Aerobic bacterial profile of blood stream infections and its antimicrobial sensitivity pattern in tertiary care hospital

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Abstract

Introduction: Blood stream infections cause significant disease and death worldwide and are among the most common healthcare associated infections. Large numbers of cases of treatment failure are being reported due to emergence of drug resistance. Early microbiological diagnosis and determination of antimicrobial sensitivity pattern have been shown to improve treatment outcome.

The present study was aimed to determine the bacterial and antimicrobial sensitivity pattern of blood stream infections in a major tertiary care hospital.

Materials and Method: Prospective cross sectional study was carried out in the Department of Microbiology, People's College of Medical College and Research Centre, Bhopal from July 2015 to March 2016. Non repetitive blood samples of 647 clinically suspected patients of blood stream infection were collected and processed by standard methods. Isolation and identification of organisms was done as per standard guidelines.

Results: Out of 647 blood culture samples, 106 (16.38%) were positive. The present study showed a predominance of Gram negative bacteremia (55.66%) over Gram positive bacteremia (44.34%).

Conclusion: Appropriate treatment of blood stream infections should be based on the current knowledge of bacterial resistance pattern as provided by microbiology laboratory. This type of study will help in formulating management guidelines and antibiotic policy for effective management and proper antibiotic therapy in patients with bacteremia.

Keywords: Blood stream Infections, Bacterial Profile, Antimicrobial Sensitivity Testing

Introduction

Blood stream infections cause significant disease and death worldwide and are among the most common healthcare associated infections.(1)

Several mechanisms play a role in the removal of microorganism from bloodstream. Patients who are debilitated, immunocompromised, or immunodeficient are at increased risk because circulating bacteria may not be cleared from blood due to impairment in defense mechanisms. Patients undergoing surgery, corticosteroid therapy, trauma, diabetes, renal failure, cirrhosis of liver, neoplasms are some other predisposing conditions.(2)

Bacteremia may be unimicrobial or polymicrobial. A variety of bacteria have been recovered from the bloodstream, both Gram positive and Gram negative. Most common ones are members of *Enterobacteriaceae*, S*taphylococcus aureus, Streptococcus pneumoniae, Enterococci, Pseudomonas areuginosa*.(3)

Since early 1950s, there is striking increase in incidence of bacteraemia caused by members of Enterobacteriaceae and other gram negative bacteria *Escherichia coli* which was reported to be common in the past is being replaced by other multidrug resistant bacteria like *Klebsiella, Enterobacter, Salmonella, Citrobacter, Pseudomonas, Acinetobacter* etc.

Illness associated with blood stream infections range from self-limiting infections to life-threatening sepsis that requires rapid and forceful anti-microbial treatment.

The timely detection of bacteremia, followed by expeditious identification of pathogens and determination of susceptibility to antimicrobial agents can have great diagnostic and prognostic importance. Prompt initiation of appropriate antimicrobial therapy is demonstrably important for preventing morbidity and mortality.(4)

The rapid and reliable detection of bacteremia by culturing blood is one of the most important functions of a clinical microbiology laboratory. It essentially comprises aseptic collection of blood from patient, most preferably before antibiotic administration, culture of this in a liquid medium, a means of detecting the presence of bacteria growing in the medium, a final phase of subculture on a solid media for identification and sensitivity testing.(5)

The isolation of a bacterium from the blood of a patient is valuable firstly in indicating the urgent need for antibacterial therapy, secondly in revealing the species of bacterial agent against which therapy should be directed and finally in providing a culture for the performance of in vitro antibiotic susceptibility tests.

The present study was thus undertaken to describe aerobic bacteriological profile and its antibiotic

sensitivity pattern from blood culture specimen in a tertiary care setting to guide clinicians to initiate empiric antibiotic therapy and to formulate antibiotic policy.

Materials and Method

Prospective cross sectional study was carried out in the Department of Microbiology, People's Medical College and Research Centre, Bhopal from July 2015 to March 2016. Patients clinically suspected of blood stream infections advised for blood culture attending Peoples Hospital, Bhopal were included. Non repetitive blood samples of 647 clinically suspected patients of blood stream infection were collected and processed by standard methods.[6] Isolation and identification of organisms was done as per standard guidelines. Antimicrobial sensitivity was determined by Kirby Bauer's disc diffusion method on Mueller Hinton agar (MHA) as per CLSI guidelines.[7]

Antibiotic discs used for sensitivity testing were Amikacin (AK) 30µg, Amoxycillin-clavulanic acid (AMC) 20/10µg, Ampicillin (AMP) 10 µg, Ampicillin-sulbactum (A/S) 10/10 µg, Aztreonam (AZM) 30 µg, Cefotaxime (CTX) 30 µg, Ceftriaxone (CTR)30 µg, Ceftazidime (CAZ) 30 µg, Cefoxitin (CX) 30 µg, Cotrimoxazole (COT) 1.25 µg/23.75 µg, Ciprofloxacin (CIP)5 µg, Clindamycin (CD) 2 µg, Chloramphenicol (C) 30 µg, Erythromycin (E) 15 µg, Imipenem (IPM)10 µg, Linezolid (LZ) 30 µg, Pipercillin-Tazobactum (PIT) 10/10 µg, Piperacillin (PI) 30 µg, Teicoplanin (TEI) 30 µg, Vancomycin (VA) 30 µg. Staphylococcus aureus (ATCC 25923), E. coli (ATCC 25922) and P. aeruoginosa (ATCC 27853) were used as quality control throughout the study for culture and antimicrobial susceptibility testing.

Statistical Analysis: The results were expressed as percentages for analysis of various epidemiological details and for analysing the distribution of different bacterial isolates and their sensitivity pattern. Microsoft excel was used for the interpretation of these results.

Result

A total of 647 samples of blood collected during July to December 2015 from clinical cases of bacteremia were included in the study. Out of 647 blood culture samples, 106 (16.38%) were positive. Out of 106 positive cultures, 47 (44.34%) were gram-positive and 59 (55.66%) were gram-negative. All 106 cultures with bacterial growth were unimicrobial.

Table 1: Distribution of Gram positive bacteria in positive blood cultures (n=47)

Name of Organism	Number	Percentage
Staphylococcus aureus	30	63.83%
Staphylococcus epidermidis	8	17.02%
Enterococcus spp	5	10.63%
Streptococcus pyogenes	4	8.51%
Total	47	100%

Table 2: Distribution of gram negative bacteria in positive blood cultures (n=59)

Name of Organism	Number	Percentage
Klebsiella pneumoniae	18	30.50%
E.coli	17	28.81%
Pseudomonas aeruginosa	10	16.94%
S.typhi	8	13.55%
Acinetobacter Spp	4	6.78%
Citrobacter Spp	2	3.39%
Total	59	100%

Table 3: Antimicrobial sensitivity pattern of Gram positive organisms (n=47)

Antibiotics	Staphylococcus aureus (n=30)	Staphylococcus epidermidis (n=8)	Enterococcus Spp (n=5)	Streptococcus Pyogenes (n=4)
Penicillin	07 (23.33%)	01 (12.50%)	03 (60.00%)	04 (100%)
Ampicillin	07 (23.33%)	01 (12.50%)	00 (00)	01 (25.00%)
Ampicillin/Sulbactum	13 (43.33%)	04 (50.00%)	Not Applied	Not Applied
Amoxycillin/Clavulanic	10 (43.33%)	03 (37.50%)	Not Applied	Not Applied
Cotrimoxazole	05 (16.66%)	01 (12.50%)	Not Applied	Not Applied
Erythromycin	12 (40.00%)	03 (37.50%)	03 (60.00%)	02 (50.00%)
Clindamycin	20 (66.66%)	05 (62.50%)	Not Applied	01 (25.00%)
Gentamicin	20 (66.66%)	05 (62.50%)	Not Applied	Not Applied
Cefoxitin	08 (26.66%)	04 (50.00%)	Not Applied	01 (25.00%)
Vancomycin	Not Applied	Not Applied	05 (100%)	04 (100%)
Teicoplanin	30 (100%)	08 (100%)	05 (100%)	Not Applied
Linezolid	30 (100%)	08 (100%)	05 (100%)	04 (100%)

Table 4: Antimicrobial sensitivity pattern of Gram negative organisms (n=59)

Antibiotics	Klebsiella spp (n=18)	Escherichia coli (n=17)	Psedomonas aeruginosa (n=10)	Salmonella typhi (n=8)	Acinetobacter spp (n=4)	Citrobacter spp (n=2)
Amikacin	08 (44.44%)	09 (52.94%)	05 (50.00%)	Not Applied	04 (100%)	02 (100%)
Ampicillin	10 (55.55%)	01 (5.88%)	Not Applied	Not Applied	Not Applied	Not Applied
Ampicillin/ Sulbactum	13 (72.22%)	08 (47.05)	Not Applied	Not Applied	03 (75.00%)	Not Applied
Amoxycillin/ Clavulanic acid	15 (83.33%)	10 (58.82%)	Not Applied	Not Applied	Not Applied	Not Applied
Aztreonam	Not Applied	Not Applied	06 (60.00%)	Not Applied	Not Applied	Not Applied
Cefotaxime	Not Applied	Not Applied	Not Applied	07 (87.50%)	Not Applied	Not Applied
Ceftriaxone	11 (61.11%)	13 (76.47%)	Not Applied	05 (62.50%)	01 (25.00%)	02 (100%)
Ceftazidime	12 (66.66%)	08 (47.05%)	03 (30.00%)	Not Applied	Not Applied	02 (100%)
Cefepime	07 (38.88%)	13 (76.47%)	Not Applied	05 (62.50%)	02 (50.00%)	02 (100%)
Cotrimoxazole	02 (11.11%)	08 (47.05%)	Not Applied	03 (37.50%)	01 (25.00%)	Not Applied
Chloramphenicol	Not Applied	Not Applied	Not Applied	06 (75.00%)	Not Applied	Not Applied
Ciprofloxacin	12 (66.66%)	11 (64.70%)	Not Applied	06 (75.00%)	03 (75.00%)	01 (50%)
Imipenem	18 (100%)	17 (100%)	10 (100%)	Not Applied	4 (100%)	2 (100%)
Piperacillin	Not Applied	Not Applied	00	Not Applied	00	2 (100%)
Piperacillin-Tazobactum	Not Applied	Not Applied	8 (80%)	Not Applied	02 (50.00%)	2 (100%)

Discussion

Bloodstream infection is a challenging problem, and sometimes, it may be life threatening; therefore, timely detection, identification, and antimicrobial susceptibility testing of blood-borne pathogens are one of the most important functions of diagnostic microbiology laboratory.

This study showed a blood culture positivity rate of 16.38% which was comparable to other Indian studies by Mehta MP et al,[8] Qureshi M et al[9] and A. Vijaya Devi et al[10] who reported a culture positive rate of 16.4% and 16.6%and 16.8% respectively. The low rate of isolation may be explained by the fact that many of the patients probably received antibiotic therapy before they came to the tertiary care hospital.

Present study highlights predominance of Gram negative bacteremia (55.66%) over Gram positive bacteremia (44.34%). Similar findings were also observed by A .Vijaya Devi et al[10] who reported 51.06% and 48.93% of Gram negative and Gram positive bactermia respectively while Vinitha Rani N. et al[11] reporting 59.1% and 37.7% respectively.

Most common Gram-negative organism isolated in the present study was *Klebsiella pneumoniae accounting* for 30.50% of total isolated Gram negative bacteria, followed *Escherichia coli (28.81%), Pseudomonas aeruginosa (16.94%), Salmonella typhi (13.55%), Acinetobacter spp. (6.78%) and Citrobacter species (3.39%) which was in concordance with study conducted by* Vinitha Rani N. et al.[11]

The high occurrence of non-lactose fermenters especially *Pseudomonas spp*. and *Acinetobacter spp*. is of concern. Both of these bacteria are associated with a high degree of resistance to antibiotics. Blood stream infections with *Pseudomonas aeruginosa* have been associated with increased morbidity in some studies.[11]

Our study highlights that Gram-positive septicaemia was encountered in 55.66%, which is in concordance with the findings of study conducted by Usha Arora et al[12] and Sumita Rajeevan et al.[13] The most common Gram-positive organism isolated was *Staphylococcus aureus* (63.83%) followed by *Staphylococcus epidermidis (17.02%). Enterococcus species (10.63%) and Streptococcus pyogenes (8.51%). Staphylococcus* seems to be emerging as the dominant organisms in blood stream infections. . Similar trend has been reported in the data from the west over the last two decades. Nosocomial infection due to *Staphylococcus aureus* constitutes a major part of the total annual nosocomial infection. *Staphylococcus epidermidis* are one of the most common cause of nosocomial bloodstream infections and also the most common blood contaminant. Because only one blood culture was obtained from each of our study patients, it was not possible to determine whether the patients who had CONS isolated had a true bacteremia or the finding was due to skin contamination. It is also possible that recovery of CONS could have resulted from other factors such as prolonged use of invasive intravascular devices, prolonged hospital stay, or other underlying co-morbidities. A Vijaya Devi et al.[10]

Among the Gram positive organisms, *Staphylococcus aureus* was found to be sensitive to linezolid (100%), followed by clindamycin (66.66%), while Staphylococcus *epidermidis* was found to be sensitive to linezolid (100%), and clindamycin (62.50%) which is in concordance with the study conducted by Jose Orsini et al.[14]

Enterococcus species was found to be sensitive to vancomycin & linezolid (100%) but was resistant to Ampicillin (100%) and erythromycin (40%), which correlates with findings of Vijaya Devi et al.[10]

Streptococcus pyogenes was found to be sensitive to vancomycin and linezolid (100%), and resistant for Ampcillin (75%) and Clindamycin (75%). Similar findings were also reported from the study conducted by Usha Arora et al.[12]

Most of the gram negative bacteria especially Enterobacteriacae (Except Salmonella typhi) showed 100% sensitivity to imipenem. *Klebsiella pneumoniae* was sensitive to amoxyclav (83.33%), ampicillin sulbactum (72.22%), Ceftazidime (66.66%) and ciprofloxacin (66.66%). Similar findings are also reported by Sumita Rajeevan el al[13] & A Vijaya Devi el al[10] respectively.

Salmonella Typhi was sensitive to Cefotaxime (87.50%) followed by Chloramphenicol (75.00%), Ciprofloxacin (75.00%), and Co-trimoxazole (37.50%). Similar trend has been reported in study conducted by A Vijay Devi et al.[10]

While the memberes of nonfermenter (Pseudomonas aeruginosa and *Acinetobacter spp*) shown 100% sensitivity to imipenem, this result is comparable to work done by other authors.[10]

Conclusion

This study on bloodstream infections will go a long way in understanding proper nature of bloodstream infections as well as its causative agents. This type of study will also help in formulating management guidelines and antibiotic policy for effective management and proper antibiotic therapy in patients with bacteremia.

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