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Evaluation of Culture Results in Pediatric Clinics of the Training and Research Hospital

Bir Eğitim ve Araştırma Hastanesi Çocuk Kliniklerinde Alınan Kültür Sonuçlarının Değerlendirilmesi

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ABSTRACT

Aim: Infections due to drug resistant microorganisms are increasing and it is important to evaluate culture specimens for early recognition, fast and effective therapy, epidemiological and prognosis of the infections. The aim of the study is to evaluate the results of blood and urine cultures taken from patients hospitalized in pediatric services outside the neonatal intensive care unit.

Materials and Methods: In this study, 2277 blood cultures and 857 urine cultures taken between the years of 2007 and 2008 were evaluated retrospectively. 6.8% (n=156) positive blood cultures and 6% (n=52) positive urine cultures were included in the study. Blood cultures were put onto Bact-Alert 3D automotized blood culture systems and urine cultures were put onto MacConkey and 5% sheep blood agar plates. Microorganisms were identified with routine bacteriological procedures and antibiotic sensitivity tests were performed.

Results: In pediatrics clinics, 79.4% gram positive microorganisms (69% *coagulase-negative staphylococcus CNS*) among-positive blood cultures 86.5% gram negative microorganisms (61.5% *Escherichia coli)* among positive urine cultures were produced. Microorganisms grew in blood cultures were as follows: 48% (n=75) *Methicillin-resistant CNS*, 21% (n=33) *Methicillin-sensitive CNS*, 7.5% (n=12) *Klebsiella* species (4.5% ESBL positive), 2.6% (n=4) *Streptococcus pneumoniae*, 2.6% (n=4) *Methicillin-sensitive staphylococci* 2% (n=3) *Acinetobacter*, 2.6% (n=4) *Candida tropicalis*, 2% (n=3) *Escherichia coli*, 2% (n=3) *Enterobacter*, 1.3% (n=2) *Haemophilus influenzae*, 0.6% (n=1) *Brucella* spp. Microorganisms detected in urine cultures are as follows: 61.5% (n=32) *Escherichia coli* (40% ESBL positive), 11.5% (n=6) *Enterococcus* spp., 5.8% (n=3) *Proteus* spp., 3.8% (n=2) *Pseudomonas* spp., 3.8% (n=2) *Stenotrophomonas maltophilia*, 2% (n=1) *Methicillin-sensitive staphylococci*, 2% (n=1) *Acinetobacter baumannii*, 2% (n=1) *Klebsiella* spp.

Conclusion: Identifying the infectious agents and their antibiotic susceptibility and resistance rates is important for adequate and effective initial empiric antimicrobial therapy and treatment of infections.

Keywords: Children, bacteremia, urinary tract infection

ÖZ

Amaç: Çoklu ilaç direnci olan mikroorganizmalar ile enfeksiyon sıklığı giderek artmakta olup; enfeksiyonların erken tanınması, etkili tedavisi ve prognoz açısından kültür örneklerinin değerlendirilmesi önemlidir. Bu çalışmanın amacı, yenidoğan yoğun bakım ünitesi dışındaki çocuk servislerinde yatan hastalardan alınan kan ve idrar kültürü sonuçlarının değerlendirilmesidir.

Gereç ve Yöntem: Bu çalışmada 2007-2008 yılları arasında bakılan 2277 kan kültürü ve 857 idrar kültürü retrospektif olarak değerlendirilmiştir. Kan kültüründe %6,8 (n=156), idrar kültüründe ise %6 (n=52) üreme anlamlı görülerek çalışmaya dahil edilmiştir. Alınan kan kültürleri Bact-Alert 3D otomatize kan kültür sistemlerinde, idrar örnekleri MacConkey ve %5 koyun kanlı agar besiyerlerine ekimi yapılarak üreyen mikroorganizmalar tanımlanmış, antibiyotik duyarlılık testleri yapılmıştır.

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Bulgular: Çocuk kliniklerinde bakteriyemi saptanan hastalarda %79,4 gram pozitif (%69'u *Koagülaz-negatif stafilokok, KNS*), idrar kültüründe ise %86,5 gram negatif (%61,5 *Escherichia coli,* %11,5 *Enterokoklar)* mikroorganizma üremiştir. Kan kültürlerinde üreyen mikroorganizmalar: %48 (n=75) *Metisilin-dirençli KNS,* %21(n=33) *Metisilin-hassas KNS*, %7,5 (n=12) *Klebsiella pneumoniae* (%4,5 *genişlemiş spektrumlu beta-laktamaz,* GSBL pozitif), %4,5 (n=7) *Pseudomonas* suşları, %3,2 (n=5) *Enterococcus* spp., %2,6 (n=4) *Streptococcus pneumoniae*, %2,6 (n=4) *Metisilin-hassas Staphylococcus aureus*, %2 (n=3) *Acinetobacter,* %2,6 (n=4) *Candida tropicalis,* %2 (n=3) *Escherichia coli,* %2 (n=3) *Enterobacter,* %1,3 (n=2) *Hemofilus influenza,* %0,6 (n=1) *Brucella* spp. idi. İdrar kültürlerinde saptanan mikroorganizmalar; %61,5 (n=32) *E. coli*, (%40 *genişlemiş spektrumlu beta-laktamaz,* GSBL pozitif), %11,5 (n=6) *Enterococcus* spp., %5,8 (n=3) *Proteus* spp., %3,8 (n=2) *Pseudomonas* spp., %3,8 (n=2) *Stenotrophomonas maltophilia*, %2 (n=1) *Metisilin-hassas Staphylococcus aureus,* %2 (n=1) *Acinetobacter baumannii,* %2 (n=1) *Klebsiella* spp. idi.

Sonuç: Enfeksiyon etkeni mikroorganizmaların ve antibiyotik duyarlılıkları ile direnç oranlarının belirlenmesi uygun ve etkili ampirik antimikrobiyal tedavi başlanmasında ve enfeksiyonların tedavisinde önemlidir.

Anahtar Kelimeler: Çocuk, bakteriyemi, idrar yolu enfeksiyonu

INTRODUCTION

The epidemiology of infectious agents detected in the bloodstream changes in parallel with the development of antibiotic resistance[1]. Today, the frequency of infection is increasing due to multi-drug resistant microorganisms. Bacteremia continues to be a common cause of febrile diseases in the world and adversely affects morbidity and increases mortality, especially in hospitalized patients[1,2]. Mortality is related to the severity of the infection, the presence of concomitant disease, age, and inappropriate use of antibiotics[3,4]. Although gram-positive microorganisms are frequently reported as the causative agent of bacteremia in childhood, recent studies have shown that the frequency of gram-negative microorganisms has increased[5-7]. Infections should be recognized, treated quickly and effectively, and culture samples should be taken in terms of prognosis[8]. It is necessary to reduce the risk of contamination with skin bacteria by paying attention to sterility while taking culture samples, to interpret the results correctly and to pay attention to the correlation with the clinic. On the other hand, false-positive blood culture results cause errors in the interpretation of circulatory system infections, and may lead to inappropriate antibiotic use, additional laboratory tests, prolonged hospitalization, and increased costs[9].

Antibiotic-resistant microorganisms, on the other hand, limit the availability of effective treatment options, cause difficulties in the treatment of some frequently encountered bacterial infections, including urinary tract infection (UTI), and may lead to increase in mortality, morbidity, and health costs[10-12]. In the treatment of urinary tract infection, it is important to apply appropriate and adequate empirical treatment in order to prevent complications such as scar formation in the urinary system.

MATERIALS AND METHODS

In this study, blood and urine cultures taken from patients in pediatric services outside the neonatal intensive care clinic between 2007 and 2008 were retrospectively analyzed. The growth in the blood culture samples taken from the patients was evaluated as bacteremia in the presence of clinical findings. If the microorganism grown in a single blood culture was not clinically compatible or there were no predisposing factors such as immunodeficiency, or if there was growth in only one of the many blood culture samples taken, this was considered as contamination. If coagulase-negative staphylococci or viridans streptococci grew, it was accepted as significant bacteremia in the presence of at least two positive results in culture[13].

In the study, 2277 blood cultures and 857 urine cultures were evaluated. Growth was detected in 10.1% (n=231) of the blood culture samples; 1% (n=24) blood cultures were not included in the study because patient information could not be reached or the same agent was produced twice. Of the 9% (n=207) blood cultures with growth, 6.8% (n=156) were considered significant and included in the study; 2.2% (n=51) were considered as contamination. Of the growths that were accepted as contamination, 84% (n=43) did not receive treatment. In 857 urine cultures taken, 6% (n=52) of the growths were considered significant and included in the study; 1.7% (n=15) of them were considered as contamination. In the study, 156 blood cultures and 52 urine cultures were analyzed.

BLOOD CULTURE METHOD

Blood cultures were evaluated in Bact-Alert 3D automated blood culture systems; hemoculture samples were incubated for five days; aerobe cultures of samples showing positive signals were made on blood agar, EMB agar and sabouraud dextrose agar at 37 ºC.

Urine culture was taken with the help of a urinary catheter or urinary bladder in infants, with midstream urine after standard cleaning in older age groups and with the help of a catheter from patients who were not compatible; urine samples sent to the laboratory were inoculated on MacConkey and 5% sheep blood agar media and incubated at 35-37 ºC for 18-24 hours. Microorganisms that grew at the end of the incubation

period were identified by routine bacteriological methods, and antibiotic susceptibility tests were performed to investigate the resistance against commonly used antibiotics.

Statistical Analysis

Statistical analyses were made with the NCSS 2007 package program in the study, descriptive statistical methods were used in the evaluation of the data as well as the Fisher reality test in the comparison of qualitative data. The value of $p<0.05$ was considered significant.

RESULTS

Of the patients, 56% (n=117) were male and 44% (n=91) were female. The mean age was 3.4±3 years in patients from whom blood cultures were taken and 3.92±3.87 years in patients from whom urine cultures were taken.

Diagnostic distribution of patients with bacteremia in blood culture is summarized in Table 1; mean leukocyte count in laboratory parameters was 11971±10243/uL; leukocyte with polymorphic nuclei was 6093±5522/uL; lymphocyte count was 3080±3008/uL, and C-reactive protein (CRP) was 51±87 mg/L.

Mean leukocyte count in laboratory tests of patients with significant growth in urine culture was 12,908±7993/uL; leukocyte with polymorphic nuclei was 6827±5991/uL; lymphocyte count was 4698±4100/uL, and CRP was 65±78 mg/L.

In blood cultures in which bacteremia was detected in pediatric clinics, 79.4% gram-positive and 20.6% gram negative microorganisms were found; in urine cultures, 86.5% gram negative and 13.5% gram positive microorganisms were grown.

Significant bacteremia causative microorganisms in blood cultures and significant infectious causative microorganisms grown in urine cultures are shown in Table 2.

There was no difference in the distribution of microorganisms grown in blood culture according to pediatric services ($p>0.05$). Considering the antibiotic resistance of microorganisms causing bacteremia in blood culture; vancomycin resistance was not detected in MSCNS, MSSA, and *Streptococcus pneumoniae* (*St. pneumoniae*) strains. In *Acinetobacter baumannii* strains, 100% resistance to cefuroxime and ceftriaxone was found. In MRCoNS strains, 84% erythromycin, 60% clindamycin, 40% ciprofloxacin, 49.3% fusidic acid resistance; 97.3% linezolid and 100% vancomycin sensitivity were detected. In MSCNS strains, 42% penicillin, 48.5% erythromycin, 21% clindamycin, and 33.3% trimethoprim-sulfamethoxazole (TMP-SMX) resistance were found; 63.6% amoxicillin clavulanic acid, 90% ciprofloxacin, and 97% gentamicin were sensitive. It was found that *St. pneumoniae* strains had 25% penicillin and erythromycin resistance and 75% trimethoprim-sulfamethoxazole resistance; vancomycin, teicoplanin and ciprofloxacillin were found to be 100%

Table 1. Diagnostic distribution of patients with bacteremia in blood culture

Diagnosis distribution	
Sepsis	47.4% (n=74)
Pneumonia	30% (n=47)
Febrile neutropenia	19.2% (n=30)
Deep neck infection	1.9% (n=3)
Brucella infection	0.6% (n=1)
Encephalitis	0.6% (n=1)

Table 2. The causative microorganisms in blood culture and their distribution by frequency

Microorganism	Blood culture	Causative microorganism	Urine culture
Methicillin-resistant CNS	n=75 (48%)	*Escherichia coli*	n=32 (61.5%) (40% ESBL positive)
Methicillin sensitive CNS	n=33 (21%)	*Enterococcus* spp.	n=6 (11.5%)
Klebsiella pneumoniae	n=12 (7.5%)	*Klebsiella* spp.	n=5 (9.6%) (80% ESBL positive)
Pseudomonas spp.	n=7 (4.5%)	*Proteus* spp.	n=3 (5.8%)
Enterococcus spp.	n=5 (3.2%)	*Pseudomonas* spp.	n=2 (3.8%)
Streptococcus pneumoniae	n=4 (2.6%)	*St. maltophilia*	n=2 (3.8%)
Methicillin-sensitive coagulase-negative staphylococcus (MSSA)	n=4 (2.6%)	*Methicillin-sensitive coagulase-negative staphylococcus (MSSA)*	n=1 (2%)
Acinetobacter spp.	n=4 (2.6%)	*Acinetobacter baumannii*	n=1 (2%)
Candida tropicalis	n=3 (2%)		
Escherichia coli	n=3 (2%)		
Enterobacter	n=3 (2%)		
Hemophilus influenza	n=2 (1.3%)		
Brucella spp.	n=1 (0.6%)		

CNS: Coagulase negative staphylococcus, MSSA: *Methicillin-sensitive Staphylococcus aureus, St. maltophilia: Stenotrophomonas maltophilia*, ESBL: Extended spectrum beta-lactamase

sensitive. In *methicillin-susceptible Staphylococcus aureus* (MSSA) strains, 50% erythromycin, penicillin and amoxicillin clovulanic acid resistance and 25% penicillin resistance were detected (Figure 1).

In *Haemophilus influenzae* (*H. influenzae*) strains, 50% erythromycin, ceftriaxone and trimethoprim-sulfamethoxazole resistance were detected; ampicillin and amoxicillin-clovulanic acid were 100% sensitive. Klebsiella strains were 100% susceptible to ciprofloxacin, meropenem and imipenem, and 40% resistant to ceftriaxone, 20% to tobramycin, and 20% to piperacillin-tazobactam.

Broad-spectrum beta-lactamase positive Klebsiella strains (4.5%) were 88% susceptible to meropenem and imipenem. In these strains, 62.5% ceftazidime, 12.5% ciprofloxacin, and 50% piperacillin-tazobactam resistance were detected. *E. coli* strains were 100% susceptible to amikacin, meropenem and imipenem, and were found to be resistant to cefuroxime and ciprofloxacin at a rate of 33% and to cefotaxime at a rate of 16%.

Pseudomonas spp strains were 87.5% susceptible to piperacillin-tazobactam, amikacin and cefepime, and 62.5% to ceftazidime; it was found 25% resistant to ceftazidime, and 25% to gentamicin and tobramycin, 12.5% to piperacillin-tazobactam, meropenem and imipenem (Figure 2).

In *Enterococcus* strains, 60% erythromycin and teicoplanin resistance, 40% gentamicin, ciprofloxacin and vancomycin resistance were detected; linezolid was found to be 100% susceptible, and gentamicin and vancomycin was 60% susceptible.

Of the patients with growth in blood culture, 69.2% had a history of other concomitant disease; 40% (n=45) of these diseases were hemato-oncological diseases. It was observed that 88.5% (n=138) of the patients with growth in blood culture received appropriate treatment according to the culture results and treatment response.

In the study, microorganisms produced in patients with mortality (5.7%, n=9) who received bacteremia treatment were 20% (n=2) *MRCNS*, 20% (n=2) *E. coli*, 20% (n=2) *Klebsiella pneumoniae*, 10% (n=1) *Candida tropicalis*, 10% *MRCNS* and *Candida tropicalis*, 10% (n=1) *Acinetobacter baumannii*, and these patients had hematologic-oncological disease.

The distribution of microorganisms accepted as 2.2% (n=51) contamination in blood culture is as 28% *MSCNS*, 17% *Alpha hemolytic streptococci*, 15% *diphtheroid bacillus*, 13% *Micrococcus* spp., 7.6% *MRCNS*, 5.7% *Bacillus* spp., 3.8% *non-hemolytic streptococci*, 2% *Cytrobacter*, 2% *Enterobacter*, 2% *E. coli* and 2% *MSSA*. Of these microorganisms, 24% (n=12) were grown under antibiotic treatment, and 76% (n=40) were grown in cultures taken before antibiotic treatment.

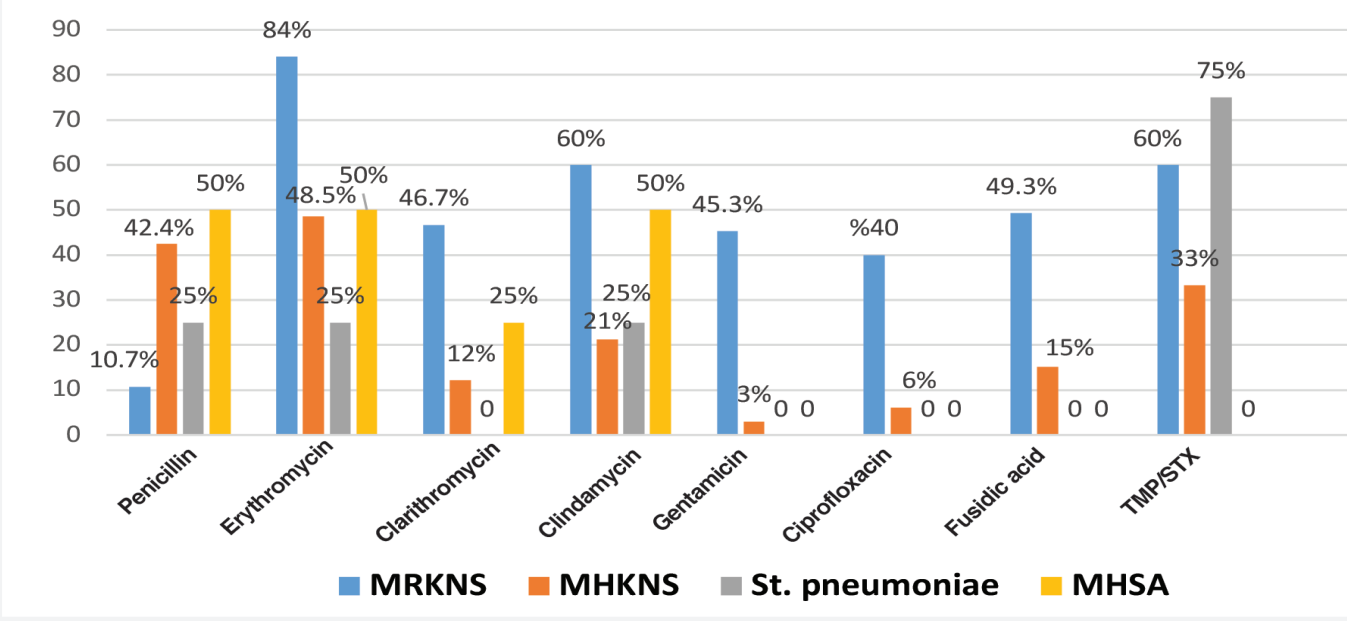

Figure 1. Antibiotic resistance of gram-positive microorganisms (coagulase negative staphylococcus, *Staphylococcus aureus* and *Streptococcus pneuomoniae*) grown in blood culture

MHKNS: Methicillin-sensitive coagulase-negative staphylococci, MRKNS: Methicillin-resistant coagulase-negative staphylococci, St. pneumoniae: Streptococcus pneumoniae, MHSA: Methicillin sensitive Staphylococcus aureus

Most specifically, trimethoprim-sulfamethoxazole (37%) resistance was found in *E. coli* strains in microorganisms grown in urine culture. In *Klebsiella* strains, resistance to cephalosporin derivatives and ciprofloxacin was seen with a high probability. ESBL positivity was detected in 80% of *Klebsiella* strains and 40% of *E. coli* strains. Ceftazidime, amikacin, and ciprofloxacin resistance were not observed in *Pseudomonas* strains (Figure 3).

No resistance to piperacillin-tazobactam, meropenem, and imipenem was detected in the microorganisms grown in urine culture. Of *proteus* strains, 33.3% were resistant to gentamicin, netilmicin and amikacin; were 100% susceptible to

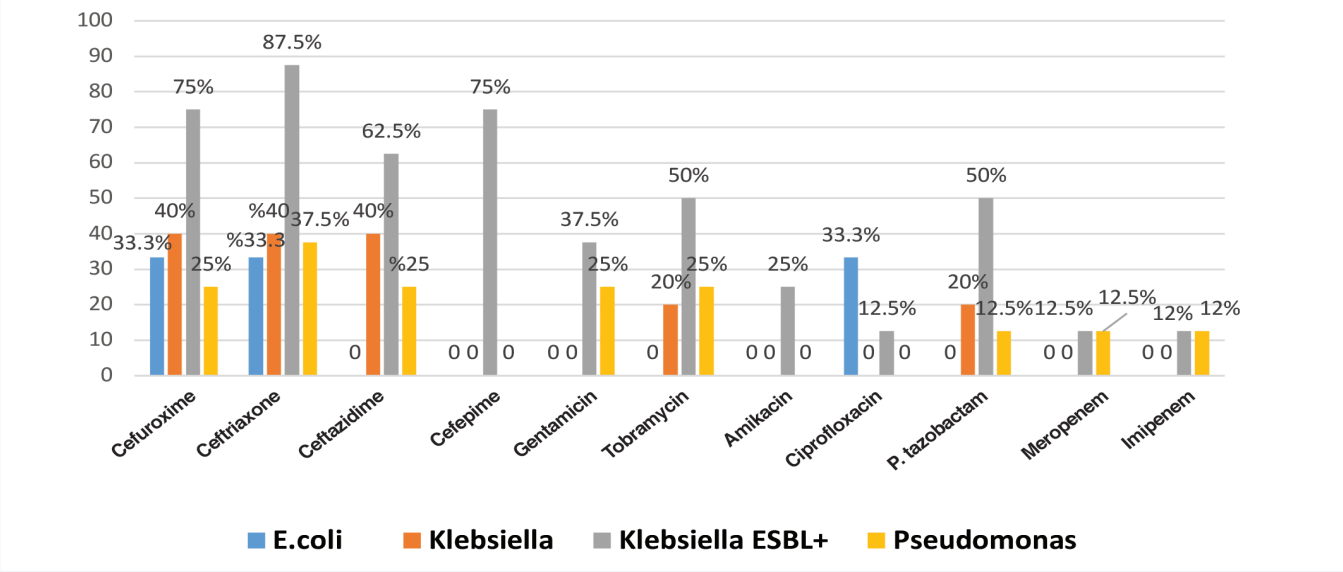

Figure 2. Antibiotic resistance of gram-negative microorganisms (*E. coli*, *Klebsiella* spp., *Pseudomonas* spp.) grown in blood culture

E. coli: Escherchia coli, K. pneumoniae: Klebsiella pneumoniae, P. tazobactam: Piperacillin-tazobactam, ESBL: Extended spectrum betalactamases

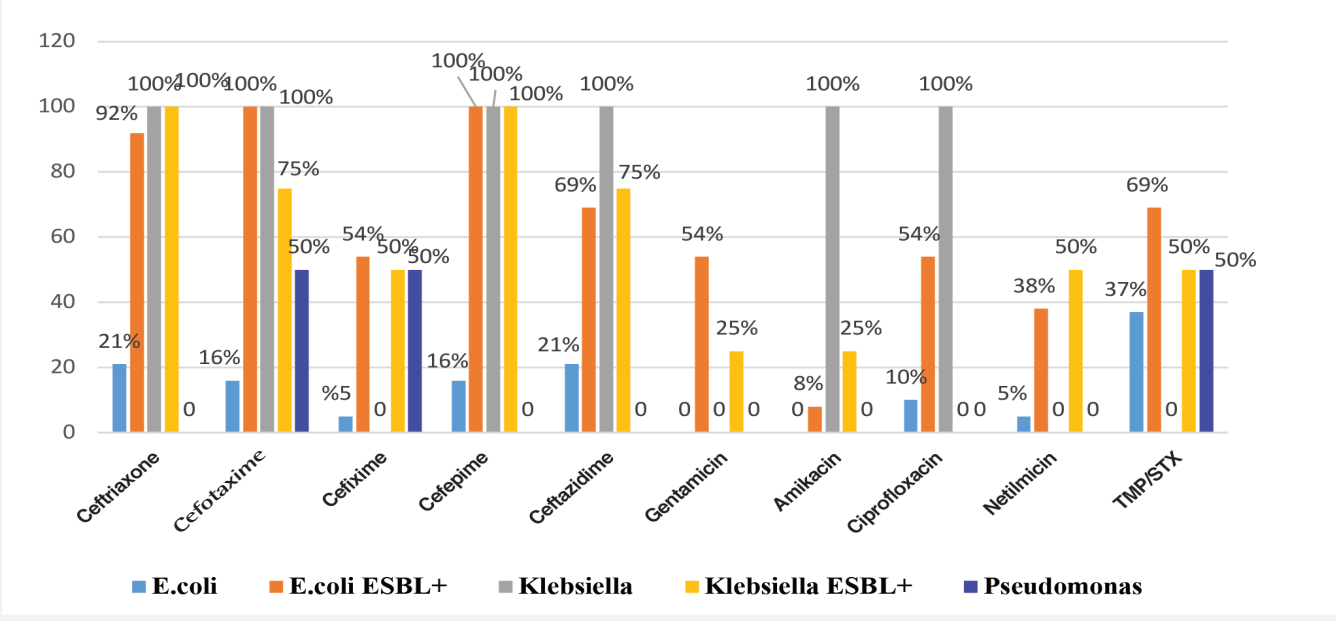

Figure 3. Antibiotic resistance of microorganisms grown in urine culture

E. coli: Escherichia coli, ESBL: Extended spectrum betalactamases, TMP-SMX: Trimetoprim-sulfametaksazol

ciprofloxacin, cefotaxime, ceftazidime, meropenem, imipenem, and were 66.7% susceptible to gentamicin, tobramycin, trimethoprim sulfamethoxazole. For *Acinetobacter baumanni*, 100% resistance was seen with piperacillin tazobactam, ceftazidime and meropenem; it was found to be 100% sensitive to gentamicin, tobramycin and netilmicin. In *Stenotrophomonas maltophilia* strain, 50% resistance to cefotaxime, cefepime and meropenem was observed. It was determined that *Enterococcus* strains had 83.3% ampicillin and penicillin resistance, and 16.7% vancomycin and teicoplanin resistance. The *MSSA* strain grown in the urine culture was penicillin resistant; it was found to be sensitive to Gentamicin, ciprofloxacin, vancomycin, trimethoprim-sulfamethoxazole, cefazolin, amikacin and netilmicin.

Reproduction was considered as contamination in 1.7% (n=15) of the patients whose urine cultures were taken. *E. coli* (40%, n=6) was found to be the most common among the microorganisms evaluated as contamination.

In the study, urinary system ultrasonography of the patients with growth in urine culture was found to be normal in 67.3%; 23.1% of the cases had hydronephrosis, 3.8% had mild ectasia, 1.9% had grade 1 parenchymal disease, 1.9% had renal calculus, and 1.9% had grade 3 ectasia.

It was observed that 90.4% (n=47) of the patients with significant growth in the urine culture received appropriate treatment according to the culture results and treatment response.

DISCUSSION

In recent studies, culture positivity has been reported as 8.9-11% (4.7-27.3%) in blood culture samples taken, and in this study, blood culture positivity was found to be 10.1% (n=231), which is compatible with the literature[14]. In blood cultures, 79.4% of gram-positive microorganisms were found to be bacteremia causative, which is compatible with the literature[5,6].

In the study, the most common microorganism in blood culture was *CNS* at a rate of 69.2%, and 69.4% of them were methicillin resistant, 30.6% were methicillin susceptible. Methicillin resistance of *CNS*s was found as 80.4% by Edmond et al.[15] as 78.5% by Johnson et al.[16] and as 76.3% by Nahaei et al.[17] in a study conducted by various clinical samples from different centers.

In the study, 84% erythromycin, 60% clindamycin, 40% ciprofloxacin resistance was detected in *MRCNS* strains produced in blood culture; linezolid was found 97.3% susceptible and vancomycin 100% susceptible. In the studies of Hope et al.[18] including pediatric and adult age groups, methicillin resistance of *CNS* strains was found to be 67%; 80.2% erythromycin, 67% ciprofloxacin, and 25.5% clindamycin resistance was reported in *MRCNS* strains. As in the study of Buckingham et al.[19], no vancomycin resistance was found in *CNS*s.

Streptococcus pneumoniae is one of the major agents of pneumonia, otitis media, and bacteremia infections in children and it is reported that multi-antibiotic resistance is increasing[20,21]. In this study, *St. pneumoniae* strains were found to have 75% trimethoprim sulfamethoxazole resistance, 25% penicillin and erythromycin resistance; no resistance to clarithromycin, vancomycin and ciprofloxacillin was observed. In the study of Gür et al.[22], moderate penicillin resistance was found to be 30%. In a study conducted in Spain, it was shown that penicillin resistance of invasive pneumococcal strains was 33%, erythromycin resistance was 25.7%, and cefotaxime resistance was 8.4%.[23] In a study conducted in Switzerland, penicillin resistance was found to be 7%.[24] Unlike this study, in the study of Opintan and Newman[14] trimethoprim-sulfamethoxazole resistance was not observed in pneumococci, and high resistance was found with ciprofloxacin (50%) and erythromycin (66.7%).

In recent years, it has been reported that the frequency of bacteremia with gram-negative microorganisms increases, and ESBL-producing *Enterobacteriaceae* and resistant *Pseudomonas* and *Acinetobacter* isolates pose a significant problem in treatment[1,10]. In blood cultures of Nivesvivat et al.[25], ESBL production that can hydrolyze penicillins, most cephalosporins and monobactam antibiotics was reported as 28.9% in *E. coli* and as 25.8% in *K. pneumoniae*[25]. In this study, ESBL positive *Klebsiella* strains were seen at a low rate (4.4%) in blood culture; however, ESBL positivity was detected in 58% of *Klebsiella* strains. ESBL positivity was not detected in *E. coli* strains. Opintan and Newman[14] reported in their study that *E. coli* strains had 87.5% cefuroxime resistance, 88.9% cefotaxime resistance, 60% ciprofloxacin resistance and 12.5% meropenem resistance; in this study, however, meropenem resistance was not detected, cefotaxime (16%) and cefuroxime (33%) resistance was lower; similarly, amikacin resistance was not observed.

In the study, 7.6% (n=12) *Klebsiella* spp. were detected and *Klebsiella* strains not producing ESBL were resistant to ceftriaxone at a rate of 40% and to piperacillin-tazobactam at a rate of 20%; ESBL producing strains were found to be 87.5% resistant to ceftriaxone, 75% to cefepime, 62.5% to ceftazidime, 12.5% to ciprofloxacin, and 50% to piperacillin-tazobactam.

The increase in antibiotic resistance of *Enterococcus* species and the occurrence of infections with multiple resistant strains cause difficulties in treatment. In particular, the increase in vancomycin resistance draws attention[26]. In a multicenter study, glycopeptide resistance of *Enterococcus* species was found as 9.7%, ciprofloxacin resistance as 27.4%, and

gentamicin resistance as 28.2%[27]. In this study, teicoplanin resistance (60%), gentamicin, ciprofloxacin and vancomycin resistance (40%) of *Enterococcus* species were found to be high in blood culture.

Pseudomonas spp. is an important bacterium that needs attention due to its multiple antibiotic resistance and can cause severe clinical pictures. *Pseudomonas aeruginosa*, which is the cause of hospital-acquired bacteremias caused by gram-negative microorganisms with a frequency of 20%, is reported to be resistant to most penicillins and cephalosporins.[6,28] Although antipseudomonal penicillins, cefoperazone, ceftazidime, cefepime, quinolones and carbapenems are effective against pseudomanas; in a multicenter study, 50% ciprofloxacin and piperacillin resistance, 30% ceftazidime resistance, and 26% amikacin resistance were found[29]. In this study, 25% ceftazidime resistance, 12.5% piperacillin-tazobactam and meropenem resistance were determined in pseudomonas species grown in blood cultures.

The causative agents of urinary tract infections are gram-negative bacteria and *E. coli* is the most frequently isolated among them (61.5%), as also found in this study. According to the results of studies obtained from various regions in our country, the frequency of *E. coli* isolation in children varies between 43-66.6%[30,31]. Bean et al.[32] found 55% ampicillin resistance and 40% trimethoprim-sulfamethoxazole resistance in *E. coli* strains. Resistance to third generation cephalosporins has been reported in the treatment of urinary tract infections. Yüksel et al.[33] found 7.5% ceftriaxone resistance in *E. coli* strains; Pape et al.[34] found 53% ampicillin resistance, 42% trimethoprim-sulfamethoxazole resistance, 12% amikacin resistance, and 6% cefuroxime resistance. Grude et al.[35] found 28% ampicillin, 12% trimethoprim-sulfamethoxazole, and 12% cefuroxime resistance. In this study, 37% trimethoprim-sulfamethoxazole, 21% ceftriaxone, and 10% ciprofloxacin resistance were found in *E. coli* strains in urine culture; no resistance was found to gentamicin and amikacin. In ESBL positive *E. coli* strains, 69% trimethoprim-sulfamethoxazole resistance, 54% gentamicin and ciprofloxacin resistance, and 38% netilmicin resistance were found.

Today, it has been reported that gram-negative strains expressing ESBL are becoming common in UTI in many countries[36,37]. In a meta-analysis conducted for urinary tract infections, the rate of ESBL positive *Enterobacteriaceae* in urine was found to be 15%; in this study, ESBL-producing *Enterobacteriaceae* in urine was found as high as 32.6%[38].

In the study, ESBL was found positive in 40% of *E. coli* strains. Of ESBL positive *E. coli* strains, 69.2% were resistant to trimethoprim-sulfamethoxazole, 53.8% to gentamicin and 7.7% to amikacin. On the other hand, 36.8% of ESBL negative strains were found to be resistant to trimethoprim-sulfamethoxazole.

Contamination rates in blood culture are reported as 0.6-3%; in this study, the frequency was 2.2% (n=51), which was consistent with the literature, and the most frequent contamination was MSCNS (28%)[39,40].

Study Limitations

The limitations of this study are that it was conducted retrospectively and it was a single-center study.

CONCLUSION

Since antibiotic-resistant microorganisms are an important problem in the diagnosis and treatment of infectious diseases, knowing the antibiotic resistance and susceptibility rates against microorganisms is necessary for the regulation of appropriate empirical treatment. Evaluating the results of the culture samples taken and reviewing the appropriateness of the empirical treatment according to the culture antibiogram is important for the success of the treatment.

In this study, the importance of initiating appropriate and adequate empirical treatment and preventing the development of antibiotic resistance was emphasized by investigating the microorganisms grown in blood and urine cultures and their antibiotic susceptibility.

Ethics

Ethics Committee Approval: Retrospective study.

Informed Consent: Retrospective study.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Concept: N.C.G., F.Ç., Design: N.C.G., F.Ç., Data Collection or Processing: N.C.G., B.D.Ç., B.B., Analysis or Interpretation: N.C.G., B.D.Ç., F.Ç., Literature Search: N.C.G., F.Ç., Writing: N.C.G., B.D.Ç., B.B., F.Ç.

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