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BLOODSTREAM BACTERIAL ISOLATES AND THEIR ANTIBIOTIC SUSCEPTIBILITY PATTERNS IN A TERTIARY CARE TEACHING HOSPITAL

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Abstract : AbstractBackground- Blood stream infections range from self-limiting infections to life-threatening sepsis causing significant mortality and morbidity worldwide and require rapid and aggressive anti-microbial treatment. Rational and correct use of antibiotics requires understanding of common pathogens and drug resistance patterns in a community. The current study reports the prevalence and antimicrobial susceptibility profiles of blood culture isolates in a tertiary care teaching Hospital.Materials and Methods-This retrospective observational study was conducted in the Microbiology Department of a tertiary care teaching hospital, using blood culture data from October 2012 to March 2013.Results- Of the 1880 blood samples collected over a period from October 2012 to March 2013, 254 (13.5) samples yielded growth, 131 (51.8) were gram-negative, 123 (48.2) were gram positive organisms. The common organisms isolated were Klebsiella pneumoniae 64 (48.8) and Coagulase Negative Staphylococci 105 (85.3)CONS. All gram negative isolates including non fermenters were sensitive to Amikacin, piperacillin tazobactum and imipenem.High resistance was noted against Cephalosporins. Among gram positive organisms Coagulase Negative Stapphylococci (CoNS) and Staphylococcus aureus (S.aureus) were highly sensitive to Amikacin, Linezolid, Vancomycin. Streptococci were highly sensitive to Penicillin, Ampicillin, Amoxyclavulanic acid, VancomycinConclusion- Our study suggests use of wide spectrum antibiotics effective against both gram positive and gram negative organisms in the initial treatment of Bloodstream infections. Combination of Amikacin and pipercillin tazobactum or Amikacin and Linezolid are found to be effective against all isolates of blood culture.

Keyword : Bloodstream infections, Bacteriological profile, Antimicrobial Suscesptiblity pattern.

BACKGROUND

Microorganisms present in the blood whether continuously, intermittently or transiently, are a threat to every organ in the body[1].Systemic inflammatory response to these organisms can have serious immediate consequences, including shock, multiple organ failure, disseminated intravascular coagulation (DIC), and death. Approximately 2, 00,000 cases of bacteremia occur annually with mortality rates ranging from 20 – 50%.Bloodstream infections are important causes of morbidity and mortality. Timely detection and identification of blood borne pathogens is one of the most important functions of Microbiology laboratory. In addition, antimicrobial susceptibility test (AST) results can affect both the clinician's choice of antimicrobial therapy and the patient's outcome. The potential for antimicrobial resistance is one consideration for physicians when selecting a regimen with which to treat patients. This is particularly important for the treatment of systemic infections as initial antimicrobial chemotherapy is almost invariably empiric and must be based on knowledge of the most frequently isolated etiological agents and their antimicrobial susceptibility patterns.

Inadequate empirical therapy seems to be the most important independent determinant of mortality for the entire patient cohort hospitalized in ICU[2]. The laboratory can contribute significantly to empiric antibiotic choice by providing ''antibiograms''. The current study reports the prevalence and antimicrobial susceptibility profiles of blood culture isolates in a tertiary care Hospital.

Materials and Methods

This retrospective observational study was conducted in the Microbiology Department of a tertiary care teaching hospital, using blood culture data. Reports of specimens submitted for blood cultures during the period of October 2012–March 2013 to the Microbiology laboratory of the hospital were analyzed and the positive cultures were identified. Data including patient demographics (age, sex), microbial species (as recorded in the blood culture reports) and the antibiotic sensitivity patterns of identified pathogens were collected from all positive blood culture reports. The data obtained were tabulated and analyzed to identify the common causative pathogens of blood stream infections and the antibiotics to which the identified organisms were sensitive and resistant.

OBJECTIVES

To detect the bacteriological profile, causing bloodstream infections in a tertiary care teaching hospital. To detect their Antimicrobial Susceptibility Pattern

Materials and Methods

This retrospective observational study was conducted in the Microbiology Department of a tertiary care teaching hospital, using blood culture data. Reports of specimens submitted for blood cultures during the period of October 2012–March 2013 to the Microbiology laboratory of the hospital were analyzed and the positive cultures were identified. Data including patient demographics (age, sex), microbial species (as recorded in the blood culture reports) and the antibiotic sensitivity patterns of identified pathogens were collected from all positive blood culture reports. The data obtained were tabulated and analyzed to identify the common causative pathogens of blood stream infections and the antibiotics to which the identified organisms were sensitive and resistant.

Sample Collection and Bacterial Identification. Appropriate volume of blood was collected in blood broth ,incubated for at least 2 days, cultured under aerobic conditions and isolated organisms were identified using standard techniques. Bacterial isolates were subjected to antimicrobial susceptibility testing. Antibiotic Susceptibility Testing.

Antibiotic susceptibility testing was performed by Kirby-Bauer's disk diffusion method on Muller-Hinton agar (Hi Media, Mumbai,India) in accordance with the standards of the Clinical Laboratory Standards Institute

Results

Of the 1880 samples collected over a period of 6 months from October 2012 – March 2013, 254 samples yielded growth. Majority of the positive samples were received from NICU. The frequency and distribution of positive blood samples among various units were as follows, NICU 104 (40.9%),

Male medical ward 38 (14.9%), Female medical ward 33 (12.9%), PICU 31 (12.2%), Labor ward 18 (7.1%), Pediatric ward 16 (6.2%), IMCU 4 (1.9%), Nephrology unit 4 (1.9%), Outpatient 4 (1.9%) [Fig. 1].

The age distribution were as follows, Infants 111 (43.7%), Children 37 (14.5%), Adolescence 7 (2.8%), Adults 99 (38.9%). The gender distribution of the positive samples were found to be Males 136 (53.5%), Females 118 (46.4%).[Table. 1]

The clinical conditions associated with positive blood culture specimens were, Sepsis 148(58.3 %), Fever 60 (22.9%), Burns 21(8.3%), Meningitis 10 (4%), Wound infection 5 (2%), Infective endocarditis 5 (2%), cerebrovascular accidents 5 (2%).[Fig 2]

Out of 254 positive samples, gram negative organisms were 131 (51.8%) and gram positive organisms were 123 (48.2%).

The most commonly isolated **gram negative organisms** were Klebsiella pneumoniae 64 (48.8%), Salmonella paratyphi A 19 (14.9%), Pseudomonas 18 (13.7%) , Escherichia coli 14 (10.6%), Enterobacter 7 (5.3%) , Acinetobacter 7 (5.3%) , Klebsiella oxytoca 1 (0.7%), Citrobacter sp 1 (0.7%).

The most commonly isolated **gram positive organisms** were CoNS 105 (85.3%), S.aureus 15 (12.3%), Streptococcus sp 3 (2.4%).[Table 2] CoNS and Klebsiella pneumoniae were found to be the most common organisms causing blood stream infections.

The Sensitivity pattern of the **gram negative organisms** were as follows, **Klebsiella pneumoniae** was sensitive for Imipenem (100%) ,Cefaperazone sulbactum (85%), Pipercillin tazobactum (80%), Amikacin (73%) , Ofloxacin (71%), Ciprofloxacin (67%), Gentamicin (43%), , Ceftriaxone (25%), Amoxyclavulinic acid (13%).

Salmonella paratyphi A was sensitive for Imipenem (100%), Ceftriaxone (100%),Ciprofloxacin (95%), Ofloxacin (95%), Amoxyclavulinic acid (95%), Amikacin (89%), Cefaperazone sulbactum (80%), Gentamicin (26%), Chloramphenicol (26%).

Pseudomonas was sensitive for imipenem (100%), Amikacin (78%), Gentamicin (78%), Pipercillin tazobactum (40%), Ciprofloxacin (45%), Ofloxacin (45%), Ceftazidime (45%),Cefaperazone sulbactum (22%), Ceftrixone (17%), Meropenem (17%), Tobramycin (17%), Amoxyclavulinic acid (5%).

Escherichia coli was sensitive for Imipenem (100%), Cefaperazone sulbactum (95%), Pipercillin tazobactum (90%), Amikacin (79%), Ofloxacin (59%), Gentamicin (57%), ,Ciprofloxacin (43%), Ceftriaxone (29%), Amoxyclavulinic acid (29%).

Enterobacter was sensitive for Imipenem (100%), Amikacin (86%), Cefaperazone sulbactum (85%), Pipercillin tazobactum (85%), Gentamicin (71 %), Ofloxacin (71%), Ciprofloxacin (71%), Ceftriaxone (43%), Amoxyclavulinic acid (29%).

Acinetobacter was sensitive for Imipenem (100%), Cefaperazone sulbactum (85%), Pipercillin tazobactum (80%), Gentamicin (43%), Amikacin (29%), Ciprofloxacin (14%), Amoxyclavulinic acid (14%), Tobramycin (14%), Chloramphenicol (14%).

Klebsiella oxytoca was sensitive for Imipenem (100%), Cefaperazone sulbactum (100%), Pipercillin tazobactum (100%).

Citrobacter sp was sensitive for Imipenem (100%), Cefaperazone sulbactum (100%), Ofloxacin (100%).[Table 3]

The Susceptibility pattern of **gram positive organisms** were as follows, **CoNS** was found to be suscesptible to, Vancomycin (100%), Amikacin (85%), Linezolid (84%), Cefoxitin (80%), Ciprofloxacin (62%), Amoxyclavulinic acid (60%), Cephalexin (56%). **Staphylococcus aureus** was found to be sensitive to Vancomycin (100%), Linezolid (93%), Amikacin (80%), Cefoxitin (80%), Ciprofloxacin (47%), Cephalexin (53%).

Streptococcus was found to be sensitive to Vancomycin (100%), Penicillin (100%), Ampicillin (100%) , Amoxyclavulanic acid (100%), Ceftriaxone (67%) [Table 4]

FIG 1-Frequency and distribution of positive blood samples among various units.

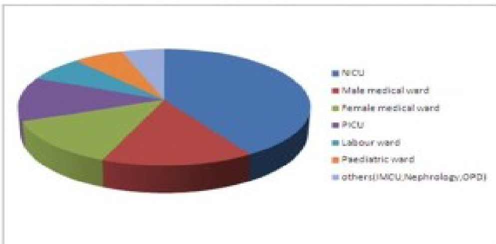
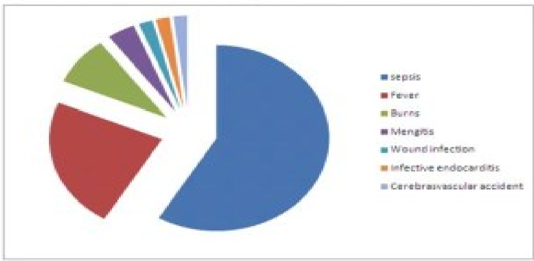


Fig 2.Clinical conditions associated with positive blood culture



Age range (years)	Male	Percantage	Female	Percantage
<1 (111)	64	47.1%	47	39.8%
1-12 (37)	27	19.8%	10	8.6%
13-18 (7)	6	4.4%	1	0.8%
>18 (99)	39	28.7%	60	50.8%
Total	136	53.5%	118	46.5%

Table 2.List of organism isolated from blood specimensØ **Gram negative organisms-131 (51.8%)**Ø Klebsiella pneumoniae-64 (48.8 %)Ø Salmonella paratyphi A-19 (14.9%) Ø Pseudomonas-18 (13.7%)Ø E .coli-14 (10.6%)Ø Enterobacter -7 (5.3%)Ø Acinetobacter-7 (5.3%)Ø Citrobacter-1 (0.7%)Ø Klebsiella oxytoca-1 (0.7%)

Ø **Gram positive organisms-123 (48.2%)**Ø CoNS-105 (85.3%)Ø Staphylococcus aureus-15 (12.3%)Ø Streptococcus sp – 3 (2.4%)

Table

Table 3.Antimicrobial Susceptibility report of bacterial isolates from blood specimens, October 2012-March 2013 Percent suscesptible Gram negative
organisms(n) Ak GEN CIP OF CTR PTZ AMC CAZ MRP CFS TOB CL Imp
Klebsiella pneumoniae(64) 73 43 67 71 25 80 13 --85 --100 Salmonella paratyphi A(19) 8926 9595100_ 95 --80 -26100
Pseudomonas(18) 78 78 45 45 17 40 5 45 17 22 17 -100 Escherichia coli(14) 79 57 43 59 29 90 29 --95 -100 Enterobacter (7) 86 71 71 71 43 85 29 --85 -100 Acinetobacter(7) 29 43 14 --80 14 --85 14 14 100 Klebsiella oxytoca(1) -----100 ---100 --100 Citrobacter(1) ---100-----100 --100

n= no of isolates

Table 4.Antimicrobial Susceptibility report of bacterial isolates from blood specimens, October

2012-March 2013

Percent Susceptible												
Gram positive organisms(n)	AK	CIP	COT	CTR	AMC	CN	LZ	VAN	CFX	P	Amp	
CoNS(105)	85	62	40	-	60	56	84	100	80	–	–	
S.aureus(15)	80	47	40	-	27	53	93	100	80	–	–	
Streptococcus sp(3)	–	–	–	67	100	-	-	100	–	100	100	

N= no of Isolates (-)
Drug not tested

Discussion

The impact of specific etiologic agents on outcome of bloodstream infections is tremendous. Bloodstream infections increase the mortality rate, prolongs patient stay in an intensive care unit and in the hospital and increased health care costs. Furthermore, inadequate empirical therapy of bacteraemic infections is associated with adverse outcomes.

Researchers have observed significant changing trends in the microbiology, epidemiology and clinical as well as prognostic significance of positive blood cultures over a period of time. For these reasons, surveillance of bloodstream infections from blood cultures and their antibiotic resistance patterns are vital to the care of patients and prevention of Bloodstream infections. Hospitalized patients are at high risk of infection for various reasons. Surveillance of Bloodstream pathogens and their antimicrobial resistance pattern in the hospital is the key to its prevention.

The results of this retrospective study conducted in our tertiary care hospital demonstrated the distribution of microbial isolates causing blood stream infections and their susceptibility pattern to commonly used anti-microbial agents.

Of the 1880 blood samples tested, 254 (13.5%) yielded bacterial growth. Similar studies conducted by Prakash K P et al[3] 2011 Dahira region, Oman, Vanitha et al[4] 2012 Chennai, Anbumani et al[5] 2008, showed a lower frequency of 5 % , 8 % , & 7.8 % respectively. But studies conducted by Khanal et al[6] 2002 , Sharma13[7], Mehta et al[8] 2005, Arora and Devi[9] 2007 , have reported high frequency of positive blood cultures accounting for 44%, 33.9%, 16.4%, 9.94%, and 20.2% respectively. The varying proportions may be due to the different methodology used in specimen collection and processing and the regional variation known to occur.

Of the 254 positive samples in blood culture 104 (40.9%) samples were from NICU where, the most common organisms isolated were CoNS (38%) and Klebsiella(30%). Neonatal septicemia is the major cause of morbidity and mortality in the world. Neonates are particularly vulnerable to infections because of their immature immune system.

Similar findings are also seen in study conducted by Saritha Otta et al[10] 2012, Bhubaneshwa, Odisha. This result is in contrast with the result of Prakash K P[13] et al, where adults and elderly patients were most commonly affected by bloodstream infections, which is contributed by chronic illness and immunocomprosied conditions like HIV.

The most common organisms in the study were gram negative organisms (51.8 %) predominantly Klebsiella pneumoniae (48.8 %), followed by Salmonella paratyphi A (14.9%). Klebsiella pneumoniae is reported to be the most common gram-negative organisms in many studies such as Latif et al[11]2009 and Mehnijad et al[12]2009. In the study conducted by Vanitha et al[4] the predominant organisms were gram negative organisms (58%) with high frequency of Escherichia coli 21.1% followed by Salmonella paratyphi A 15.22%. Mehta et al[13] 2005 and Garg et al[14] 2007 has revealed Pseudomonas as the most common cause and Sobhani et al[15] has revealed Salmonella as the commonly isolated organisms. Salmonella bacteremia is common in areas where salmonellosis is considered endemic, which is also evident in our study. In the present study, we observed a gradual but definite rise in frequency of Pseudomonas aeruginosa (13.7%) and Acinetobacter (5.3%).

The high occurrence of non 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 known to be associated with increased morbidity .and mortality

The incidence of gram-positive organisms has been 48.2 % in our study. The most common gram-positive organism isolated was CoNS (85.3 %) followed by Staphylococcus aureus (12.3 %). Similar results are found in the study conducted by Karunakaran et al[17] Kuala Lumpur. The role of CoNS in bacteremia is divisive. Until the 1970's, Coagulase-negative Staphylococci were mainly recognized as a contaminant. Since then, several studies have reported increasing incidence of infections due to CoNS[18].They are commonly associated with catheter related infections and invasive procedures, as they are indigenous skin flora and possess characters like slime production.

Most of the gram negative bacterial isolates including non-fermenters were sensitive to Amikacin, Cefaperazone sulbactum , Piperacillin + tazobactum, Imipenem and highly resistant to Cephalosporin. Resistance to Cephalosporin can be attributed to ESBL production. Salmonella paratyphi A was found to be highly sensitive to ciprofloxacin and cefotaxime. These results are consistent with study conducted by T.D.Sundaram[19], CMC, Vellore, and Vanitha et al[4].

The gram-positive organisms showed high sensitivity to Linezolid, Vancomycin. MRSA accounted for 20 % of Staphylococcus aureus which also showed high sensitivity to the above drugs. Streptococcus showed high sensitivity to Penicillin, Ampicillin, Amoxyclavulanic acid and Vancomycin

Majority of other studies have reported similar results. **Conclusion**

Avoidance of irrational and inappropriate use of antibiotics and strict implementation of hospital infection control measures are essential aspects to be followed, to combat the rise in antibiotic resistance to first line drugs and to reduce the incidence of non fermenters which are frequently associated with hospital environment.

Our study suggests use of wide spectrum antibiotics effective against both gram positive and gram negative organisms in the initial treatment of Bloodstream infections.

Combination of Amikacin and pipercillin tazobactum or Amikacin and Linezolid are found to be effective against all isolates of blood culture.

It is apparent that surveillance programs are necessary to identify changes in the spectrum of microbial pathogens, risk factors causing them and to monitor trends in antimicrobial resistance patterns. Pathogen frequency and resistance patterns may vary significantly from country to country and also in different hospitals within a country. Thus, national or regional or at the hospital level surveillance programs are essential to guide therapy and infection control measures**.**

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