Epidemiological study of antimicrobial susceptibility profile among bloodstream infection cases in ICU setting of a tertiary care hospital

[1]NP Singh, Director Professor and Head, Department of Microbiology, University College of Medical Sciences & Guru Teg Bahadur Hospital, Delhi.

[2]Rituparna Saha, Senior Resident, Department of Microbiology, University College of Medical Sciences & Guru Teg Bahadur Hospital, Delhi.

[3]Nisha Goyal, Senior Resident, Department of Microbiology, University College of Medical Sciences & Guru Teg Bahadur Hospital, Delhi.

Corresponding Author: Nisha Goyal, Senior Resident, Department of Microbiology, University College of Medical Sciences & Guru Teg Bahadur Hospital, Delhi.

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Abstract

Objective: Blood stream infections in ICUs are increasingly becoming a therapeutic challenge. The augmented vulnerability of admitted patients, multiple therapeutic and diagnostic procedures, further aggravates infection rates. Thus elucidation of the epidemiological profiles of BSIs caused by these resistant bacteria can help us in better understanding of the pathogens surviving in these settings.

Methods: Over a period of six months, all blood samples received in the Microbiology lab from intensive care units (ICU) for culture and sensitivity, were included in the study.

Results: Over a period of six months, 96 blood samples from ICU patients yielded positive growth. Gram negative bacilli accounted for 73% of all blood stream infection isolates, while gram positive cocci attributed to 27% of all such infections, in the present study. *Klebsiella pneumoniae* amounted for 30% of all isolates.

Conclusions: The findings of the study further emphasizes the need for adequate hospital antibiotic policies

Key words: BSI, Antimicrobial Resistance, ICU

Introduction

Blood stream infections in ICUs are increasingly becoming a therapeutic challenge. The augmented vulnerability of admitted patients, multiple therapeutic and diagnostic maneuvers, further aggravate infection rates. The frequent transfer of patients from acute to long-term treatment facilities and vice versa, as well as, the concentration of multidrug resistant strains in such high risk settings often complicate the scenario.[1] These multidrug resistant strains, often colonize various surfaces within the ICU environment and have become increasingly pertinent to health-care associated infections. Over the past few years the incidence of bacterial Blood Stream Infections (BSIs), that are resistant to multiple antimicrobial agents, have risen considerably.[2] The ICU patients are already critically ill and often have a compromised immunity. When they are infected, prompt

institution of narrow spectrum targeted therapy becomes the essence of treatment. The high mortality and morbidity rates of BSIs in ICU settings is at least partly attributable to the delay in targeted antimicrobial therapy. Inadequacy in choice of antimicrobials in such settings, not only add in terms of patient morbidity and adverse outcome rates, but also the selection and spread of these multi-drug resistant strains within the ICU.

Thus elucidation of the epidemiological profiles of BSIs caused by these resistant bacteria, not only help us formulate optimal antibiotic policies, but also help us form preventive strategies. The aim of this study is to provide an overview of the antimicrobial susceptibility patterns of the pathogens causing BSIs in an ICU of a high volume centre.

Material and Methods

The present study was a prospective, cross-sectional study, conducted at a high volume tertiary care centre of north India. Over a period of six months, all blood samples received in the Microbiology lab from intensive care units (ICU) for culture and sensitivity, were included in the study. Samples were received in BD BACTEC (Becton, Dickinson and Company, USA) bottles and were incubated in the BD BACTEC Automated blood culture system for 5 days. Any sample, emitting positive growth signal was sub cultured on blood agar and MacConkey agar. The samples were processed as per the standard protocol. The culture and antibiotic sensitivity were performed using the BECKMAN COULTER MicroScan WalkAway 96 plus. Only the first blood sample received in our lab from the same patient was included in this study.

Results

Over a period of six months, 96 blood samples from ICU patients yielded positive signals for growth in BD

BACTEC Automated blood culture system. Figure 1 illustrates the distribution of various organisms isolated from blood specimens of ICU patients. Gram negative bacilli accounted for 73% of all blood stream infection isolates, while gram positive cocci attributed to 27% of all such infections, in the present study.

The most common pathogen isolated from blood stream of ICU patients, was *Klebsiella pneumoniae,* amounting to 30% of all isolates. *Acinetobacter baumannii* (24%) was the second most common organism isolated, followed by (13%) *Stenotrophomonas maltophila.* Among gram positive isolates, *Staphylococcus spp*. (25%) was the most predominant, followed by *Enterococcus spp.* Coagulase negative *Staphylococcus* (CoNS) were most common gram positive organisms isolated, comprising 60% of all gram positive isolates. Among CoNS, *Staphylococcus epidermidis* followed by *Staphylococcus hemolyticus* and *Staphylococcus hominis*. This was closely followed by *Staphylococcus aureus* and *Enterococcus spp.*

Figures 2 and 3 illustrate the antibiograms of the major gram negative isolates in this study. The antibiotic least sensitive against *Klebsiella spp.* isolates was Ampicillin. On the other hand, Imipenem showed the highest sensitivity against *Klebsiella spp* isolates. The most sensitive antimicrobial agents against gram positive organisms were Vancomycin, Teicoplanin and Linezolid. Approximately 65% of all *Staphylococcus aureus* stains were Methicillin Resistant *Staphylococcus* (MRSA) (Figure-4). Tetracycline, Cotrimoxazole and Clindamycin were found to be relatively sensitive against MRSA strains.

Discussion

Gram negative organisms constituted the predominant share (73%) of all blood stream isolates from ICU patients in the present study. This was in concordance with the

findings of other studies conducted by Sakr Y et al[3], Russoto et al[4] , which have reported gram negative organisms contributing 67% and 57% respectively of all blood stream infections. However, studies conducted by Basetti et al[5], Orsini et al [6] reported gram positive organisms to be the predominant cause of blood stream infections in ICU setting. Relatively higher rates of isolation of gram negative organisms have been reported from ICU setting from a study conducted by Lachhab et al amounting to 84% of all isolates.[7]

The most common pathogen isolated in the present study was *Klebsiella pneumoniae* (30%). This was in contrast to studies conducted by Russoto et al[4] and Lachhab et al[7] where *Acinetobacter baumanii* was the commonest blood stream pathogen. *Acinetobacter baumanii* was the second most common organism isolated in our study. The above studies have reported *Klebsiella pneumonia* and *Pseudomonas aeruginosa* as the second and third most common BSI pathogens. Few studies have also reported *E.coli* as the commonest gram negative pathogen for blood stream infections in ICU settings, which differed from the findings of our study.[8, 5]

We have recovered *Stenotrophomonas maltophila* in 13% of all blood stream infection isolates from the ICU. *Stenotrophomonas maltophila* is an emerging nosocomial gram negative non-fermenter. It is known to cause bacteremias in patients with underlying malignancies, immunosuppresion, indwelling devices, chronic respiratory diseases, long term antibiotic therapy and prolonged in hospitalization, especially in ICUs.[9] *S. maltophilia* BSIs are associated with high mortality, which in turn is related to severe neutropenia, shock, and *S. maltophilia* pneumonia.[10] The drug of choice for such infections is Cotrimoxazole, which was found to be sensitive in 100% of all our blood stream isolates.

The most common gram positive organisms isolated in our study were CoNS. This finding was in concordance to the findings of other studies conducted by Orsini et al. and Rehman et al [6,11] CoNS are mostly, considered as contaminants rather than the true pathogens. Despite, increasing isolation of CoNS as true pathogen of blood stream infections, distinguishing true infection from contamination by CoNS remains difficult without a gold standard.[12,13] The commonest CoNS isolated in the present study was *S. epidermidis* followed by *S. hemolyticus* and *S. hominis.* Similar findings have also been reported from other studies across India and other parts of the world.[14,15,16]

In our study the most susceptible antibiotics against gram positive organisms were Vancomycin, Teicoplanin and Linezolid. This has been in agreement with the findings of other studies conducted across the world.[6,8] Approximately 65% of all *Staphylococcus spp.* isolates in our study were Methicillin Resistant *S. aureus* (MRSA). However, other studies conducted by Orsini et al (40%), Lachhab et al (20%) and Russotto et al (48%), from various geographical regions, have reported lower rates of MRSA isolation from blood stream infections. [6,7,16] Among the CoNS, *S. epidermidis* showed methicillin resistance in 100% isolates. This propensity of *S. epidermidis* and other CoNS towards increasing methicillin resistance is also consolidated by the findings of other studies. [11,16, 15]

The most sensitive antimicrobials for gram negative blood stream infections were Imipenem, Gentamicin and Tetracycline. Imipenem was found to be more susceptible than Meropenem for treating gram negative BSI. This could be partially attributed to the increased usage of Meropenem in the ICU settings. Only 33% and 12% of *Acinetobacter spp.* were susceptible to Imipenem and

Meropenem respectively. Such high rates of Carbapenem resistance have also been reported by various authors from different parts of the world. [7,8,17,18] However, a study conducted by Lachhab et al has reported 100% resistance of *Acinetobacter baumanii* to Imipenem, which was much higher in comparison to our finding.[7] The diverse Carbapenem susceptibility patterns can be explained on the basis of geographical variations and difference in antibiotic pressure on isolates. Several studies have postulated prolonged hospital stay, especially in ICUs; invasive procedures and unregulated carbapenem usage as plausible risk factors for carbapenem-resistant *Acinetobacter baumannii* and other gram negative blood stream infections.[19,20]

Conclusion

The ICUs form an epicenter of infection due to multi-drug resistant BSIs. The predominant isolates from BSIs in ICU patients were *Klebsiella pneumoniae* followed by *Acinetobacter baumannii*. CoNS were the commonest gram positive organisms causing BSIs in the ICU. Also, the CoNS showed higher rates of Methicillin resistance as compared to *S. aureus*. The findings of the study further emphasizes the need for adequate hospital antibiotic policies. Targeted narrow spectrum therapy and vigilant de-escalation of high end antibiotics is the need of the hour.

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Legends Figure

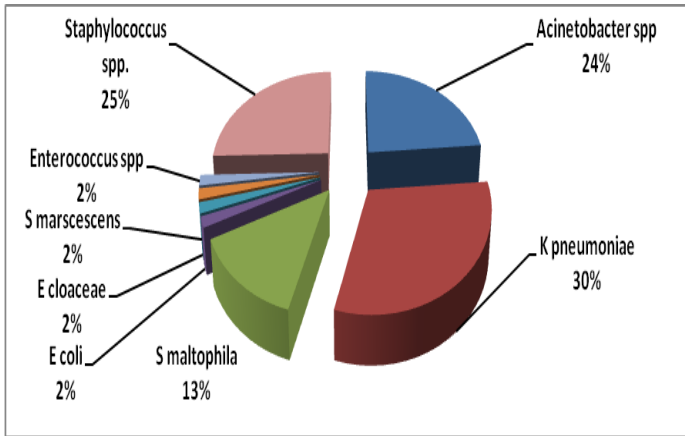**Figure 1: Distribution of Blood stream infection isolates from ICU**
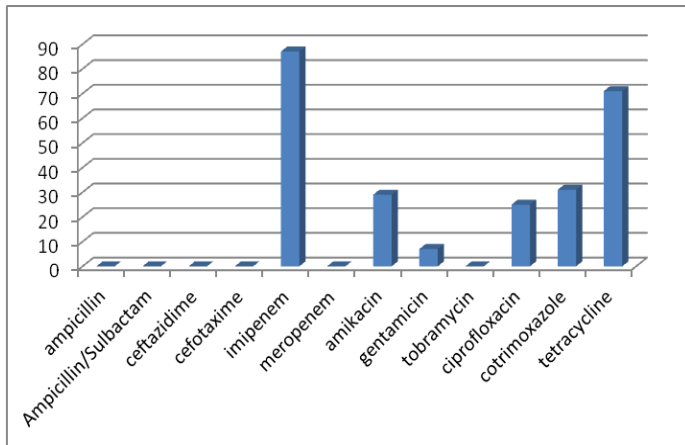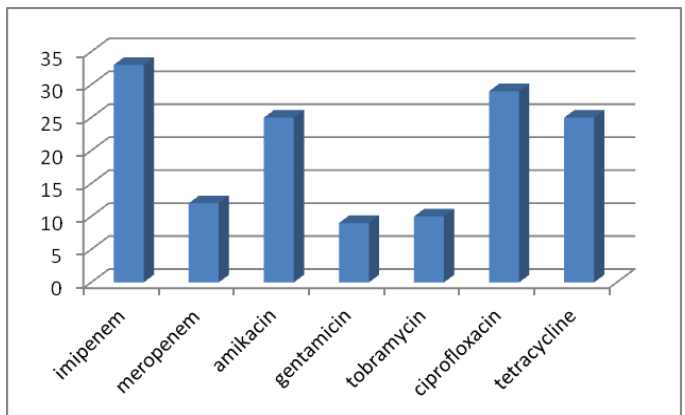

Figure 4: Percentage sensitivity of major gram positive isolates

Figure 2: Percentage susceptibiity of *Klebsiella spp*

Figure 3: Percentage susceptibiity of *Acinetobacter spp*