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Analysis of Intensive Care Units (ICUs) Blood stream Infections (BSI) in Kafkas University Health Research and Application Hospital

Review Article

Calik Z[1], Acar O[1],Karamese M[1*], Acar N[2]

[1] Department of Microbiology, Faculty of Medicine, Kafkas University, Kars, Turkey.
[2] Yusufpasa Family Health Center, Kars, Turkey.

Abstract

Objectives: Sepsis is one of the most important cause of admission in Intensive Care Units, probably due to the more severe illnesses of hospitalized patients and to the persistently high incidence of nosocomial infections. However, despite the availability of potential antibiotics and refined supportive care the mortality of septic patients remains high, with overall estimates of about 30% and increasing to 50% when associated with shock. In this study, our aim is to determine retrospectively the epidemiology of blood stream infections occurred in Intensive Care Units of Kafkas University Health Research and Application Hospital and to present the first data from this university hospital.

Materials and Methods: Total 1004 blood culture bottle were sent to Microbiology Laboratory of Kafkas University Health Research and Application Hospital between January 2013 to January 2015. All bottles were placed into Automated BACTEC 9050 Blood Culture System. After the positive bottles were detected by machine, the bacteria were identified and antibiotic susceptibility test were performed by using both BD Phoneix Microorganism Identification System and Kirby-Bauer Disk Diffusion method.

Results: Total 202 positive samples were detected and the biggest part of total positive samples (n:164, 81.2%) were sent by Internal Intensive Care Unit. The identified bacteria were MRCNS (n:67, 33.2%), MSCNS (n:42, 20.8%), MRSA (n:29, 14.3%), *E.coli* (n:23, 11.3%), MSSA (n:16, 7.9%), *P.aeruginosa* (n:9, 4.5%), *Enterococcus* spp (n:9, 4.5%), *K.pneumoniae* (n:4, 1.9%), A.baumannii (n:1, 0.5%), Proteus mirabilis (n:1, 0.5%), Stenotrophomonas maltophilia (n:1, 0.5%), respectively. Additionally Extended-Spectrum Beta-Lactamase (ESBL) were detected as positive in 7 *E.coli*.

Conclusions: Gram negative bacteria are still important. However; in recent years, coagulase negative staphylococci are the most detected bacteria in Intensive Care Units. For this reason, increased MRCNS rate may restrict antibiotic options and lead increasing the usage of glyco- peptides prophylactically. It is necessary to perform active surveillance studies, obey standard infection control measures and develop an appropriate antibiotic policy for decreasing the frequency of resistant microorganisms, due to the changes in microorganism types in ICUs and their antibiotic susceptibilities.

Keywords: Intensive Care Units; Blood stream Infections; Epidemiology.

***Corresponding Author**:
Murat Karamese,
Department of Microbiology, Faculty of Medicine, Kafkas University, 36100, Kars, Turkey.
Tel: +90 554 863 8853
E-Mail: murat_karamese@hotmail.com

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Introduction

Infection is a major problem for patients in intensive care units (ICUs) [1]. Nosocomial infections occurs in 3-18% of hospitalized patients, with the rates being upto 54% in ICUs [2]. ICU patients are at a high risk for nosocomial infections, 5 to 10 times more than those in general medical clinics [3]. Infections caused by resistant bacteria are frequently seen patients in ICUs becaues of using of invasive devices (e.g., mechanical ventilators, central venous catheters or urinary catheters), broad spectrum antibiotics, general poor health, long hospital stays [4, 5].

Antimicrobial agents are used in more than 60% of ICU patients for several reasons. Frequent use of antimicrobial agents contributed developing to resistant both of gram positive and gram negative bacteria. Methicillin resistant staphylococcus aureus (MRSA), vancomycin resistant enterococcus (VRE), glycopeptide-intermediate *S.aureus* (GISA), Extended-spectrum beta-lactamases (ESBL) positive *Escherichia coli*, *Klebsiella* spp, *Enterobacteriaceae spp*, *Acinetobacter* spp and Pseudomonas aeruginosa are resistant microorganisms that caused various infection by using of antimicrobial agents in ICUs [6]. Especially the use of third generation cephalosporins, fluoroquinolones and carbapenem derivatives play an important role in the development of nosocomial infections caused by resistant bacteria [7].

Nosocomial blood stream infection (BSI) is a important and potentially avoidable complication of hospitalization and is a com-

mon cause of morbidity and mortality [8, 9] Nosocomial BSIs are one of the most frequent and severe infectious complications of hospitalization and medical care. Therefore understanding the origins, treatment and outcomes of nosocomial BSIs is important [10].

Early initiation of convenient antimicrobial treatment is considerable in decreasing mortality and morbidity among patients with BSI [11]. On the other hand using of inappropriate antimicrobial therapy for blood stream infections may be associated with antibiotic resistance. Especially hospital acquired BSIs which are associated with higher hospital mortality rates [12].

Factors of developing nosocomial infections in ICUs might differ between hospitals even in a different ICUs of the same hospital. Furthermore distribution of the pathogenic microorganisms for nosocomial bacteraemia may show change by passage of time [13].

In ICUs of hospitals, understanding trends in infection rates, incidence and proportion among different causative organisms and regular monitoring of antimicrobial drug resistance are important for infection control, determination of prescription and choice of drug for empirical therapy [14].

In this study, our aim is to determine retrospectively the epidemiology of blood stream infections occurred in Intensive Care Units of Kafkas University Health Research and Application Hospital and to present the first data from this university hospital.

Materials and Methods

Study Design

Total 1004 patient samples for blood culture were sent to Microbiology Laboratory of Kafkas University Health Research and Application Hospital from different ICUs of our hospital between January 2013 to January 2015. Blood samples (10ml) were collected from the patients into the blood culture bottles. In this study, the epidemiology and antibiotic resistance of microorganisms isolated from blood culturein ICUs were examined retrospectively.

If only one of at least three blood cultures was positive, it was considered as contamination. It was considered as pathogen when same microorganism was detected at more than one blood culture.

Organism Identification and Susceptibility Tests

Automated BACTEC 9050 Blood Culture System was used for investigate of the presence of microorganisms in blood culture. All blood culture bottles were placed into the machine and followed for seven days. When the machine detected positive blood culture bottles, culture passages were made to the 5% Sheep Blood Agar and Eosin-Methylene Blue (EMB) agar. The agar plates were incubated for 24 - 48 hours at 37°C.

The microorganisms were identified by conventional methods such as gram staining, biochemical tests, catalase, coagulase test and Phoneix 100 BD Microorganism Identification System (Becton Dickinson, Diagnostic Instrument Systems, Sparks,USA.

Antibiotic susceptibility test were performed by using both BD Phoneix Microorganism Identification System and Kirby-Bauer Disk Diffusion method according to the standards of Clinical and Laboratory Standards Institute (CLSI).

Statistical Analysis of Data

The statistical analysis was performed using SPSS for Windows Version 17.0 (Statistical Package for Social Sciences version 17.0).

Results

During the 25 month period started at January 2013 till January 2015, a total of 1004 blood culture bottle were sent to Microbiology Laboratory of Kafkas University Health Research and Application Hospital from different ICUs of our hospital. Total 202 samples were detected. The biggest part of total positive samples (n:164, 81.2%) were sent by Internal Intensive Care Unit. Other positive samples were isolated from the blood culture which came from different ICUs such as; Surgery Intensive Care Unit (n:22, 10.9%), Cardiovascular Surgery Intensive Care Unit (n:13, 6.4%), Neurology Intensive Care Unit (n:3, 1.5%), (Table 1).

The identified bacteria were MRCNS (n:67, 33.2%), MSCNS (n:42, 20.8%), MRSA (n:29, 14.3%), E.coli (n:23, 11.3%), MSSA (n:16, 7.9%), *P. aeruginosa* (n:9, 4.5%), *Enterococcus* spp (n:9, 4.5%), *K. pneumoniae* (n:4, 1.9%), *A.baumannii* (n:1, 0.5%), Proteus mirabilis (n:1, 0.5%), Stenotrophomonas maltophilia (n:1, 0.5%), respectively (Table 2).

In this study all gram positive bacteria were susceptible to teicoplanin, vancomycin and linezolid. Among the MRCNS, the rates of resistance to ciprofloxacin, erythromycin, clindamycin, gentamycin and tetracycline were 68.6%, 77.6%, 70.1%, 53.7% and 41.7% respectively. On the other hand at the MSCNS, ciprofloxacin, erythromycin, clindamycin, gentamycin and tetracy-

Table 1. Distribution of positive samples according to isolated clinics.

Clinics	Number (n)	%
Internal Intensive Care Unit	164	81.2
Surgery Intensive Care Unit	22	10.9
Cardiovascular Surgery Intensive Care Unit	13	6.4
Neurology Intensive Care Unit	3	1.5
Total	**202**	**100**

Table 2. Isolated microorganisms from positive samples.

	Internal ICU	Surgery ICU	Cardiovascular Surgery ICU	Neurology ICU	Total
MRCNS	53	10	3	1	67
MSCNS	35	2	5	-	42
MRSA	21	4	3	1	29
E.coli	20	2	1	-	23
MSSA	13	3	-	-	16
P.aeruginosa	8	-	-	1	9
***Enterococcus* spp**	7	1	1	-	9
K.pneumoniae	4	-	-	-	4
A.baumannii	1	-	-	-	1
P. mirabilis	1	-	-	-	1
S. maltophilia	1	-	-	-	1

cline resistance rates were detected 54.77%, 66.6%, 50.0%, 38.0% and 19.0% respectively. Various antimicrobial resistance rate of MRSA isolates such asciprofloxacin, erythromycin, clindamycin, gentamycin and tetracycline were 79.3%, 75.8%, 72.4%, 65.5% and 65.5% respectively. Additionally the rates of resistance to-ciprofloxacin 31.2%, erythromycin 50%, clindamycin %25, gentamycin 6.2% and tetracycline %37.5 in MSSA isolated from blood culture (Table 3).

In the present study among the *E. coli*, the rates of resistance to ampicillin, amoxicillin clavulonic acid, piperacillin tazobactam, ceftazidime, ceftriaxone, cefepime, ciprofloxacin, trimethoprim sulfamethoxazole, gentamicin, amikacin imipenem and meropenem were 86.9%, 21.7%, 17.3%, 43.4%, 56.5%, 30.4%, 43.4%, 34.7%, 17.3%, 0%, 8.6% and 4.3% respectively. Additionally Extended-Spectrum Beta-Lactamase (ESBL) were detected as positive in 7 *E.coli* .On the other hand the rates of resistance topiperacillin tazobactam 33.3%, ceftazidime 55.5%, cefepime 44.4%, ciprofloxacin 44.4%, gentamicin 22.2%, amikacin 11.1%, imipenem 11.1% and meropenem 0.0% in *P. aeruginosa* isolated from blood culture (Table 4).

Discussion

Table 3. Antimicrobial resistance rates of gram positive bacteria isolated from blood culture in ICUs (%).

	MRCNS	MSCNS	MRSA	MSSA
Ciprofloxacin	68.60%	54.77%	79.30%	31.20%
Erythromycin	77.60%	66.60%	75.80%	50%,
Clindamycin	70.10%	50.00%	72.40%	25%,
Gentamycin	53.70%	38.00%	65.50%	6.20%
Tetracycline	41.70%	19.00%	65.50%	37.50%
Teicoplanin	0%	0%	0%	0%
Vancomycin	0%	0%	0%	0%
Linezolid	0%	0%	0%	0%

Table 4. Antimicrobial resistance rates of *E.coli* and *P. aeruginosa* isolated from blood culture in ICUs (%)

	E.coli	***P. aeruginosa***
Ampicillin	86.9%	-
Amoxicillin clavulonic acid	21.7%	-
Piperacillin tazobactam	17.3%	33.3%,
Ceftazidime	43.4%	55.5%,
Ceftriaxone	56.5%	-
Cefepime	30.4%	44.4%,
Ciprofloxacin	43.4%	44.4%,
Trimethoprim sulfamethoxazole	34.7%	-
Gentamicin	17.3%	22.2%,
Amikacin	0.0%	11.1%,
İmipenem	8.6%	11.1%,
Meropenem	4.3%	0.0%

Blood stream infection (BSI) is a serious problem in hospitals because of leading to morbidity and mortality in the world [15, 16]. BSI can be seen primary or secondarily. The cause of these infections may be another localized infection at different body regions. Focus of infection are not identified at primary BSIs. Likewise BSIs are frequently seen in ICUs and associated with multisystem organ dysfunction, severe sepsis and septic shock. Therefore early suitable antimicrobial therapy and blood culture results are very important for patients with BSI [17].

Over the past 30 years, frequency of bacteremia, etiology and epidemiology have occurred some changes especially among patients requiring intensive care treatment. The most frequently isolated pathogens in the 1970s were gram-negative bacteria but gram positive cocci began to come to the fore in the 1980s and 1990s [13]. Additionally the incidence of pathogens isolated from blood cultures may vary over the years. In study of Starnes et al, changing microbial trends was investigated among the six years period in the surgical intensive care unit. In this study, when blood culture results were evaluated, frequency of the Enterococcus specieswere decreased over time. In contrast, the incidence of oxacillin-resistant Staphylococcus aureus (ORSA) isolated from blood cultures was found to increase in later years [18]. In our study, the most isolated pathogens from blood culture were gram positive cocci, MRCNS, MSCNS, MRSA, MSSA, 33.2%, 20.8%, 14.3%, 7.9% respectively, indifferent ICUs of our hospital. Several studies on this subject shows that vary the distribution of infection in the ICUs between hospitals and countries. In study of Laupland et al, total of 244 isolates were invetstigated from isolated to ICU acquired blood stream infections. They reported that gram positivecocci predominate as pathogens in the Calgary health region and deteceted major species were *S. aureus*, coagulase negative staphylococci and *E. faecalis*, 18%, 11% and 8% respectively [19]. In another study conducted in Estonia [20], they reported that *Pseudomonas spp*., CNS and *Candida spp*. isolated from blood stream infections was considerably more prevalent among ICU than non ICU cases. Also in this study, *S. aureus* and *E.coli* isolated from blood stream infections were detected more frequently in non ICU patients than ICU cases [20]. In another study conducted, 2846 positive samples isolated from blood cultures in ICU at a tertiary care hospital in North India were analysed by Wattal et al. [21] and in their study CNS was the most prevalent pathogens isolated from blood cultures in ICU patients followed by *Candida* spp. in 20.3% and 17.5% respectively. It was reported that the other most commonly isolated pathogens were *Klebsiella* spp. followed by *Acinetobacter* spp. among gram negative bacilli [21].

Consequently, in our study we detected that CNS is the most common pathogens isolated from blood culturesin ICU at our hospital. This result is found consistent with other studies [20-22]. CNS is member of the indigeneous micribiota of healthy peoples. Hospitalized patients often become colonized with CNS as a result of its presence in the patient's flora and hospital environment. Therefore when these microorganisms are detected in blood cultures, it should be examined for the purpose of pathogen or contamination. Because of difficult to make this distinction, clinicians should be warned for rules must be followed when the blood cultures are taken from patients [13]. If only one of blood cultures was positive, it was evaluated as contamination. It is considered as pathogen, if same microorganism is detectedfrom two or more blood cultures or if microorganism is isolated from another infectious focus (urine, sputum or wound) in addition to blood culture [23].

Bacteremia is an independent risk factor for mortality of patients in ICUs. Early initiation of appropriate antimicrobial therapy of blood stream infection with guidelines and previous knowledgeis very important. Therefore initiation of empiric treatment with targeting etiologic pathogens is necessary for reduction ofmorbidity and mortality of patients with blood stream infection. Furthermore patients should be treated with broad spectrum antimicrobial agents when presence of risk factors of antibiotic resistance in cases with a serious infection. On the other hand using of inadequate antimicrobial therapy for blood stream infections cause to antibiotic resistance in pathogen microorganisms. Considering the insufficiency of new antimicrobial agents in the pharmaceutical industry and development of resistance to available antibiotics, restrict the choice of antibiotics for treatment of infections and the success of treatment is decreasing [17].

Multidrug resistant microorganisms including, MRSA, carbapenem resistant *Enterobacteriaceae*, VRE, non-fermenters pathogens and non-albicans *Candida* spp. are caused to blood stream infectionat ICU patients. In study of Wattal et al found that in CNS strains the resistance rates topenicillin, oxacillin, clindamycin, gentamicin and vancomycin were 99.5%, 94%, 80%, 72% and 0% respectively. Also in this study resistance of *S. aureusstrains* for these antimicrobial agents were detected as 100%, 47%, 49%, 56% and 0% respectively [21]. In our study, among the MRCNS, the rates of resistance to ciprofloxacin, erythromycin, clindamycin, gentamycin and tetracycline were 68.6%, 77.6%, 70.1%, 53.7% and 41.7% respectively. Additionally the rates of resistance tociprofloxacin 79.3%, erythromycin 75.8%, clindamycin 72.4%, gentamycin 65.5% and tetracycline 65.5% in MRSA isolated from blood culture in ICU patients. In this study, we observed that MRSA and MRCNS strains had significantly higher resistance than MSSA and MSCNS strains. In our study, there was no resistance to teicoplanin, vancomycin and linezolidin all gram positive bacteria including *S. aureus*, CNS and *Enterococcus* spp.

E. coli and *P. aeruginosa* for Gram negative are important in bloodstream infections of ICU patients at this and another studies [3, 13, 17, 19, 21]. In our study, especially beta-lactam group of antibiotics, we found high resistance rates in microorganisms isolated from blood culturein ICUs (Table 4).

Conclusion

In conclusion, gram negative bacteria are still important. However; in recent years, coagulase negative staphylococci are the most detected bacteria in Intensive Care Units. For this reason, increased MRCNS rate may restrict antibiotic options and lead increasing the usage of glyco- peptides prophylactically. It is necessary to perform active surveillance studies, obey standard infection control measures and develop an appropriate antibiotic policy for decreasing the frequency of resistant microorganisms, due to the changes in microorganism types in ICUs and their antibiotic susceptibilities.

References

[1]. Vincent JL, Rello J, Marshall J, Silva E, Anzueto A, Martin CD, et al. (2009) International study of the prevalence and outcomes of infection in intensive care units. JAMA. 2;302(21): 2323-9.

[2]. Ding JG, Sun QF, Li KC, Zheng MH, Miao XH, Ni W, et al (2009). Retrospective analysis of nosocomial infections in the intensive care unit of a

tertiary hospital in China during 2003 and 2007. BMC Infect Dis.; 9: 115.
[3]. Custovic A, Smajlovic J, Hadzic S, Ahmetagic S, Tihic N, et al (2014) Epidemiological surveillance of bacterial nosocomial infections in the surgical intensive care unit. Mater Sociomed. 26(1): 7-11.
[4]. Aytekin ÇIKMAN NSG, Faruk KARAKEÇİLİ, Ebru KORKMAZ, Öztekin ÇIKMAN (2012) Microorganisms Isolated from Various Clinical Samples of Intensive Care Unit Patients and their Antibiotic Susceptibilities. ANKEM Derg. 26(3): 131-6.
[5]. Fridkin SK, Welbel SF, Weinstein RA (1997) Magnitude and prevention of nosocomial infections in the intensive care unit. Infect Dis Clin North Am. 11(2): 479-96.
[6]. YALÇIN AN (2009) Antibiotic Usage and Resistance Problem in Intensive Care Unit. ANKEM Derg. 23(addition 2): 136-42.
[7]. Ayşe ERTÜRK AÇÇ, Ersin KÖKSAL, Zeynep ŞENTÜRK KÖKSAL, Songül ÖZYURT (2012) Microorganisms Isolated from Various Clinical Samples and their Antibiotic Susceptibilities in Intensive Care Unit Patients. ANKEM Derg. 26(1): 1-9.
[8]. Prowle JR, Echeverri JE, Ligabo EV, Sherry N, Taori GC, et al (2011) Acquired bloodstream infection in the intensive care unit: incidence and attributable mortality. Crit Care. 15(2): R100.
[9]. Karchmer AW (2003). Nosocomial bloodstream infections: organisms, risk factors, and implications. Clin Infect Dis. 31 Suppl 4:S139-43.
[10]. Cosgrove SE, Carmeli Y (2003). Studies of bloodstream infection outcomes: reading between the lines. Infect Control Hosp Epidemiol. 24(12): 884-6.
[11]. Erdem I, Ozgultekin A, Sengoz Inan A, Ozturk Engin D, Senbayrak Akcay S, et al (2009) Bloodstream infections in a medical-surgical intensive care unit: incidence, aetiology, antimicrobial resistance patterns of Gram-positive and Gram-negative bacteria. Clin Microbiol Infect. 15(10): 943-6.
[12]. Kollef MH (2000). Inadequate antimicrobial treatment: an important determinant of outcome for hospitalized patients. Clin Infect Dis. Suppl 4: S131-8.
[13]. Nisel YILMAZ ŞK, Neval AĞUŞ, Gülfem ECE, Gülgün AKKOÇLU (2010), Cenk KIRAKLI. Microorganisms Isolated from Blood Cultures of Intensive Care Unit Patients, their Antimicrobial Susceptibility and Etiological Agents in Nosocomial Bacteremia. ANKEM Derg. 24(1): 12-9.
[14]. Liu CY, Liao CH, Chen YC, Chang SC (2010) Changing epidemiology of nosocomial bloodstream infections in 11 teaching hospitals in Taiwan between 1993 and 2006. J Microbiol Immunol Infect. 43(5): 416-29.
[15]. Wisplinghoff H, Bischoff T, Tallent SM, Seifert H, Wenzel RP, et al (2004) Nosocomial bloodstream infections in US hospitals: analysis of 24,179 cases from a prospective nationwide surveillance study. Clin Infect Dis. 39(3): 309-17.
[16]. Suljagic V, Cobeljic M, Jankovic S, Mirovic V, Markovic-Denic L, et al (2005) Nosocomial bloodstream infections in ICU and non-ICU patients. Am J Infect Control. 33(6): 333-40.
[17]. Timsit JF, Soubirou JF, Voiriot G, Chemam S, Neuville M, et al (2014) Treatment of bloodstream infections in ICUs. BMC Infect Dis. 2014; 14:489.
[18]. Starnes MJ, Brown CV, Morales IR, Hadjizacharia P, Salim A, et al (2008). Evolving pathogens in the surgical intensive care unit: a 6-year experience. J Crit Care. 23(4): 507-12.
[19]. Laupland KB, Kirkpatrick AW, Church DL, Ross T, Gregson DB (2004) Intensive-care-unit-acquired bloodstream infections in a regional critically ill population. J Hosp Infect. 58(2): 137-45.
[20]. Mitt P, Adamson V, Loivukene K, Lang K, Telling K, et al (2009) Epidemiology of nosocomial bloodstream infections in Estonia. J Hosp Infect. 71(4): 365-70.
[21]. Wattal C, Raveendran R, Goel N, Oberoi JK, Rao BK (2014) Ecology of blood stream infection and antibiotic resistance in intensive care unit at a tertiary care hospital in North India. Braz J Infect Dis. 18(3): 245-51.
[22]. Marra AR, Camargo LF, Pignatari AC, Sukiennik T, Behar PR, et al (2011) Nosocomial bloodstream infections in Brazilian hospitals: analysis of 2,563 cases from a prospective nationwide surveillance study. J Clin Microbiol. 49(5): 1866-71. PubMed PMID: 21411591.
[23]. Shafazand S, Weinacker AB (2002) Blood cultures in the critical care unit: improving utilization and yield. Chest. 122(5): 1727-36.