria was *Escherichia coli* and after that *Pseudomonas aeruginosa* [22]. However. In some other studies Klebsiella and then *Escherichia coli* were the main gram negative bacteria [13, 17]. The probable explanation for the alteration could be the difference in blood culture method, geographical location, and epidemiological difference of the etiological agents.

In this study Coagulase positive *Staphylococcus* was mostly sensitive to the Vancomycin (20%). *Escherichia coli* was fre-

quently susceptible to nitrofurantoin (15%), ciprofloxacin (14%), and amikacin (12%). Amikacin (23%) and nitrofurantoin (19%) were the most effective antibiotic for Pseudomonas aeruginosa. Vancomycin (16%) and imidazole (12%) were the most effective antimicrobials for *Streptococcus* Group D and Coagulase-Negative *Staphylococcus*, respectively. *Klebsiella* and *Bacillus* were mostly sensitive to nitrofurantoin and amikacin. Therefore, according to the results gram negative bacteria were mostly sensitive to nitrofurantoin, amikacin, and ciprofloxacin. In addition, gram positive bacteria were mostly sensitive to vancomycin, amikacin, cefotaxime, ciprofloxacin, imidazole, colistin, erythromycin, and oflatoxin. In this study similar to some previous study ciprofloxacin was found to be effective against both Gram positive and Gram negative isolates [13, 17, 18]. In the study of Dagnew the susceptibility of the isolated organisms to the third generation cephalosporin was generally good [13].

The result of the current study determined the most prevalent bacteria that are responsible for septicemia in Tehran, Iran, and the most effective antimicrobials for treatment of septicemia in this area which could help physicians to select a proper antibiotics for initial antimicrobial therapy.

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CONFLICTS OF INTEREST

There is no conflict of interest for the present study.

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