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ANALYSİNG OF BLOOD CULTURE RESULTS İN A MİCROBİOLOGY LABORATORY OF TRAİNİNG AND RESEARCH HOSPİTAL İN TERMS OF İDENTİFİCATİON AND ANTİBİOTİC SUSCEPTİBİLİTY

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ABSTRACT

Background: Blood culture is the gold standard for identifying the causative agent and selecting appropriate antimicrobial therapy in patients with sepsis. It was aimed to isolate the causative agent and analyze antibiotic susceptibility reports by using the automatic culture antibiogram system in blood samples sent to our laboratory between 2014-2018.**Methods:** Blood culture bottles containing blood samples from a total of 3,153 patients from different clinics were incubated in the incubator for at least five days. With a positive signal, they were inoculated into appropriate media and kept in an incubator at 37 ºC for 24-72 hours. Identification and antibiotic susceptibility tests were performed on the isolates using an automated system. Patient results were reported approximately 8-12 hours later.**Results:** Of the 3,153 patients studied, 48% were female and 52% were male; 78% were adults and 22% belonged to the under-eighteen age group. It was observed that 84% of the isolates were gram positive and 16% gram negative, and 75% of gram positive bacteria were *coagulase negative Staphylococci* and 42% of gram negative bacteria were *Escherichiae coli*. In antibiotic susceptibility, 58% of the isolates were found to be susceptible, 2% to intermediate, and 40% to be resistant (for gram negatives it was 51%, 4%, and 45%, respectively). The highest susceptibility rates were found for vancomycin, linezolid, and teicoplanin (99%, 98%, and 96%, respectively) in gram-positive isolates. In Gram-negative isolates, the highest rates were found in colistin, amikacin, imipenem and meropenem (87%, 80%, 78% and 78%, respectively). **Conclusions:** Small increases in the bacteria's resistance profiles indicated that it became more important to wait for antibiotic sensitivity results.

KEYWORDS: Blood culture, septicemia, blood stream pathogens, antibiotic susceptibility tests, antibiotic resistance.

INTRODUCTION

Blood culture is the most important diagnostic method used in the identification of life-threatening bloodstream system infections and in the selection of appropriate antimicrobial therapy, and it is the gold standard for accurate identification of these infectious agents. Blood culture test has been used in many parts of the world for many years. Treatment of a patient suffering from bloodstream system infection can be very costly. However, due to the importance of identifying the causative agent, it has become a test used with increasing frequency. Despite the development of technology, diagnosis and treatment techniques are developing day by day, blood cultures continue to be the most reliable method in the detection of septicemia today. Blood culture is a vitally important test that provides diagnosis in cases such as endocarditis, pneumonia, fever of unknown origin and suspected sepsis. For this reason, blood culture is a very useful method in the identification of an invasive infection characterized by fever in pediatric or adult healthcare settings using the peripheral intravenous route.[1-5] However, when taking a blood sample for culture, necessary precautions should be taken to prevent contamination of the normal flora that may be transmitted through the skin. Thus, the chance of producing pathogens will increase. However, all over the world, circulatory system infections continue to be the leading causes of morbidity and mortality despite antimicrobial and other supportive treatments. In addition, since the early diagnosis and appropriate treatment of these infections is clinically very important, blood cultures play an important role in identifying the microbial etiologic agent and guiding the treatment in cases of suspected infection.[6-10] Invasion of the circulating blood in our body by microorganisms can create one of the most serious conditions in terms of

infectious diseases. This can result in microorganisms continuing to growe in our blood, posing a major threat to almost every organ in our body. The prevalence and antimicrobial susceptibility of the infecting microorganism may vary depending on the geographical location of the relevant country and the prevalence of antibiotic use there. Depending on the prevalence of these microorganisms, serious consequences such as respiratory failure, shock, disseminated intravascular coagulation, organ failure and even death may occur. As a result, the increase in the length of hospital stay of the patients and the associated increase in costs are the most undesirable results.[9-13] The treatment of infections in the circulatory system is generally based on known information about the microorganisms causing this disease and their antimicrobial susceptibility studies. Studies on this subject show that it can shorten the time from blood collection to the reporting of the culture result to a short time, approximately 24 hours. Thus, this information also provides a supportive basis for making recommendations for initial empirical treatment when a circulatory system infection is suspected.[10-15] Specific treatment to be applied to patients can only be started after the causative organism is isolated and the antimicrobial susceptibility test result is analyzed. However, blood culture procedures are time-consuming and, moreover, dependent on the growth of the causative organism in the culture medium. However, thanks to the studies showing that these processes can be done more quickly, and with the development of automatic culture techniques, methods that can conclude blood culture tests more quickly are also being developed. Fortunately, recently developed automated blood culture incubation systems have a high ability to detect the growth status of the causative agent.[13,16-21] In our study, the microorganisms in the blood culture bottles sent to the culture laboratory of our hospital were incubated with the help of an automated blood culture system, and it was aimed to isolate the agent and analyze the culture antibiogram results by removing the samples with positive signals from the incubator.

MATERIALS AND METHODS

1. **Sample population:** Blood culture bottles containing blood samples from a total of 3,153 patients sent from different clinics to the Microbiology Laboratory of the Training and Research Hospital between January 2014 and December 2018 were included in the study. This study was carried out with the approval of the Ethics Committee of Adiyaman University, numbered 2019 / 3-10.
2. **Processing of samples:** Blood culture bottles (Plus aerobic, Plus anaerobic, Peds Plus, BD, USA) containing 5-10 ml (approximately 0,5 ml in children) blood samples of the patients, sent from various clinics, were accepted by the microbiology culture laboratory staff. received. Collected blood culture bottles were incubated in a blood culture incubator (Bactec Fx, BD, USA) for five days. During the incubation period, the blood culture bottles in the incubator were constantly monitored on the monitor and the positive bottle was removed from the device with the positive signal indicating growth. Then, with help of a special needle (BD Vacotainer, BD, USA) with both ends, 1-2 drops from the bottle with a positive signal, 5% sheep blood agar (SBA), eosin methylene blue (EMB) agar and chocolate agar (CA) media (SBA, EMB, CA, BD, USA) were dripped and inoculated. The media, whose inoculation process was completed, were incubated at 37 ºC for 24-72 hours in a bacteriological incubator (EN-120, Nüve, Turkey). If the positive signal was obtained for an anaerobic bottle, inoculation was performed quickly after the appropriate anaerobic environment was prepared and the media were placed in the anaerobic system (BD GasPak EZ, BD Anaerobe Container, BD, USA) and incubated at 37 ºC for 24-72 hours. kept on hold.
3. **Identification of growing microorganisms:** After incubation, different colonies grown in the medium were evaluated. In the identification of microorganisms, firstly, pre-identification processes were performed with conventional methods (catalase, coagulase, oxidase, IMVIC, gram staining, etc.), and then they were categorized as being loaded into the automatic device for identification and antibiotic susceptibility tests.
4. **Identification and antibiotic susceptibility testing:** One or two colonies were taken from the colonies grown in the medium of the microorganisms, which were pre-identified by Gram staining and other conventional methods, with the help of a loop, and mixed in a broth (ID broth, BD, USA), MacFarland was diluted to be between 0.5-0.63 µg for identification. Approximately 0.50 µl of this prepared solution was taken and transferred to the antibiogram solution (AST broth, BD, USA). After the prepared solution was gently shaken, it was transferred to the appropriate identification and antibiotic susceptibility kits (PMIC/ID-AST 87, NMIC/ID-AST 400, SMIC/ID-AST 11, YEAST ID, BD, USA) and automated culture antibiogram system (Phoenix 100, USA). BD, USA) identification and antibiotic susceptibility tests were performed. The patient results were reported to the automation system as seen by the clinician after approximately 8-12 hours.
5. **Data analysis:** The blood culture results were divided into gram-positive, gram-negative and yeast categories, and the identification of the microorganism grown in the medium was done at the genus and species level. When the same type of microorganism was grown in more than one blood culture of the same patient, only one blood culture was evaluated. When microorganisms of different genus or species were grown in more than one blood culture of the same patient, each of them was included in the study as a separate patient. When

more than one genus or species of microorganism was grown in a blood culture of the same patient, each was included in the study as a separate blood culture. In addition, using the European Committee on Antimicrobial Susceptibility Testing (EUCAST), breakpoint tables for interpretation of MICs and zone diameters Version 10.0 (valid from 2020-01-01), antibiotic susceptibility test results of the reproducing microorganisms were evaluated, including susceptible (S), intermediate susceptible (I) and resistant (R), and arranged in tables. Microorganisms that could not be tested for antibiotic susceptibility were categorized only at the genus or species level and included in the tables. All the data obtained were evaluated on a yearly basis and tables were created.

6. **Statistical Analysis:** In this study, statistical analyzes were performed using the SPSS program (SPSS 15.0, IBM, USA) and continuous data analysis results were arranged as minimum, maximum, median and mean values. In addition, the results of some categorical variables were given as frequency and percentage.

RESULTS

In the culture laboratory of our hospital, it was determined that the total number of blood culture bottles inoculated after being removed from the incubation device, which was accepted as an indicator of growth due to the positive signal, was 3,153. Of these, 1,511 (48%) were female and 1,642 (52%) were male patients. In addition, 2,456 (78%) were adults, and 697 (22%) were under the age of eighteen (Table 1).

Table 1: Distribution of positive blood cultures according to years, age and sex.

Age/Sex	2014 n(%)	2015 n(%)	2016 n(%)	2017 n(%)	2018 n(%)
≤18	140 (30,4)	145 (26,3)	161 (22,3)	135 (21,8)	116 (14,5)
>18	321 (69,6)	406 (73,7)	560 (77,7)	484 (78,2)	685 (85,5)
Female	199 (43,2)	251 (45,6)	365 (50,6)	298 (48,1)	398 (49,7)
Male	262 (56,8)	300 (54,4)	356 (49,4)	321 (51,9))	403 (50,3)
Total	**461**	**551**	**721**	**619**	**801**

n: number of blood culture bottles

It was determined that 74% (2.342) of the total 3.153 blood cultures sent to the culture section of our laboratory and included in the study with a positive signal, belonged to the intensive care units and the remaining 26% (811) were samples from other clinics (Table 2).

Table 2: Distribution of blood cultures according to clinics sending blood culture bottles.

Clinics	2014 n	2015 n	2016 n	2017 n	2018 n
Intensive Care (Internal Diseases)	185	254	360	321	434
Intensive Care (Child)	130	140	143	66	56
Intensive Care (Cardiology)	33	46	60	57	57
Infectious Diseases	17	20	18	7	12
Nephrology	15	18	15	12	20
Internal Medicine	12	13	14	16	12
Orthopedics and Traumatology	7	10	6	6	21
Medical Oncology/Haemotology	6	7	7	7	34
Neurology	6	7	21	10	7
Chest Diseases	8	5	10	7	7
Pediatrics clinic	10	5	18	56	37
Gynecology	5	4	10	4	4
Cardiology clinic	3	4	2	8	11
Neurosurgery	5	4	7	6	21
Urology	3	4	4	4	15
Gastroenterology	-	3	7	3	2
General surgery	5	3	2	5	4
Cardiovascular Surgery	3	2	2	3	1
Otolaryngology	1	1	2	-	-
Ophthalmology	1	-	1	-	-
Endocrinology and Metabolism	-	-	2	1	-
Plastic and Reconstructive Surgery	1	1	1	-	6
Thoracic surgery clinic	3	-	6	-	-

Pediatric Surgery	-	-	1	15	36
Dermatology	1	-	1	1	3
Physical Med and Rehabilitation	1	-	1	2	-
Surgical oncology	-	-	-	2	1
Total	461	551	721	619	801

n: number of blood culture bottles

Colonies obtained from samples that were inoculated into appropriate media and kept in incubation after being evaluated as positive due to the signal of the bacteriological incubation device were categorized according to gram staining results. Accordingly, out of a total of 3,153 samples, 2,649 (84%) stained gram positive (including yeasts), and 504 (16%) stained gram negative. Samples categorized accordingly were studied with the appropriate kit and automatic culture identification and antibioram device. When the examined isolates were identified by genus or species level, 75% (1,879) of 2,514 gram positive bacteria were found to be coagulase negative Staphylococci, and 42% (213) of 504 gram negative bacteria were Escherichiae coli. In addition, 43% (58) of 135 yeasts grown in blood cultures were identified as *Candida albicans* (Table 3).

Table 3: Distribution of bacteria isolated from positive blood cultures at the genus or species level in terms of gram staining by years.

Microorganisms	**2014**	**2015**	**2016**	**2017**	**2018**
Gram positive bacteria	367	452	577	506	612
Staphylococcus aureus	24	21	19	42	53
Coagulase negative staphylococci	289	344	436	351	459
Staphylococcus epidermidis	98	137	203	177	212
Staphylococcus hominis	96	91	109	86	92
Staphylococcus haemolyticus	48	55	49	38	52
Staphylococcus saprophyticus	10	10	13	15	22
Staphylococcus capitis	10	23	15	9	19
Staphylococcus schleiferi	2	6	10	2	13
Staphylococcus warneri	8	2	3	2	8
Other coagulase negative staphylococci	17	20	34	22	41
Enterococcus faecalis	9	19	29	16	29
Enterococcus faecium	6	19	26	18	20
Other gram positive bacteria	39	49	67	79	51
Gram negative bacteria	63	76	106	94	165
Escherichia coli	18	29	36	39	91
Klebsiella pneumoniae	6	13	15	19	24
Acinetobacter baumannii complex	15	7	19	9	16
Pseudomonas aeruginosa	2	8	9	10	12
Enterobacter cloacae complex	2	6	3	4	5
Brucella spp	5	4	2	4	5
Other gram negative bacteria	15	9	22	9	12
Yeasts	31	23	38	19	24
Candida albicans	9	9	19	9	12
Other yeasts	22	14	19	10	12
Total	461	551	721	619	801

When antibiotic susceptibility tests were applied to gram-positive bacteria, it was found that 58% (25,488) of the total 44,233 antibiotics studied were susceptible, 2% (819) intermediate, and 40% (17,926) were resistant. In addition, the antibiotics with the highest susceptibility rates were vancomycin with 99% (2,157), linezolid with 98% (2,105), teicoplanin with 96% (2,042), daptomycin with 93% (1,981), and nitrofurantoin with 89% (1,750). On the other hand, penicillin with 96% (1,702), ampicillin with 90% (1,237), oxacillin with 79% (1,582), cefazolin with 75% (451) and cefoxitin with 74% (1,382) were the antibiotics with the highest resistance rates. In addition, the sensitivity and resistance numbers of gentamicin and streptomycin synergy tests were found as follows: 1.312-169 and 1.168-131 (Table 4).

Table 4: Distribution of antibiotic susceptibility test results for gram positive bacteria.

Antibiotics	2014			2015			2016			2017			2018		
	S	I	R	S	I	R	S	I	R	S	I	R	S	I	R
AM	6	-	225	29	2	381	28	-	456	25	-	121	43	-	52
AMC	-	-	-	20	-	56	116	-	406	93	-	309	111	1	297
AX	-	-	-	10	1	7	8	-	6	8	-	1	8	-	-
C	-	-	-	13	3	2	11	2	-	7	1	-	8	-	-
CIP	15	-	10	33	-	44	210	-	314	191	-	224	197	1	257
CTX	-	-	-	11	-	7	7	-	6	8	-	1	8	-	-
CXM	-	-	-	7	2	7	5	-	7	7	-	2	6	-	-
CZ	62	-	192	86	-	257	-	-	-	-	-	2	-	-	-
DA	145	1	138	207	1	243	211	14	318	195	4	228	245	11	214
DAP	275	-	-	417	-	4	488	35	20	366	30	16	435	14	22
E	76	9	207	126	16	296	145	3	396	124	-	312	159	4	314
FA	13	10	12	21	-	51	178	3	346	151	2	269	165	-	304
FF	16	-	18	-	-	-	-	-	-	-	-	-	-	-	-
FOX	26	-	180	103	1	304	86	-	403	97	39	261	97	47	234
GN	176	12	103	224	20	141	243	1	279	199	5	216	245	-	229
LEV	143	6	21	235	5	53	188	16	274	206	10	214	219	6	250
LNZ	291	-	-	431	1	2	528	-	16	385	4	14	470	2	11
MEM	-	-	-	10	-	3	13	-	1	8	-	1	5	-	-
MOX	193	1	21	238	5	13	25	4	24	9	1	1	8	-	-
MUP	46	10	21	-	-	-	-	-	-	-	-	-	-	-	-
NF	276	2	9	381	10	25	393	27	65	362	23	16	338	13	18
NOR	136	8	103	181	16	130	-	-	-	1	-	1	-	-	-
OX	67	-	223	89	-	234	87	-	407	74	-	348	95	-	370
P	9	-	277	25	-	397	15	-	488	14	-	285	14	-	255
PR	-	-	-	13	1	1	10	1	1	9	-	-	6	-	-
RIF	168	23	78	229	-	118	71	5	157	218	4	145	158	3	146
SXT	142	-	117	210	-	217	259	1	267	247	1	167	256	-	151
SYN	227	8	-	366	16	8	470	16	41	380	10	33	429	10	29
TEC	285	1	4	430	7	7	502	-	30	384	-	21	441	-	19
TEL	-	-	-	15	1	1	1	-	-	-	-	-	-	-	-
TET	194	2	85	259	20	136	201	87	196	213	65	154	230	67	153
TGC	77	-	-	-	-	-	-	-	-	2	-	-	-	-	-
TOB	-	-	-	32	-	23	218	2	308	184	1	225	228	-	241
VA	289	1	2	431	1	1	540	-	7	419	-	8	478	-	5
GMS	-	-	-	102	-	10	488	-	45	358	-	52	364	-	62
SMS	-	-	-	16	-	7	405	-	60	360	-	34	387	-	30
Total	3.353	94	2.046	5.000	129	3.196	6.150	217	5.344	5.132	200	3.681	5.853	179	3.659
(%)	(61)	(2)	(37)	(60)	(2)	(38)	(53)	(1)	(46)	(57)	(2)	(41)	(60)	(2)	(38)

Abbreviations of antibiotic names in the antibiotic column: AM: ampicillin, AMC: amoxicillin/clavulanic acid, AX: amoxicillin, C: chloramphenicol, CIP: ciprofloxacin, CTX: cefotaxime, CXM: cefuroxime, CZ: cefazolin, DA: clindamycin, DAP: daptomycin, E: erythromycin, FA: fusidic acid, FF: fosfomycin, FOX: cefoxitin, GN: gentamicin, LEV: levofloxacin, LNZ: linezolid, MEM: meropenem, MOX: moxifloxacin, MUP: mupirocin, NF: nitrofurantoin, NOR: norfloxacin, OX: oxacillin, P: penicillin, PR: pristinamycin, RIF: rifampicin, SXT: trimethoprim/sulfamethoxazole, SYN: quinopristin/dalfopristin, TEC: teicoplanin, TEL: telithromycin, TET: tetracycline, TGC: tigecycline, TOB: tobramycin, VA: vancomycin, GMS: gentamicin synergy, SMS: streptomycin synergy.

When antibiotic susceptibility tests were applied to gram negative bacteria, 51% (4,217) of the 8,237 tests studied were found to be susceptible, 4% (291) were intermediate, and 45% (3,729) were resistant. In addition, colistin 87% (336), amikacin 80% (369), imipenem and meropenem with 78% (346), ertapenem with 66% (282) and levofloxacin with 61% (63) were the antibiotics with the highest susceptibility rates. On the other hand, ampicillin with 88% (319), amoxicillin/clavulanic acid with 79% (1,582), cefuroxime with 74% (451) and ampicillin/sulbactam with 73% (62) were observed as the antibiotics with the highest resistance rates (Table 5).

Table 5: Distribution of antibiotic susceptibility test results for gram negative bacteria.

Antibiotics	2014			2015			2016			2017			2018		
	S	I	R	S	I	R	S	I	R	S	I	R	S	I	R
AK	36	5	12	56	2	13	80	2	30	81	1	9	116	2	17
AM	4	-	30	6	-	19	10	-	73	10	-	80	14	-	117
AMC	1	1	4	1	-	15	22	-	86	17	-	70	27	2	91
ATM	12	-	30	21	5	44	41	8	57	36	10	44	48	14	71
CAZ	24	-	32	27	2	42	48	5	52	40	7	42	60	19	55
CFM	5	-	9	-	-	-	-	-	-	2	-	-	1	-	3
CIP	29	-	23	39	1	30	57	2	46	57	1	32	67	5	62
CRO	15	-	27	14	-	49	38	1	66	33	-	57	47	2	82
CT	24	-	9	60	-	8	89	-	16	83	-	7	80	-	9
CXM	3	1	8	2	-	15	23	-	80	26	3	59	28	1	90
CZ	13	-	38	9	-	44	1	-	-	-	-	-	-	-	-
ETP	30	1	21	34	-	23	65	2	37	65	3	22	88	2	36
FEP	16	2	24	28	1	42	48	6	51	38	5	43	57	7	68
FF	7	-	7	-	-	-	-	-	-	-	-	-	-	-	-
FOX	18	3	33	23	2	28	6	-	22	-	-	-	-	-	-
GN	30	1	26	64	2	39	63	13	40	68	1	21	89	2	45
IMP	33	3	18	56	1	14	73	3	25	78	2	10	106	5	17
LEV	37	5	16	25	1	19	1	-	-	-	-	-	-	-	-
MEM	35	-	19	56	1	14	71	7	25	75	4	8	110	4	16
NET	1	-	1	3	2	10	56	5	43	54	6	29	74	8	45
NF	6	3	7	-	-	-	21	4	4	1	1	-	4	1	2
PIP	2	-	3	-	-	15	40	4	61	30	1	57	35	2	89
SAM	9	3	26	8	1	36	1	-	-	-	-	-	-	-	-
SCP	11	2	11	27	1	25	1	-	-	-	-	-	-	-	-
SXT	30	-	17	37	-	33	59	3	43	40	1	37	63	5	65
TCC	13	4	24	16	12	26	1	-	-	-	-	-	-	-	-
TET	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-
TGC	1	1	3	1	1	1	3	2	1	-	1	4	-	-	-
TOB	-	-	4	15	-	22	-	-	-	-	-	-	-	-	-
TZP	27	2	23	42	5	24	64	6	36	61	8	24	84	9	42
Total (%)	472 (46)	37 (4)	508 (50)	670 (49)	40 (3)	650 (48)	982 (50)	73 (4)	894 (46)	895 (56)	55 (3)	655 (41)	1.198 (52)	86 (4)	1.022 (44)

Abbreviations of antibiotic names in the antibiotic column; AK: amikacin, AM: ampicillin, AMC: amoxicillin/clavulanic acid, ATM: aztreonam, CAZ: ceftazidime, CFM: cefixime, CIP: ciprofloxacin, CRO: ceftriaxone, CT: colistin, CXM: cefuroxime, CZ: cefazolin, ETP: ertapenem, FEP: cefepime, FF: fosfomycin, FOX: cefoxitin, GN: gentamicin, IMP: imipenem, LEV: levofloxacin, MEM: meropenem, NET: netilmicin, NF: nitrofurantoin, PIP: piperacillin, SAM: ampicillin/sulbactam, SCP: cefoperazone/sulbactam, SXT: trimethoprim/sulfamethoxazole, TCC: ticarcillin/clavulanic acid, TET: tetracycline, TGC: tigecycline, TOB: tobramycin, TZP: piperacillin/tazobactam.

DISCUSSION

Blood culture, which has a very important place in the microbiological laboratory diagnosis of septicemia, is an indispensable method for isolating and identifying pathogenic agents and for accurate and timely reporting of antibiotic susceptibility tests. Therefore, blood culture is a test that is desperately needed for an urgent and appropriate treatment in sepsis patients.[8-11]

Vasudeva et al.[10] using the Bactec BD 9050 system and Kirby B disc diffusion method, it was reported that the most frequently grown bacteria was *Staphylococcus aureus* in 53 blood cultures with positive signals, and the most sensitive antibiotics for gram positive cocci were vancomycin and linezolid. It was stated that the antibiotics to which gram negative bacilli were most sensitive were cefoperazone/sulbactam and imipenem. In our study, when all years were taken into account, *Staphylococcus epidermidis* was the most commonly grown bacteria, while vancomycin and linezolid were the most sensitive antibiotics for gram-positive cocci, while amikacin, imipenem and meropenem were found to be the most sensitive antibiotics for gram-negative bacilli. However, in our study, unlike the above, the number of patients included in the study was much higher and antibiotic susceptibility tests were performed using the automated culture antibiogram device BD Phoenix 100.

Passerini et al.[11] in the catheter-related blood culture study in oncology patients, 2799 blood cultures were examined. Of the 487 isolates grown, 252 (52%) were gram positive cocci (36% *CoNS*, 5% *S.aureus*), 139

(29%) were gram negative bacilli (9% *E.coli*, 4% *P. aeruginosa*) and 47 (10%) were identified as yeast. In our study, 2,514 (80%) of 3.153 isolates were from gram positive bacteria (60% *CoNS*, 5% S. aureus), 504 (16%) were from gram negative bacteria (8% *E. coli*, and 2% each *K. pneumoniae* and *Acinetobacter baumannii complex*) and 135 (4%) were found to be *yeasts*. The data we obtained were found to be compatible with the above study data, except for *CoNS*.

Samuel et al.[22] reported that 52% of the isolates produced in blood cultures of 3.057 patients were gram negative and the only dominant isolate was *S. aureus* with 36%. This was followed by *E. coli, K. pneumoniae* and *coagulase negative Staphylococci* (33%, 12%, 2%), respectively. In addition, most isolates have been reported to be susceptible to fluoroquinolones and third generation cephalosporins. And if there is no contraindication in the empirical treatment of septicemia, a combination of third generation cephalosporins and fluoroquinolones is recommended. On the other hand, in our study, the majority of isolated microorganisms (84%) consisted of gram positive bacteria. In particular, *coagulase-negative Staphylococci* comprised 60% (33% of which were *S. epidermidis*).

In the study conducted by Prakash et al.[23] antimicrobial resistance profiles of microorganisms grown in blood cultures of 348 patients were investigated. Of the microorganisms isolated in the study, 58% were gram positive and 42% were gram negative. Streptococcus species were the most frequently isolated bacteria with 21%, coagulase negative Staphylococci 21%, E. coli 12%, and Staphylococcus aureus 11%. In our study, 84% of the isolated microorganisms were gram positive and 16% gram negative, but the rate of gram positive bacteria was found to be higher. Also, considering all bacteria, *coagulase negative Staphylococci* 60%, *E. coli* 8%, *Staphylococcus aureus* 5% and *Streptococcus species* 3% were isolated. As seen here, the rate of *CoNS* was slightly higher and the rate of *Streptococci* was found to be lower in our study. This situation; can be explained by geographic location, cross-sectional study or bacterial contamination.

Asaad et al.[24] in their study, isolation frequency and antimicrobial resistance profiles of *coagulase-negative staphylococci* isolated in blood cultures were analyzed. Approximately 35% of the 208 isolates examined were *S. epidermidis*, followed by *S. hominis* with 21%, *S. haemolyticus* with 16% and *S. saprophyticus* with 12%, respectively. Considering the antibiotic sensitivities; vancomycin, daptomycin and teicoplanin were 99%, 99% and 93% susceptible, respectively, while the highest resistance rates were reported for penicillin, oxacillin and erythromycin at 95%, 91% and 85%, respectively. In our study, *S. epidermidis* was the most isolated gram positive bacteria with 33%, which was very close to these values, followed by *S. hominis* (19%), *S. haemolyticus* (10%) and *S. aureus* (5%), respectively. Our antibiotic susceptibilities were similarly found to be 99%, 98% and 96% sensitive for vancomycin, linezolid and teicoplanin, respectively, while our highest resistance rates were found to be 96%, 79% and 70% for penicillin, oxacillin and erythromycin, respectively.

In the study conducted by Romero-Gómez et al.[25] MALDI-TOF MS and Vitek-2 Compact were used for direct positive blood cultures. From a total of 324 blood cultures, 257 gram negative and 67 gram positive isolates were produced. The most frequently isolated gram-negative bacteria were *E. coli*, *K. pneumoniae*, *P. aeruginosa*, and *E. cloacae* (137, 59, 24, and 16), respectively, while gram-positive cocci, 18 from each, *S. aureus*, *S. epidermidis* and *E. faecalis*. In our study, the number of gram-positive bacteria isolated was higher (84%), and the most common ones were *S. epidermidis*, *S. hominis S. haemolyticus* and *S. aureus* (33%, 19%, 10%, and 5%), respectively. The number of gram negative bacteria was much less (16%) and the most common ones were *E. coli*, *K. pneumoniae* and *A. baumannii complex* (7%, 2% and 2%), respectively.

In the study conducted by Abebaw et al.(26), bacterial profiles and antibiotic susceptibilities of patients with suspected bacteremia between 2003 and 2013 were retrospectively examined. Of the total cases, 58% were male and 42% female. The highest rate of culture positivity (44%) was in the age group ≤28 days, and CoNS was reported to be the most common bacteremia agent among gram positive isolates. In our study, 52% of the cases were male and 48% were female, and the values were very close to each other. Our culture positivity rate was highest (78%) in the >18 age group. Similarly, the most common bacteremia agent was CoNS (33%, *S. epidermidis*).

CONCLUSIONS

While there was no significant change in the rates of microorganisms grown in the cultures during the periods included in the study, small increases were observed in the resistance profiles of the bacteria. Considering this situation, it is recommended to organize the treatment according to the antibiotic sensitivity test results as much as possible and to limit the random use of antibiotics.

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