Prevalent pathogens and their behaviour in blood stream infections in a tertiary care hospital

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Abstract
Bloodstream infections (BSIs) can range from in apparent bacteremia until fulminant septic shock with high mortality. The present study was undertaken to analyze the various prevalent pathogens causing BSIs and study their behavior in a tertiary care hospital. A total of 8091 blood specimens from clinically suspected cases were studied for 6 months from January 2018 to June 2018. Blood specimens were incubated in BacT/ALERT® 3D system. The positive blood isolates were identified and their antimicrobial resistance patterns were checked using modified Kirby-Bauer method. Out of 8091, 1445 (17.8%) yielded growth of significant microorganisms. Among them Gram positive bacteria were 540 (37.3%). Gram negative bacilli were 899 (62.2%). Among the gram positive bacteria maximum resistance was seen with Erythromycin, ciprofloxacin and cotrimoxazole. Most of gram negative bacilli were multidrug resistant. Monitoring of data regarding the prevalence of microorganisms and its resistance patterns would help in formulating policies for empirical antimicrobial therapy.

Keywords: Blood, sepsis, sensitivity, resistance

1. Introduction
Blood is considered to be a sterile fluid unless proved otherwise. Invasion of the bloodstream by microorganisms constitutes one of the most serious situations in infectious disease. Microorganisms present in circulating blood whether continuously, intermittently, or transiently are a threat to every organ in the body [1]. Bloodstream infections (BSIs) are associated with a high mortality rate of 20%–50% and one of the most common health-care associated infections [2]. Clinical presentation ranges from benign transient bacteremia with little or no symptoms to fulminant septic shock with high mortality [3]. It requires rapid and aggressive antimicrobial therapy [4]. The change of prevalence and antimicrobial resistance pattern among bloodstream pathogens is a significant problem worldwide with severe consequences including increased cost of care, morbidity, and mortality [2, 5]. The increasing resistance to most commonly used antimicrobials results in a reduction in therapeutic options [5]. Thus, the detection of BSIs must be given priority in all health-care settings. Clinical laboratory diagnosis is crucial to avoiding delay in treatment [6-8]. Prevalence and susceptibility patterns of microorganism vary according to geography and even within the same hospital with time. A positive blood culture does not necessarily confirm infection, since contamination of blood can occur. The recovery of organisms traditionally considered as pathogens pose no problems in interpretation [9]. The use of automated culture system for monitoring blood cultures increases the speed and improves efficiency in detection of bloodstream pathogens. The system monitors the consumption of carbon dioxide by calorimetric method, generally detecting positive growth after 48 hours. The infections caused by multidrug-resistant organisms are more likely to be associated with prolonged hospital stay, increased mortality and thus requires treatment with more expensive antimicrobials. In almost all cases, antimicrobial therapy is initiated empirically before the results of blood culture are available. Monitoring and analyzing the antimicrobial resistance pattern of most frequently isolated microorganisms help the clinicians to choose effective antimicrobial therapy as well as empirical antimicrobials. Therefore, the present study was undertaken to analyze the various prevalent pathogens causing BSIs and study their behavior in a tertiary care hospital to guide the clinicians for formulating antimicrobial policies for empirical therapy.
2. Material and Methods
A total of 8091 blood specimens from clinically suspected cases of septicemia were studied at a tertiary care hospital for 6 months from January 2018 to June 2018. This prospective study was conducted in the department of microbiology, PGIMER & Dr RML Hospital, New Delhi. During the six months period, 8091 samples received from various departments were processed and relevant findings were noted. Patients presented with prolonged fever or clinical impression of septicaemia/bacteraemia. History of antibiotic usage empirically either before or after admission was also obtained.

Single blood specimen was collected from inpatients and outpatients of our hospital during the study, and the specimens were processed in clinical microbiology laboratory. The contaminated, duplicate, and repeat specimens were excluded from the study. Blood sample was collected aseptically from each patient before the start of antimicrobial therapy. In case of adults, 5–10 ml (average 7 ml) and pediatrics 1–5 ml (average 3 ml) were inoculated in BacT/ALERT® FA and PF plus-aerobic bottles (BioMerieux, Durham, NC, USA), respectively. After inoculation, these bottles were immediately incubated in BacT/ALERT® 3D system (a fully automated blood culture system for detection of aerobic growth in blood samples). The blood specimens were incubated for a maximum period of 7 days, and if there was no growth, the result was read as negative. While in case of positive growth, the BacT/ALERT® system automatically showed an alert. Then the positive blood culture bottles were taken out and subcultured on blood agar and MacConkey agar plates. The growth was stained by Gram’s staining method and was further identified by biochemical tests. Antibiotic sensitivity testing was done by modified Kirby-Bauer method as per Clinical Laboratory Standards Institute guidelines. The discs tested for Gram positive organisms were Cefoxitin (30ug), Ciprofloxacin (5ug), Cotrimoxazole (1.25/23.75ug), Vancomycin (30ug), Erythromycin (15ug), Tetracycline (30ug), Cefuroxime (30ug) and Linezolid (30ug). Gentamicin high (120ug) was used for Enterococcus species.

For Gram negative isolates gentamicin (10ug), amikacin (30ug), ciprofloxacin (5ug), cotrimoxazole (1.25/23.75ug), Ceftazidime (30ug), Cefotaxime (30ug), aztreonam (30ug), piperacillin-tazobactam (100/10ug), Meropenem (10ug), colistin (10ug), tigecycline (15ug) were tested.

3. Results
During the study of 6 months, a total of 8091 blood culture specimens were received from various clinical wards. Out of 8091 specimens, 1445 (17.8%) yielded growth of different microorganisms. From these isolates, 899 (62.2%) were Gram-negative bacilli, 540 (37.3%) were Gram-positive cocci and rest 7 (0.4%) were yeasts. Figure 1 shows that the most common microorganism isolated are Escherichia coli followed by Staphylococcus aureus, Pseudomonas spp. and others.

Among the gram positive bacteria maximum resistance was seen with Erythromycin, ciprofloxacin and cotrimoxazole. (Table 1) No resistance was seen with vancomycin. Most of gram negative bacilli were multidrug resistant. (Table 2) Resistance was more in case of admitted patients than out patients.

<table>
<thead>
<tr>
<th>Table 1: % Sensitivity of Gram negative isolates</th>
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<tr>
<td>Gram negative bacilli</td>
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<tr>
<td><em>Acinetobacter</em></td>
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<td><em>Salmonella typhi</em></td>
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Fig 1: Distribution of various isolates from different areas
positive organisms were sensitive to cotrimoxazole (58%). Arora et al. have reported Ampicillin resistance (89.96%), cephalaxine (68.7%) and piperacillin (51.71%). In this study we found carbapenems to be effective in the treatment of multidrug resistant gram negative infections in patients admitted in wards and ICUs. OPD isolates were usually sensitive to most of the antibiotics.

4. Discussion

BSI is a major cause of morbidity and mortality worldwide. Antimicrobial therapy is the mainstay of treatment of BSI along with management of severe sepsis and septic shock. During last few years, clinicians have witnessed a growing incidence of BSIs along with resistance against commonly used antimicrobials. Therefore, this present study was undertaken to detect the prevalence of microorganisms isolated from blood and study their antimicrobial resistant patterns in a tertiary care hospital. In our study, the total number of positive cultures was 1445 (17.8%). Whereas Arora, Khanal and DS Murthy et al. have reported 20.02%, 44% and 24.3% respectively. In India, the variation might be due to the fact that most of the patients are given the antibiotics before they come to the tertiary care hospital & other reason is that in most of the cases self-medication is very common.

In our study, the predominant organisms were E. coli (40.5%) and Staphylococcus aureus (34.3%), followed by Pseudomonas spp. (12.3%), Klebsiella spp (5.2%), Enterococcus spp. (3.1%), Acinetobacter spp. (2.7%) and Salmonella spp. (1.6%). Similar distributions of microorganisms were noted by Fayyaz et al. and Parihar et al. respectively.

Amongst the gram positive organisms maximum resistance was seen with Ciprofloxacin (76%) followed by Erythromycin (58%) and Cotrimoxazole (58%). Arora et al. has reported maximum resistance with erythromycin (69.67%). None of our strain showed resistance against vancomycin and this drug therefore can be effectively used if methicillin resistance is suspected during treatment. Most of the gram negative bacilli were multidrug resistance. Other workers also have reported majority of gram negative isolates in their study as multidrug resistance. Maximum resistance was seen against ciprofloxacin (83%), ceftazidime (80%), amikacin (70%), Gentamicin (83%) and piperacillin (76%). It was shown by Escherichia coli, Pseudomonas, Klebsiella and Acinetobacter spp. Arora et al. have reported Ampicillin resistance (89.96%), cephalaxine (68.7%) and piperacillin (51.71%). In this study we found carbapenems to be effective in the treatment of multidrug resistant gram negative infections in patients admitted in wards and ICUs. OPD isolates were usually sensitive to most of the antibiotics.

5. Conclusion

Escherichia coli and Staphylococcus aureus were the predominant blood borne pathogens isolated in our region. Most of the Gram- negative bacilli were sensitive to tigecycline and colistin. The majority of Gram- positive cocci were sensitive to vancomycin and linezolid. There is the emergence of antimicrobial resistance in almost every corner of the world pointing toward active microbial surveillance in all clinical settings. Such monitoring of data regarding the prevalence of microorganisms and its resistance patterns would definitely benefit the current prescribed antimicrobial regimens, especially in resource- limited countries.

6. References


