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Evaluation of the Results Obtained from Microbiological Analysis of Blood Cultures over 5 Years

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Abstract: The infections caused by bacteria that reproduce in blood cultures are important medical problems that cause morbidity and mortality. The infections caused by resistant microorganisms are gradually increasing because of the patient's long stay in hospital, invasive procedures, and application of multi and parenteral antibiotic treatment. The microorganisms that reproduced in the blood cultures of patients in different cultures between 2010-2015 in Diyarbakır Selahaddin Eyyübi State Hospital and the resistance of these microorganisms to antibiotics were assessed retrospectively. In the study, a total of 196 patients' blood culture results were examined retrospectively. A total of 66.8% of the growth microorganisms (127) were composed of Gram positive cocci, 26.5% of them (52) were composed of Gram-negative bacilli and 6.7% of them (11) were composed of *Candida* spp. Among the reproduced microorganisms, coagulase negative staphylococci (CNS) were found to be 52.5% (103), *Staphylococcus aureus* to be 4.9% (9), *Acinetobacter* spp to be 7.3% (14), *Escherichia coli* to be 4.7% (9), *Klebsiella* spp to be 8.4% (16), *Candida* spp. to be 6.7% (11), *Pseudomonas* spp. to be 4.7% (9), *Enterococcus faecalis* to be 2% (4), *Micrococcus luteus* to be 2% (4), *Kocuria kristinae* to be 2.5% (5), *Rhizobium radiobacter* to be 0.5% (1), *Leuconostoc mesenteroides subsp. cremoris* to be 1% (1), *Sphingomonas paucimobilis* 0.5% (1), *Pantoea* spp. to be 0.5% (1), and *Stenotrophomonas maltophilia* to be 0.5% (1). The highest rate of resistance was found to be against meropenem, imipenem and ceftazidime in *Acinetobacter* spp with 80%, against ceftazidime in *Klebsiella* spp with 73.4%, against imipenem with 75%, against meropenem and ciprofloxacin with 62.5% in *Pseudomonas aeruginosa*, and against ceftriaxon, cefuroxime and cefuroxime axetil in *Escherichia coli* with 60%. Penicillin with 100% and tetracycline with 33.3% in *S. aureus*; penicillin with 97.6% and erythromycin with 82.1% were the antibiotics to which the highest resistance developed. While no resistance was determined against fusidic acid, trimethoprim sulfamethoxazole, linezolid, vancomycin, teicoplanin, and tigecycline in *S. aureus*, the resistance was not determined only against tigecycline and vancomycin in CNS. Fifty seven % of *S. aureus* strains and 83.8% of CNS strains were found to be resistant to methicillin. In our study, it is aimed to determine the mostly reproduced bacteria in blood samples as the result of blood circulation infections of patients staying in different clinics and to research their resistance profiles that developed against antibiotics retrospectively.

Keywords: Blood Cultures, Antibiotic Sensitivity, *S. aureus*, Coagulase Negative Staphylococcus

1. Introduction

The infections caused by the bacteria that develop in blood cultures appear as a problem of public health that gives rise to morbidity and mortality. Susceptibility to the infections caused by resistant microorganisms is increasingly rising because of the long stay of the patients admitted to the hospital, intense invasive procedures, and application of multi and parenteral antibiotic treatment. The diversity of microorganisms and the increase in their rates of resistance cause problems in treatment and these infections progress

with high mortality [1].

The infections caused by Gram negative bacteria are mostly opportunistic and are related to invasive procedures, mechanical ventilation, burn and surgical operations [2]. *Pseudomonas aeruginosa* bacteremia is an important cause fo hospital infections with high morbidity and mortality [3]. Candidemia, one of the invasive infections, is a severe clinical picture whose diagnosis and treatment are hard and which have rather high mortality. In our study, it is aimed to determine the mostly reproduced bacteria in blood samples as the result of blood circulation infections of patients staying in different clinics and to research their resistance profiles that developed against antibiotics retrospectively.

2. Material and Methods

The microorganisms reproduced from blood cultures of patients in different clinics between 01/01/2010 and 01/01/2015 in our hospital and their resistance situations to various antibiotics were researched and assessed retrospectively. Blood culture samples, having completed 7-day incubation period and giving " negative warning", from blood culture bottles followed with blood culture BACTEC 9050 (Becton Dickinson, USA) automatized blood culture system were assessed in terms of fake negativity by passaging to blood agar, and culture result was accepted to be negative. Those giving "positive warning" by the automatized system among the blood culture bottles were applied Gram strain and kept for 24 hours at 37ºC by passaging to 5% blood agar, Eosine Methilene Blue Agar (EMB), chocolate agar, Sabouraud Dextrose Agar (SDA) media. Of the reproduced colonies, the identification and antibiotic susceptibility of microorganisms were determined by using VITEC version 2.0 (Biomerieux, France) system. Manual methods were utilized when needed.

3. Results

One of the samples reproducing the same bacterium taken from the right and the left arm of the same person and the samples contaminated by skin flora were excluded from the study; 169 isolates all belonging to different patients being included in the study. Sixty seven% of reproducing microorganisms (127) were composed of Gram positive coccus, 26.5% of them (52) of Gram negative bacilli and 6.7% of them (11) of *Candida* spp. Among the reproducing microorganisms, Coagulase Negative *Staphylococcus* (CNS) were found to be 52.5% (103), *S. aureus* to be 4.6% (9), *Acinetobacter* spp to be 7.3% (14), *Escherichia coli* to be 4.7% (9), *Klebsiella spp* to be 8.4% (16), *Candida spp.* to be 6.7% (11), *Pseudomonas spp* 4.7% (9), *Kocuria kristinae* to be 2.5% (5), *Enterococcus faecalis* to be 2% (4), *Micrococcus luteus* 2% (4), *Rhizobium radiobacter* to be 0.5% (1), *Leuconostoc mesenteroides* subsp. cremoris 1% (1), *Sphingomonas paucimobilis* to be 0.5% (1), *Pantoea spp* to be 0.5% (1), *Stenotrophomonas maltophilia* to be 0.5% (1) (Table 1).

Table 1. *Distribution of growth bacteria from blood cultures between 2010-2015.*

		n	(%)	n	%
Candida	*albicans*	12	6.7%	7	63.6
	parapsilosis			2	18.1
	tropicalis			1	9
Pseudomonas aeruginosa		9	4.7%		
Staphylococcus	*aureus*	117	58.9%	9	8
	capitis			8	7.1
	epidermidis			45	40
	haemolyticus			12	10.7
	equorum			1	0.9
	hominis			35	31.2
	saprophyticus			2	1.7
	scuri			1	0.9
	warnerii			4	3.5
Klebsiella pneumoniae		16	8.4%		
Acinetobacter	*baumannii*	14	7.3%	12	85.7
	iwoffii			2	14.2
Escherichia coli		9	4.7%		
Enterococcus faecalis		4	2%		
Micrococcus luteus		4	2%		
Kocuria kristinae		5	2.5%		
Rhizobium radiobacter		1	0.5%		
Leucostonococcus mesent cremoris		2	1%		
Sphingomonas paucimobilis		1	0.5%		
Pantoea spp		1	0.5%		
Stenotrophomonas maltophilia		1	0.5%		
Total		**190**			

In staphylococcus, *S. aureus* was found to be 8% (9), *S. epidermidis* to b 40% (45), *S. hominis* to b 31.2% (35), S. *haemolyticus* to be 10.7% (12), *S. equorum* to be 0.9% (1), S. *saprophyticus* to be 1.7% (2), *S. scuri* to be 0.9% (1), *S. warnerii* to be 3.5% (4), *S. capitis* to be 7.1% (8); in *Acinetobacter spp, A baumannii* was found to be 85.7% (12), *A. iwoffii* to be 14.2% (2); in *Candida spp*, *C. albicans* was found to be 63.6% (7), *C. parapsilosis* to be 18.1% (2), *C. tropicalis* to be 9% (1) (Table 1). When the resistance profiles to antibiotics were examined, it was found that in staphylococcus, *S. aureus* was resistant to penicillin with 100% and to tetracycline with 33.3%, CNS was resistant to penicillin with 97.6%, and to erythromycin with 82.1%, *S. aureus* strains were resistant to methicillin with 57.1% and CNS strains were resistant to methicillin with 83.8% (Table 2). All strains were found to be resistant to vancomycin. Resistance rates in *S. aureus* were found to be 33.3% for tetracyclin, 28.5% for rifampicin, 16.6% for erythromycin, ciprofloxacin, gentamicin, imipenem and clarithromycin, 14.2 % for moxifloxacin, 57.1% for oxacillin, 14.2% for fosfomycin, 100% for penicillin. In *S. aureus* isolates, resistance to fusidic acid, trimethoprim/sulphametoxazole, linezolid, vancomycin, teicoplanin and tigecyclin was not detected (Table 2). In CNSs, tetracycline was found to be resistant by 61.7 %, rifampin by 51.2%, erythromycin by 82.1%, ciprofloxacin by 43.1%, gentamicin by 12.2%, imipenem by %24.5, clindamycin by % 18.8, moxifloxacin by 39.5%, fosfomycin by 65.6%, penicillin, by 97.6%, fusidic acid by 41.6%, linezolid by 8.4%, teicoplanin by 3.1%, trimethoprim/sulfamethoxazole by 22.4 % (Table 3). In CNS isolates, resistance to tigecycline and vancomycin

was not found out.

Table 2. *Antibiotic sensitivity rates of Staphylococcus aureus in blood culture between 2010-1015.*

	Sensitivity %
Ciprofloxacin	83.3
Gentamicin	83.3
Erytromicin	83.3
Imipenem	83.3
Moxifloxacin	85.7
Trimethoprim/sulfamethoxazole	100
Linezolid	100
Oxacillin	42.8
Fosfomicin	85.7
Tetracyclin	66.6
Fusidic acid	100
Rifampin	71.4
Penicillin	0
Tigecycline	100
Teicoplanin	100
Vancomycin	100
Clindamycin	83.3

For *Pseudomonas aeruginosa*, resistance rates were found to be 100% for amoxicillin/clavulanic acid and trimethoprim/sulphamethoxazole, 62,5% for ciprofloxacin, 75% for imipenem, 12.5% for meropenem, gentamicin, ceftazidime, 25% for piperacillin/tazobactam, 20% for cefepime; in *P. aeruginosa*, resistance to amikacin was not detected (Table 4).

Table 3. *Antibiotic sensitivity rates of Coagulase Negative Staphylococcus in blood culture between 2010-1015.*

	Coagulase Negative *Staphylococcus*		
	S %	Intermediate %	R %
Ciprofloxacin	49	7.8	43.1
Gentamicin	77.1	10.5	12.2
Erytromicin	17.8		82.1
Imipenem	24.5		75.4
Moxifloxacin	60.4		39.5
Trimethoprim/sulfamethoxazole	77.5		22.4
Linezolid	91.5		8.3
Oksacillin	16.1		83.8
Tetracycline	38.2		61.7
Fusidic acid	34.3	23.9	41.6
Rifampin	41.2	7.5	51.2
Penicillin	2.3		97.6
Tigecycline	100		
Teicoplanin	88.9		11.1
Vancomycin	100		
Clindamycin	78.2	2.8	18.8

In *Acinetobacter spp,* 80% resistance developed against meropenem, imipenem, ceftazidime, 72.7% against cefoperazon, 60% against gentamicin, 50% against ampicillin /sulbactam, 25% against levofloxacin and 18.1% against ciprofloxacin (Table 4).

Table 4. *Resistance rates of isolated Gram negative microorganisms to antimicrobials [(%)].*

	Amoxicillin/clavulanic acid	Ampicillin /sulbactam	Ciprofloxacin	Gentamicin	Meropenem	Ertapenem	Imipenem	Piperacillin/tazobactam	Trimethoprim/sulfamethoxazole	Cefixime	Ceftriaxone	Ceftazidime	Cefuroxime	Cefuroxime axetil	Cefoxitin	Cefepime	Levofloxacin	Cefoperazon/sulbactam	Amikacin	Ampicillin
E. coli	40	75	55,5	33,3	33,3		44.4	33,3	44,4		60	55,5	60	60	33,3	20	-	33.3	-	-
Acinetobacter spp	-	50	81.7	70	90	-	80	-	-	-	-	90	-	-	-		50	81.8	-	-
Klebsiella pneumoniae	58.3		87.5	13,3	7,1	0	7,1	53.3	66,6	100	93.3	73,3	91.6	91,6	41.6	-	75	14.2	*	100
Pseudomonas aeroginosa	100		62,5	12,5	62.5	-	75	25	100	-	-	12,5	0	0	0	20	-	-	0	-

For *Escherichia coli*, it was observed that ceftriaxon, cefuroxime axetil and cefuroxime developed resistance by 60%, ceftazidime and ciprofloxacin by 55.5%, amoxicillin/ acid and cefepim by 20%, trimethoprim/sulphamethoxazole by 44.4%, ampicillin/sulbactam by 25%, cefoxitin, cefoperazon/sulbactam, piperacillin/tazobactam, meropenem, gentamicin and imipenem by 33.3% (Table 4).

In *Klebsiella pneumoniae*, resistance was determined to be 91.6% to cefixim, cefuroxime axetil, cefuroxime, to be 73.3% to ceftazidime, 75% to ciprofloxacin, levofloxacin, 66.6% to trimethoprim/sulfamethoxazole, 63.6% to nitrofurantoine, 33.3% to cefoxitin, 13.3% to gentamicin, tazobactam/piperacillin, 8.3% to amoxicillin/clavulanic acid, 7.7% to ceftriaxon, 7.1% to meropenem, imipenem. In *Klebsiella spp*, resistance to ertapenem was not found (Table 4).

When the highest resistance rates of microorganisms to antibiotics were examined, it was observed that in *Acinetobacter* spp, 80% resistance was to meropenem, imipenem and ceftazidime; in *Staphylococcus*, *S. aureus*, 100% to penicillin, in CNS 97.6% to penicilline and 82.1% to erithtomycin, in *Klebsiella* spp 100% to cefixim, 91.6% cefuroxim axetil and cefuroxime, in *P. aeruginosa* 100% to amoxicillin/clavulanic acid and trimethoprim /sulphamethoxazole, 75% to imipenem. In *E. coli* the highest

resistance was to ceftariaxon, cefuroxime and cefuroxime axetil by 60%, which is followed by ceftazidime by 55.5%.

4. Discussions

Bacteremia and sepsis are clinical pictures with high morbidity and mortality that must be early diagnosed and treated [4]. According to the USA data, the rate of hospital stay due to bacteremia and sepsis has risen from 326000 up to 727000 in the last 10 years [5]. Blood circulation infections may cause several clinical pictures such as sepsis that threatens life with self-limiting infection, multiple organ failure, disseminated intravascular coagulopathy. Thus, it needs rapid and aggressive antimicrobial treatment [6]. Blood culture is commonly used for microorganisms that cause sepsis and bacteremia to be isolated and identified. Blood culture results are of great importance in revealing the infection factors, in directing to the accurate treatment by performing antibiotic susceptibility tests, and in reducing mortality. These microorganisms reproduced in blood cultures have a broad distribution. Although this is generally caused by Gram positive cocci and Gram negative bacilli, yeasts especially *Candida* species cause it effectively. Considering the studies on the issue; when Karakoç et al. examined blood culture results of 1 year, they isolated 67.4 % Gram positive cocci, 15.6% Enterobacteriaceae, 3.6% yeasts, and 3.4% nonfermantative Gram negative bacteria. [7]. Yuce et al. found 59.3% Gram negative bacteria, 28.1% Gram positive bacteria, 12.5% *Candida* spp [8], Çopur et al. found 80% Gram positive, 17% Gram negative and 3% *Candida* spp. [9]. In Kayseri, 64% Gram positive cocci, 19% Gram negative bacilli, and 8% *Candida* spp. was found [10], and Kuvat et al, in their study, stated that 48.5% of the microorganisms reproducing in blood cultures was composed of Gram positive, 47.5% of them was composed of Gram negative and 4% of them was composed of *Candida* spp. [11].

In a two-year study in Düzce, 64.4% Gram positive, 35.6% Gram negative bacteria were reproduced [12]. In a study carried out in Ankara, 337 were stated to be Gram positive, 78 to be Enterobacteriaceae and 18 to be *Candida* spp. [11]. Duman et al, in a study in which they assessed blood culture reproductions of on year, stated that th rate of Gram positive bacteria was 68.5%, the rate of Gram negative ones was 31.5% [13].

In a study made in İzmir, 27.82% of bacteria having reproduced was Gram negative, 71.12% of them was Gram positive bacteria and 1.06% of them was *C. albicans* [14]. In another study made in İzmir again, 59% Gram negative, 37.1% Gram positive bacteria and 3.9% fungi were determined [15]. The fact that bacteria profiles were found to be different in the same region from different hospitals made us think that one of the studies was based on the reproductions in blood cultures taken from intensive care unit patients. Considering the microorganisms reproducing in blood cultures abroad, Wasihun et al. determined that Gram positive was 68%, Gram negative was 22.9% in one year period [16], Nwadioha et al. determined that 69.3% of patients with sepsis were Gram negative, and 30.7% of them were Gram positive [17].

In our study, 59.75 of microorganisms reproducing in blood culture were composed of Gram positive cocci, 26.5% of them were composed of Gram negative bacilli, and 6.7% of them were composed of *Candida spp*. When we looked at the studies on the issue, our study was observed to comply with the results from many parts of our country and from some centers abroad although Gram negative and Gram positive bacteria distributions had different percentages depending on regions.

In another study made in İzmir, among the factors isolated from the cultures with reproduction, *A. baumannii* was at the first rank with 21.5%, *Enterococcus* spp. being found to be 17.4%, *S. aureus* to be 12.1%, *P. aeruginosa* to be 1.2%, *K. pneumoniae* to be 8.8%, CNS to be 8.4% and *E. coli* to be 7% [15]. In Kayseri, CNS was found to be 54%, *S. aureus* and *Acinetobacter* to be %, *E.coli* to be 5% [10]. At the first rank among the microorganisms isolated in blood cultures by Er et al. there is *S. aureus* with 38.3%, followed by CNS with 18.2%, *E. coli* with 12.1%, *Enterococcus* spp. with 7.3%, *K. pneumoniae* with 7.1%, *A. baumannii* with 4.8%, *P. aeruginosa* with 4.1% and *Candida* spp with 3.3% [18]. The study of Kuvat et al. had a distribution of CNS with 34.8%, *Klebsiella* spp with 12.8%, *E. coli* with 2.6%, *S. aureus* with 3%, *Candida* spp with 3.7%, *Pseudomonas* spp with 11.5%, *Acinetobacter* spp. 9.6%, *Enterococcus* spp. with 7.3% [11].

In a study made in Düzce, 52.4% of Gram positive bacteria were identified to be CNS and 37.8% of them to be *S. aureus* and 7.4% of them to be *Enterococcus;* 36.9% of Gram negative bacteria were identified to be *E. coli*, 17.1% of them to be *Klebsiella* spp., 17.1% of them to be *P. aeruginosa*, 14.4% of them to be *Enterobacter* spp., 2.7% of them to be *Acinetobacter* spp. and 2.7% of them to be *Stenotrophomonas maltophilia* [12]. In the study of Yüce et al, *S. aureus* was at the first rank with 13.9%, followed by Candida spp. with 12.5 % and *E.coli* with11.3% [8]. Willke determined in the studies that CNS and *E.coli* were the most frequently reproducing bacteria in blood cultures with 48% and 7%, respectively [19].

Khorshed determined that in CNS isolates, 48.7% were *S. hominis*, 17.3% were *S. haemolyticus*, 3.3% were *S. saprophyticus*, 3.3% were *S. simulans*, 2.1% were *S. warneri,* 2.1% were *S. chromogenes*, 1.3% were *S. eguorum*, 1.3% were *S. capitis* and 0.7% were *S. cohnii* [24]. We, in our study, isolated *S. aureus* by 8%, S. capitis by 7.1%, *S. epidermidis* by 40%, *S. haemolyticus* by 10.7%, *S. equorum* by 0.9%, *S. hominis* 31.2%, *S. saprophyticus* by 1.7%, *S. scuri* by 0.9% and S. *warnerii* by 3.5% in *Staphylococcus*.

Nwadioha et al. found that the most isolated bacteria were *E. coli* and *S. aureus* with 44.3% and 30.7%, respectively [17]. Çopur et al. identified Gram negative bacteria as *E. coli* with 26 %, *Klebsiella spp* with 21.7%, *Pseudomonas spp* with 21.7%, *Acinetobacter spp* with 30.4%, and identified Gram positive bacteria as coagulase negative staphylococcus with 87%, *S. aureus* with .7%, and *Enterococcus spp* with

9.3% [9]. In another similar study made in Northern Ethiopia, it was found out that the distribution of bacteria reproducing in blood culture were *S aureus* with 37.5%, CNS with 30.6 %, *E.coli* with 3.1% [16].

In our retrospective study, among the reproducing microorgansims, Gram positives were found to be CNS (103) %52.5, *S. aureus* (9) %4.6, *K. kristinae* spp. (5) %2.5, *E. faecalis* (4) %2, *M. luteus* (4) %2, *L. mesenteroides* subsp. cremoris (1)%1; Gram negatives were found to be *Klebsiella* spp (16) %8.4, *Acinetobacter* (14) % 7.3, *E. coli* (9) %4.7, *Pseudomonas* spp. (9) %4.7, *R. radiobacter*(1) %0.5, *S. paucimobilis* (1) %0.5, *Pantoea* spp (1)%0.5, *S. maltophilia* (1) %0.5. *Candida* spp. (11) was detected by 6.7%, *C. albicans* (7) by 63.6%, *C. parapsilosis* (2) by 18.1% and *C. tropicalis* (1) by 9%. Distribution of species is shown in Table 1.

In the studies domestically, methicillin resistance was found in CNS by 56%, 70.2%, 42%, 91%, 75%, 79%, respectively [8,9,12,14,19,20], and in *S. aureus* strains by 69%, 50%, 25 %, 34%, respectively [8,9,19,20]. In the studies abroad, methicilline resistance was found in all *S. aureus* by 62.5%, 27% and 36% [16, 21, 22]. In our study, 57.1% of *S. aureus* strains and 83.8% of CNS strains were found to be resistant to methicillin.

Considering the resistance to vancomycin, Mootsikapun et al. detected vancomycin resistance by 0.1-0.8% among MRSA isolates [21]. In a study made in Northern Ethiopia, all of the staphylococcus strains were found to be resistant to glycopeptides [16], but in the domestic studies vancomycin and teicoplanin resistance was not found in *Staphylococcus* strains [8, 9]. All strains by Dokutan et al. were susceptible to vancomycin and teicoplanin, and 2.4% linezolid resistance was found [20]. Yılmaz et al. and Wasihun et al. did not report vancomycin resistance in *Staphylococcus* strains, and Khorsed et al, on the other hand, did not report vancomycin resistance in all CNS s isolated other than *S. xylosus* [16, 23, 24]. In a study made in Kocaeli, teicoplanin resistance developed by 0.2% in CNS but was not encountered in *S. aureus*, vancomycin resistance was not found in CNS and *S. aureus* [19]. In our study, glycopeptide resistance was not seen among *S. aureus*.

In CNS, tetracyclin was found to be resistant by 61.7%, rifampin by 51.2%, erithromycin by 82.1%, ciprofloxacin by 43.1%, gentamicin by 12.2%, imipenem by 24.5%, clindamycin by 18.8%, moxifloxacin by 39.5%, fosfomycin by 65.6%, penicillin by 97.6%, fusidic acid by 41.6%, clindamycin by 21.6%, linezolid by 8.4%, teicoplanin by 11.1%, trimethoprim/sulfamethoxazole by 22.4%. In CNSs vancomycin and tigecycline resistance was not found but teicoplanin and linezolid resistance was observed. The resistance rates in *Staphylococcus* were found to be 33.3% for tetracycline, 28.5% for rifampicin, 16.6% for erythromycin, ciprofloxacin, gentamicin, imipenem, and clindamycin, 14.2% for moxifloxacin, 14.2% for fosfomycin, 100% for penicillin. In *S. aureus* isolate, resistance to fusidic acid, trimethoprim/sulfamethoxazole, linezolid, vancomycin, teicoplanin, and tigecyclin was not detected.

Yılmaz et al. in Izmir, found the resistance in *S. aureus* with and without hospital infection by 100-71% in penicillin, 92-26% in erythromycin, 93-23% in clindamycin and levofloxacin, 33-16% in trimetoprim/sulphametoxazole, 67-13% in fusidic acid, and the resistance in CNS by 100-83% in penicillin, 92-63% in erythromycin, 83-51% clindamycin, 83-40% in levofloxacin, 42-28% trimetroprim sulphametoxasol, 58-27% in fusidic acid [23].

16 of 35 CNS strains isolated in another study made in 2010 in Portugal were found to be resistant to trimoxazole, 25 of them to ciprofloxacin, 19 of them to clindamycin [25]. Yet, in our study, resistance to fusidic acid, trimethoprim/sulphamethoxazole was not found for *S.aureus.* To other antibiotics, the same rate or more susceptibility was observed for CNS and *S.aureus*.

Köksal et al. found amoxicillin/clavulanic acid resistance to be 72% and 32% in *Enterobacter- Klebsiella* group and *E. coli*, Yüce et al. found it to be 64% in *Klebsiella* spp*.,* 46% in *E. coli* [8, 26]. In our study, amoxicillin/clavulanic acid resistance was found to be 58.3% in *Klebsiella* spp., 40% in *E. coli.*

Ceftriaxon resistance was reported to be 38 % in *E. coli*, 84% in *Pseudomonas* spp. [27] and it was detected to be 73 % in *Acinerobacter* spp. 46% in *Pseudomonas* spp [8]. In our study, ceftriaxon resistance was found to be 93.3% in *Klebsiella* spp and 60% in *E.coli.*

Resistance to meropenem did not develop in *E. coli* strains produced by Fındık et al. and Köksal et al. while Yüce et al found the resistance to meropenem by 2% [8, 26, 27]. Bektöre et al. did not find *E. coli* resistant to carbapenem but detected 16 *K. pneumoniae* resistant to carbapenem [28]. In a study in İzmir, resistance to karbapanem was not found in *Enterobacteriaceae* members [14]. Carbapenem resistance was not seen in *E. coli* and *Klebsiella* spp strains reproducing in blood cultures, while resistance was detected in non-fermentative bacteria [23]. In our study, 4 *E. coli* were found to be resistant to imipenem and 3 to mereponem.

The resistance to meropenem in *Pseudomonas* spp was reported in the performed studies to be 12%, 25%, 24%, 38.8% [8, 14, 27, 28]. In *P. aeruginosa* without hospital infection factor, resistance to meropenem was not seen, while resistance to imipenem was detected in one out of eight strains. Imipenem resistance was found in two out of five *P. aeruginosa* with nosocomial bacteremia factor, and meropenem resistance was found in three of them [23]. In our study, six out of eight *Pseudomonas* strains were found to be resistant to imipenem and six to meropenem.

In *A. baumanni* isolates, carbapenem resistance was found to be 66.7%, 85.75% in the involved studies [14, 28]. Yüce et al. reported 2% imipenem resistance and Çopur et al. reported 85.7% [8,9]. Imipenem was found to be 56-74% and meropenem to be 50-71% in Kocaeli [19]. Al-Dorzi et al., in a six-year study, reported that bacteremia related to *Acinetobacter* spp are associated with strains resistant to multiple drugs [29]. In another study, almost half of *A. baumannii* strains were found to be resistant to carbapenems [23]. In our study, we found the resistance to carbapenem in

Acinetobacter spp as 80% compatible with the studies.

Although in carbapenem resistance in *Klebsiella* isolates, Uzun et al. found imipenem as effective in all *E. coli* applied susceptibility tests and in *K. pneumoniae* not reproducing extended-spectrum beta lactamase (ESBL), they found resistance by 18% in *K. pneumoniae* strains reproducing ESBL [30]. Imipenem resistance in *K. pneumoniae* was found to be 1.3% [31]. When taken a look at carbapenem resistance in our study, it was found to be 7.1% in *Klebsiella* spp.

In Turkey data of Compact study, doripenem and meropenem show similar activities against *Enterobacteriaceae*, while imipenem was found to be four times as less active as them [31]. The most frequently isolated *E. coli* of Gram negative bacteria was found to be the most susceptible antimicrobial imipenem in *Klebsiella* spp. and *Pseudomonas* spp. [9].

Also, there are studies in which high resistance rates were followed as 72.6% in *E. coli* and 82.2% in *K. pneumoniae* for ciprofloxacin; besides a report for resistance was seen by 19% in a study [27] and 18% in another study in *E. coli* strains [26]. In *Acinetobacter* spp., 20% [8] and 81% [30] ciprofloxacin resistance was reported. In our study high rate of resistance to ciprofloxacin was found by 55.5% in *E. coli*, 81.7% in *Acinetobacter* spp and 82.5% in *Klebsiella* spp.

Ceftazidime resistance in *Pseudomonas* spp. in a study made in Elazığ was found to be 34% [8]; ceftazidime resistance ranging in 15-63% in *Pseudomonas spp*. was determined in the studies made in our country, while this rate was reported to be much higher in intensive care patients [8]. In our study we detected ceftazidime resistance 12.5%. Resistance was reported to be by 2% for amikacin, 5% for piperacillin/tazobactam and 15% for ciprofloxacin in *Pseudomonas* spp. [8], by 28% [32], by 36% [33] and by 79.5% for ciprofloxacin [4]. In our study, no strains resistance to amikacin was found, while the resistance was obtained to be 25% to piperacillin/tazobactam, 62.5% to ciprofloxacin.

The incidence of ESBL was found to be 88.9% for *E. coli*, 56.2% for *K. pneumoniae* in our study. In the studies made in our country, ESBL positivity was detected to be 45.7% in *E. coli*, 67.8% in *K. pneumoniae* [28], 66.7% in *E. coli,* 74% in *K. pneumoniae* [14], 32% in *E. coli* strains and 38% in *K. pneumoniae* strains [30]. ESBL positivity by 47.3% was detected in *K. pneumoniae* isolated from blood cultures in a multi-centered widespread study [25].

In a study made abroad, it was stated that there was an increase in the infections caused by ESBL positive *E. coli* [35]. ESBL rates were found to be 43% and 45% in *E. coli* and *Klebsiella* strains without hospital infection factor, these rates were found to be 56% and 63%, respectively in nosocomial bacteremia. ESBL reproduction of bacteria in hospital originated infections is a severe problem and ESBL reproduction in society originated infections as well is increasing day by day [36].

Candidemia, one of the invasive infections, is a severe clinic picture which is diagnosed and treated difficultly and which has a quite high mortality. An increase is observed in the incidence of Candida infections in parallel to the developments in diagnosis and treatment field through the increase in the number of patients receiving immunosuppressive treatment, in the usage of big surgical operations and broad spectrum antibiotics and in the patients whose general circumstances are disordered followed in intensive care units [37].

There are studies reporting that although the most common factor is *C.albicans* in Candidemia, the incidence of the species apart from *C. albicans* is gradually increasing. Gültekin et al., reproduced *Candida* in 0.48% [38] of 24709 blood cultures; *C. albicans* were detected to be by 23%, *C. parapsilosis* to be 10%, *C. tropicalis* to be 14%. In a study made in Adana, *C. parapsilosis* by 33.9%, *C. albicans* by 27.5%, *C. tropicalis* by 16% were isolated [37], and in Kocaeli *C. albicans* by 50%, *C. tropicalis* by 10.8%, *C. propsilosis* by 21.7% were isolated [39]. In our study, *Candida* by 6% was reproduced ranging as 53.6% *C. albicans*, 18.1% *C. parapsilosis*, 9% *C. tropicalis*. Antifungal susceptibility of *candida* spp was not considered in this study. Other microorganisms reproducing in blood cultures are not scrutinized because of the insufficiency of their number.

5. Conclusion

Bacterial infections are frequently encountered problems in ICUs. Patients' having weak immune system and chronic disease, and the frequency of catheterization facilitates infection development. The diversity and antibiotic susceptibility of the bacteria isolated in blood cultures can differ according to geographical regions, hospital flora, antibiotics used in hospital and the profiles of the patients staying in hospitals. Therefore, each hospital should document the bacteria distribution and antibiotic susceptibility from time to time and establish treatment protocols according to these results. We are of the opinion that these results will guide especially in empirical treatment protocols of the clinician.

Conflict of Interest

The authors have declared that there is no conflict of interest and ethical adherence in this work.

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