Bacteriological profile and antimicrobial susceptibility patterns of organisms responsible for blood stream infections

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Abstract

Background: Blood stream infections (BSI) are an important cause of morbidity and mortality. An assessment of a patient with BSI includes routinely a blood culture. Blood cultures provide us information on the causative organism and their antibiotic susceptibility over the past few decades.

Objective: To identify organisms responsible for Blood stream infections, study their bacteriological profile and antimicrobial susceptibility patterns.

Methods: This study was undertaken to analyze all blood culture reports from January 2015-July 2015 at a tertiary care hospital in Hyderabad, India. A total of 485 blood culture reports were analyzed all suspected cases of septicemia.

Results: Best sensitivity of the gram positive isolates were for vancomycin and Tigecycline, both giving 97.67% sensitivity followed by Linezolid at 91.86%.The isolates showed good sensitivity of 77.91% to Teicoplanin and Beta-Lactamase combination showing a sensitivity of 72.09% to cefoperazone sulbactam, 66.28% to Ampicillin-sulbactam and 73.26% to cefepime-tazobactum. Resistance was high to other Beta-lactam antibiotics and the Macrolides.

Conclusion: The study showed a predominance of gram positive organisms as compared to gram negative isolates, most of the isolates were resistant to multiple antibiotics.

Key words: Staphylococcus aureus, Blood stream infections, Vancomycin

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Introduction

Blood stream infections (BSI) are an important cause of morbidity and mortality. An assessment of a patient with BSI includes routinely a blood culture. Blood cultures provide us information on the causative organism and their antibiotic susceptibility over the past few decades, several studies have emphasized the significance of positive blood cultures with technological advances in medical practice and increased incidence of diseases, several risk factors have been identified and epidemiology of Blood stream infections has changed. The more frequent use of invasive or prosthetic devices, increase in solid organ transplants, bone marrow transplantation and the advent of AIDS. There is also an increased incidence of Blood stream infections in the outpatient setting.[1,2,3]

Laboratory blood culture systems are the proven gold standard test for the identification of pathogen recovered from blood stream infection over the years, improvements have been made in the blood culture system in the form of enriched growth media, advances in automated continuous monitoring blood culture system. These methods have reduced the turn around time and ensured more accurate results.[4,5]

This study was undertaken to identify organisms responsible for Blood stream infections, study their bacteriological profile and antimicrobial susceptibility patterns.

Material and Methods

This study was undertaken to analyze all blood culture reports between January 2015-July 2015 at a tertiary care hospital in Hyderabad, India. A total of 485 blood culture reports were analyzed blood cultures were done for all suspected cases of septicemia.

Specimen collection and Processing

Blood culture samples were collected by venipuncture from a peripheral vein under aseptic conditions. The local site was cleansed with 70% alcohol and povidone iodine. Blood was inoculated into blood culture bottles, adult or pediatric according to the age group and introduced into the BACTEC-9050 blood monitoring system. The bottle was taken out when it beeped positive and subcultured on to blood and Mac Conkey's agar plates and incubated overnight at 37 degree centigrade. The isolate was identified based on their growth pattern on the media, gram staining and biochemical tests; using standard protocols. Gram negative organisms were identified by Indole production, H2S production, citrate utilization, urease test, oxidase test, motility, carbohydrate utilization tests. Gram positive isolates were identified

by the catalase, coagulase, bacitracin and optochin susceptibility tests. Antimicrobial susceptibility testing was done by the Kirby-Bauer disc diffusion method.

Results

The study included 485 blood cultures both from the pediatric and adult patients suspected clinically of having septicemia. Among the pediatric till the age of 12 years were 251 cultures and blood cultures among adult were 234.

In the pediatric age group, of the 251cultures done, blood culture reports were positive in 155 (61.75%) and negative in 96 (38.25%). In the adult group consisting of 234 blood culture reports were positive in 84 (35.90%) and negative in 150 (64.10%).

125 males and 126 females constituted the pediatric blood culture group and 104 males and 130 females, the adult group.

Table 1: Frequencies of bacterial species isolated from blood cultures of pediatric patients

Organism Gram Positive	**No. of Isolates**	**% of isolates**
Staphylococcus aureus	45	29.03
Coagulase Negative Staphylococcus	44	28.39
Enterococcus	5	3.23
Streptococcus pneumoniae	2	1.29
Organism Gram Negative	**No. of Isolates**	**% of isolates**
Escherichia coli	15	9.68
Pseudomonas species	6	3.89
Klebsiella species	23	14.83
Acinetobacter species	12	9.74
Citrobacter species	2	1.29

Among gram positive organisms, staphylococcus aureus was the most common organism isolated in 29.03% of cases and Streptococcus pneumoniae was the least in 1.29% of cases. Among gram negative organisms, Klebsiella species was the commonest species in 14.83% of cases.

Table 2: Frequencies of bacterial species isolated from blood cultures of adult patients

Organism Gram Positive	**No. of Isolates**	**% of isolates**
Staphylococcus aureus	28	33.33
Coagulase Negative Staphylococcus	15	17.86
Enterococcus	0	0
Streptococcus pneumoniae	3	3.58
Organism Gram Negative	**No. of Isolates**	**% of isolates**
Escherichia Coli	12	14.29
Pseudomonas Species	7	8.33
Klebsiella species	10	11.90
Acinetobacter species	3	3.58
Citrobacter species	5	5.95
Proteus vulgaris	1	1.19
Candida albicans	1	1.19

In the adult group, among the gram positive isolates, staphylococcus aureus was the most commonly isolated 28 (33.33%), followed by coagulase negative staphylococcus 15 (17.8%) and streptococcus pneumoniae 3 (3.58%). Among the gram negative isolates the most common pathogen was Escherichia coli 12 (14.29%), and the least common was Candida albicans (1.19%) isolated from adult blood cultures.

Table 3: Antibiotic susceptibility profile of gram positive bacteria

Antibiotic	Sensitive	Resistant
Vancomycin	84 (97.67%)	2 (2.33%)
Tiecoplanin	67 (77.91%)	19 (22.09%)
Linezolid	79 (91.86%)	7 (8.14%)
Tigecycline	84 (97.67%)	2 (2.33%)
Cefepime	0 (0%)	86 (100%)
Cotrimoxazole	30 (34.88%)	56 (65.12%)
Azithromycin	25 (29.07%)	61 (70.93%)
Cefoperazone-Sulbactam	62 (72.09%)	24 (27.91%)
Cefuroxime	38 (44.19%)	48 (55.81%)
Ofloxacin	31 (36.05%)	55 (63.95%)
Erythromycin	26 (30.23%)	60 (69.77%)
Ampicillin-Sulbactam	57 (66.28%)	29 (33.72%)
Penicillin	2 (2.33%)	84 (97.67%)
Cefepime-Tazobactam	63 (73.26%)	23 (26.74%)
Ceftriaxone	68 (79.07%)	18 (20.93%)

Table 4: Antibiotic susceptibility profile of gram negative bacteria

Antibiotic	Sensitive	Resistant
Piperacillin-tazobactam	21 (91.30%)	2 (8.70%)
Cefepimetazobactam	21 (91.30%)	2 (8.70%)
Imipenem-cilastin	21 (91.30%)	2 (8.70%)
Cefoperazone-sulbactam	17 (73.91%)	6 (26.09%)
Amikacin	17 (73.91%)	6 (26.09%)
Meropenem	17 (73.91%)	6 (26.09%)
Ciprofloxacin	10 (43.48%)	13 (56.52%)
Cotrimoxazole	11 (47.83%)	12 (52.17%)
Ceftriaxone	15 (65.22%)	8 (34.78%)
Cefuroxime	3 (13.04%)	20 (86.96%)
Tigecycline	20 (86.96%)	3 (13.04%)
Nitrofurantoin	14 (60.87%)	9 (39.13%)
Ampicillin-sulbactam	9 (39.13%)	14 (60.87%)
Colistin	18 (78.26%)	5 (21.74%)
Tobramycin	18 (78.26%)	5 (21.74%)

Table 3 and 4 shows the antibiotic susceptibility pattern in gram positive and gram negative isolates. Best sensitivity of the gram positive isolates was for vancomycin and Tigecycline, both giving 97.67% sensitivity followed by Linezolid at 91.86%. The isolates showed good sensitivity of 77.91% to Teicoplanin and Beta-Lactamase combination showing a sensitivity of 72.09% to cefoperazonesulbactam, 66.28% to Ampicillin-sulbactam and 73.26% to cefepime-tazobactum. Resistance was high to other Beta-lactam antibiotics and the Macrolides.

Among gram negative isolates, sensitivity was best for piperacillin-Tazobactam, cefepime-Tazobactam and Imipenem-cilastin at 91.30%, followed by cefoperazone-sulbactam, Amikacin and Meropenem at 73.91%, Colistin and Tobramycin at 78.26%. The isolates show a good response, with 86.96% strains being sensitivity to Tigecycline. 65.22% of the strains were sensitive to Ceftriaxone and 60.87% to Nitrofurantoin. The Gram negative isolates showed poor sensitivity to the Beta-lactams, Fluoroquinolones, and co-trimoxazole.

Discussion

For the effective management of cases of septicemia, bacteriological profile and antibiotic susceptibility Patterns are important Parameters that guide the clinicians significantly. Periodic epidemiological analysis of the causative organisms and their susceptibility patterns leads to an identification of the commonly relevant pathogens in different geographical areas. Of the 485 cultures, 239 (49.28%) were Positive and 246 (50.72%) were negative. Blood culture positivity for aerobic organisms varies from 25% to 60%. In this study blood culture positivity rate is 49.28%, similar high culture positivity rate of 56% in septicemic children was reported by other authors also.[6,7,8&9]

In this study the causative pathogens of true bacteremia in order of frequency were Staphylococcus

aureus (73), CONS (Coagulase Negative Staphylococci) (59), Klebsiella Pneumoniae (33), Escherichia coli (27), Acinetobacter (14), Pseudomonas (13), Citrobacter (7), Streptococcus Pneumoniae (6) and Enterococci (5). There is a predominance of gram positive organisms (142) against gram negative organisms (96) and only 1 candida albicans species Weinstein MP et al in the mid 70's reported in his study the frequency of isolates as Escherichia coli (16.3%), Staphylococcus aureus (10%), Streptococcus Pneumoniae (6.3%), Klebsiella pneumoniae (6.3%) and Pseudomonas auroginosa (5.3%). In the 1990's another study was conducted by the same authors where they reported the prevalence as Staphylococcus aureus (18.9%), Escherichia coli (15%), Coagulase Negative Staphylococci (9.2%) and both Klebsiella Pneumoniae and Entero-coccus species at 6.9%. The beginning of 2000 had Pien et al reporting Staphylococcus aureus at (23.1%), Escherichia coli (12.5%), Entero-coccus (9.4%), Klebsiella pneumonia (8.2%) and CONS (7.7%).

Comparing the above data from the previous 4-5 decades, our study shows staphylococcus aureus 73 (30.54%) followed by Coagulase negative staphylococcus 59 (24.69%); a preponderance of gram positive bacteremia showing an emerging increase of these organisms as compared to the past. The modern technological advances such as the increasing use of devices and intravenous catheters could be contributory to this significant increase. Studies from 1970-1990's indicate that Escherichia coli, Klebsiella pneumoniae, Pseudomonas auroginosa and Candida species are the major pathogens of true bacteremia. In the current study; all isolates were considered as pathogens and no episode was attributed to be due to contamination. Previous studies[10,11,12,13,14,15,16] show that 6-12.4% of cases of coagulase negative staphylococcus were causing Bacteremia. The present study shows a frequency of (24.69%), higher than the above because they were all considered pathogenic and not contaminants.

Vancomycin, Tigecycline showed a sensitivity pattern of (97.67%) and Linezolid (91.86%) to gram positive isolates where as multidrug resistance was seen to the commonly used Beta-lactam antibiotics. Similarly the gram negative isolates were susceptible to Piperacillin-tazobactam, Imipenem-cilastin, Cefepime-tazobactam (91.30%), Cefoperazone-sulbactam, Meropenem and Amikacin (73.91%). The commonly used Beta-lactams, fluoroquinolones and Co-trimoxazole proved ineffective with the gram negative isolates showing a high degree of resistance to these antibiotics, the susceptibility pattern showed a disturbing trend with the isolates showing susceptibility to reserve the drugs; which have to be used with caution otherwise we will not be left with any treatment options if the isolates become resistant to these drugs too.

Conclusion

The study showed a predominance of gram positive organisms as compared to gram negative isolates, most of the isolates were resistant to multiple antibiotics. Stringent hygienic measures like hand washing, good infection control measures, a robust surveillance system with an antibiotic policy for the hospital, rotation of antibiotics, avoiding indiscriminate use of antibiotics and restricting the use of broad spectrum antibiotics are some simple and effective measures that will go a long way in reducing the incidence of infection in the hospitals; and contribute to lowering the morbidity and mortality due to blood stream infections.

References

1. Weinstein MP, Towns ML Quarterly SM et al. The Clinical significance of Positive Blood cultures in the 1990S. A prospective comprehensive evaluation of the microbiology, epidemiology, and outcome of Bacteremia and fungemia in adults, Clin Infect Dis 1997;24:584-602.
2. Weinstein MP, Murphy Jr, Reller LB, Lichtenstien KA. The Clinical significance of positive blood cultures: A comprehensive analysis of 500 episodes of bacteremia and fungemia in adults. Clinical observations, with special reference to factors influencing prognosis. Rev. Infect, Dis 11983;5:54-70.
3. Weinstein MP, Merrett, S, Van Pelt L et al: Clinical importance of indentifying coagulase-negative staphylococci isolated from blood cultures: Evaluation of microscan rapid and dried overnight Gram-Positive panels versus a conventional reference method. J Clin Microbiol 1998;36:2089-2092.
4. Weinstein MP Clinical importance of blood cultures. Clin Lab Med 1994;14:9-16.
5. Pien BC, Sundaram P, Raoof N et al. The clinical and prognostic importance of positive blood cultures in adults. Am J Med 2010;123:819-828.
6. McDonald LC, Fune J, Gaido LB et al. Clinical importance of increased sensitivity of bact/alert for aerobic and anaerobic blood culture bottles. J Clin Microbiol 1996;34:2180-2184.
7. Patel R, Velter EA, Harmsen WS, Schleck CD, Fadel HJ, Cockerill FR111 optimized pathogen detection with 30- compared to 20-milliliter blood culture draws J Clin Microbiol: 2011;49(12):4047-4051.
8. Bleck T, Carroll K, Kalil AC, et al Guidelines for evaluation of new fever in critically ill adult patients 2008 update from the American college of critical care Medicine and the Infectious Diseases, society of America. Crit Care Med. 2008;36(4):1330-1349.
9. Weinstein MP, Doon GV. A Critical appraisal of the role of the clinical microbiology laboratory in the diagnosis of blood stream infections. J. Clin Microbiol 2011;49(9):S26-S29.
10. Clinical and Laboratory Standards Institute Principles and Procedures for Blood cultures; Approved Guideline wayne, PA: Clinical and laboratory Standards Institute; 2007 CLSI document M47-A Lass Mann B, Gustafson DR, Wood CM Rosenblatt J.E. Re emergence of Anaerobic bacteremia Clin Infect Dis 2007,44(7):895-900.
11. Richter SS, Beekmann SE, Croco JL, Deikema D.T. Koontz PP, Pfaller MA, et al. Minimizing the workup of blood culture contaminants, implementation and

evaluation of a Laboratory, based algorithm. J. Clin Microbiol 2002;40:2437-44 - PMID: 12089259.
12. Weinstein MP. Current blood culture methods and systems: clinical concepts, technology and interpretation of results. Clin infect Dis 1996,23:40-6 PMID: 8816127.
13. Chaudry IH, Ayala A, Ertel W, Stephan RN Haemorrhage and resuscitation: immunological aspects Am J Physiol 1990,259:R663-78 PMIID: 2145776.
14. Lee CC, Lin WJ, Shih HI, WU CJ, Chen PL, Lee HC et al Clinical Significance of Potential contaminants in blood cultures among patients in a medical center. J. Microbiol Immunol Infect 2007;40:438-44, PMID: 17932605.
15. Des Jardin JA, Falagas ME, Ruthazer R, Griffith J, Wawrose D, Schenkein D, et al. Clinical utility of blood cultures drawn from indwelling central venous catheters in hospitalized patients with cancer. Ann Intern Med. 1999; 131:641-7. PMID: 10577325.
16. Finkelstein R. Clinical and epidemiologic significance of Coagulase – negative staphylococci bacteremia in a tertiary care university Israeli Hospital. Am J Infect control. 2002;30:21-5 PMID: 11852412.

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