Int J Pharm Bio Sci 2015 April; 6(2): (B) 341 - 346

Research Article **Microbiology**

International Journal of Pharma and Bio Sciences **ISSN 0975-6299**

BACTERIOLOGIC PROFILE AND ANTIBIOGRAM OF PAEDIATRIC BLOOD CULTURES IN A TERTIARY CARE CENTRE

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ABSTRACT

Bloodstream infections and sepsis are a common cause of morbidity and mortality in neonates and children. Blood culture provides the definitive diagnosis with identification of the causal organism and its antibiotic susceptibility. The etiologic agents are seen to vary between regions as well as over time. In this prospective study, 17.3% culture positivity was seen in blood culture samples from paediatric patients, with maximum isolation in neonatal age-group. Gram negative bacteraemia was more common than gram positive bacteraemia. *S. aureus* and *P. aeruginosa* were the most frequent isolates and showed a high degree of resistance to most drugs, including second line antibiotics. These results reveal the upsurge of multidrug resistance in paediatric patients and highlight the need for stringent regulation of antibiotic prescription.

KEYWORDS: **Bloodstream infection, sepsis, neonates, multidrug resistance**

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INTRODUCTION

Bloodstream infection (BSI) can be defined as the presence of viable bacteria or fungi in the blood (i.e. bacteraemia or fungaemia) documented by a positive blood culture result.[1] Bloodstream infection may arise through multiple routes including translocation across mucosal barriers as in the nasopharynx, gut, lungs, physical breaks in barriers such as the skin, ascending infection through the urogenital tract and through direct access to the bloodstream via indwelling catheters or devices.[2] BSIs are very common in the paediatric age group and are one of the common causes of morbidity and mortality in neonates and children.[1] The risk for developing BSI and sepsis depends on the biological age, immunologic maturity, physiologic state of the child and location of the child (community, hospital ward or intensive care). Neonates are particularly vulnerable to infections because of their weak immune barrier.[2] Sepsis is one of the commonest causes of neonatal mortality contributing to 19% of all neonatal deaths. According to the data from National Neonatal Perinatal Database (NNPD, 2002-03), the incidence of blood culture proven sepsis was 8.5 per 1000 live births in India.[3] The frequency of bloodstream infections has increased with the emergence of multidrug resistant organisms and the use of intravascular devices, particularly among the hospitalized patients. In the 1970s, nearly 75% of nosocomial infections were caused by gram-negative bacilli. However, by the early 1980s, a change in the spectrum of nosocomial pathogens was noted, and gram-positive cocci began to re-emerge as predominant nosocomial pathogens.[4] The spectrum of bacteria causing bloodstream infections may vary from one geographical area to another and within a given area over time. Knowledge about the prevailing trends can help guide empirical therapy, which may be initiated before culture results can be obtained. The present study was undertaken to determine the bacteriological profile and antimicrobial susceptibility patterns of blood culture isolates from children attending a tertiary care centre in North India.

MATERIALS AND METHODS

Blood culture samples received from paediatric patients (0-14 years) in the department of Microbiology, Pt. B.D. Sharma PGIMS, Rohtak, over a period of eight months, were processed. Patients were divided into four age-groups for analysis: 0-28 days (neonates), 28 days - 1 year (infants), 1-5 years and older than 5 years. Two to five milliliters of blood sample was collected aseptically and inoculated into 10 ml of glucose broth. After 24 hours incubation at 37^{o}C, these were subcultured on blood agar and MacConkey agar. For negative samples, subcultures were repeated after 48 hours, 72 hours and on the 7th day. The isolates obtained were identified by colony morphology, Gram staining and biochemical reactions, and then subjected to antimicrobial susceptibility testing by Kirby-Bauer disc diffusion method as per Clinical and Laboratory Standard Institute (CLSI) guidelines. *Staphylococcus aureus* ATCC 25923, *Pseudomonas aeruginosa* ATCC 27853 and *Escherichia coli* ATCC 25922 were used as control strains.[5-9]

RESULTS

Out of 5667 blood culture samples received from paediatric patients, 982 samples (17.3%) showed bacterial growth. The rate of isolation of bacteria from these samples was 18.2% (1030). Out of this, 519 random isolates were studied further and antimicrobial susceptibility testing performed. The gram negative organisms (59.5%) were more numerous than gram positive cocci (40.5%). However, the most common organism isolated was *S. aureus* (21.4%), closely followed by *P. aeruginosa* (20.6%). These were followed by *Acinetobacter* spp. (14.1%), coagulase negative staphylococci (CONS) (11.9%) and *Klebsiella* spp. (10.6%) (Chart 1).

Chart 1

Distribution of bacterial isolates (in %) from paediatric blood culture samples

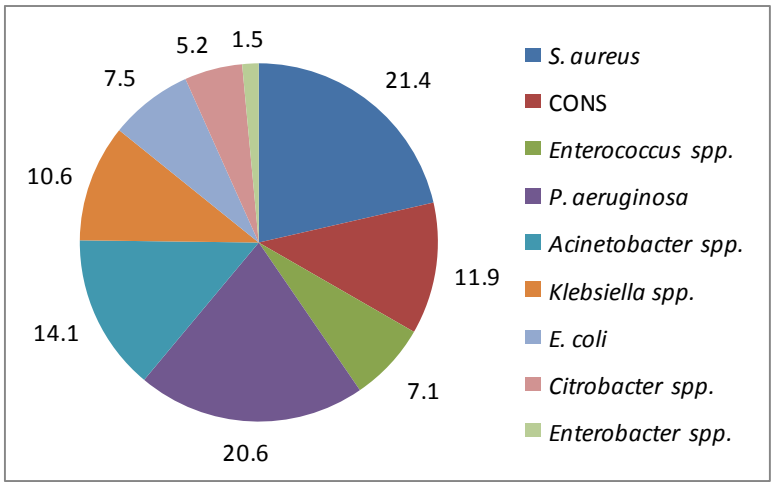

Table 1

Age-wise distribution of various isolates

Organism	<28 days	28 days – 1 year	1 – 5 years	>5 years
S. aureus	66 (20.3%)	11 (20.4%)	20 (23.5%)	14 (25.5%)
CONS	41 (12.6%)	5 (9.3%)	10 (11.8%)	6 (10.9%)
Enterococcus spp.	26 (8.0%)	2 (3.7%)	4 (4.7%)	5 (9.1%)
P. aeruginosa	66 (20.3%)	14 (25.9%)	18 (21.2%)	9 (16.4%)
Acinetobacter spp.	38 (11.7%)	10 (18.5%)	18 (21.2%)	7 (12.7%)
Klebsiella spp.	42 (12.9%)	2 (3.7%)	7 (8.2%)	4 (7.3%)
E. coli	25 (7.7%)	4 (7.4%)	3 (3.5%)	7 (12.7%)
Citrobacter spp.	16 (4.9%)	4 (7.4%)	5 (5.9%)	2 (3.6%)
Enterobacter spp.	5 (1.5%)	2 (3.7%)	0	1 (1.8%)
Total	325	54	85	55

S. aureus and P. aeruginosa were the most common isolates among all age groups. Acinetobacter spp. was also isolated frequently, especially in children 1-5 years old (21.2%) and infants (18.5%). Members of the family Enterobacteriaceae were recovered in fewer numbers (0-12.7%) (Table 1).

Table 2

Antibiotic sensitivity pattern of gram positive bacterial isolates

Antibiotics	*S. aureus* (n=111)	CONS (n=62)	*Enterococcus* spp. (n=37)
Erythromycin	44 (39.6%)	28 (45.2%)	NA
Penicillin	5 (4.5%)	6 (9.7%)	3 (8.1%)
Ampicillin	14 (12.6%)	22 (35.5%)	8 (21.6%)
Cefoxitin	39 (35.1%)	29 (46.8%)	NA
Trimethoprim-sulfamethoxazole	49 (44.1%)	27 (43.5%)	NA
Linezolid	110 (99.1%)	62 (100%)	37 (100%)
Vancomycin	111 (100%)	62 (100%)	37 (100%)
Clindamycin	81 (73.0%)	49 (79.0%)	NA
Doxycycline	104 (93.7%)	55 (88.7%)	NA
Rifampicin	106 (95.5%)	58 (93.5%)	NA
Chloramphenicol	84 (75.7%)	47 (75.8%)	NA
Ciprofloxacin	81 (73.0%)	46 (74.2%)	NA
Pristinamycin	NA	NA	26 (70.3%)
Amoxicillin-clavulanate	NA	NA	18 (48.6%)
Piperacillin-tazobactam	NA	NA	20 (54.1%)

S. aureus, CONS and Enterococcus spp. were highly sensitive to linezolid, vancomycin (100%), rifampicin (95.5%), doxycycline (93.7%), chloramphenicol (75.8%), clindamycin (79.0%) and ciprofloxacin (74.2%). The sensitivity for ampicillin, penicillin and erythromycin, though low, was better in case of CONS than in S. aureus (Table 2).

Table 3
Antibiotic sensitivity pattern of gram negative bacterial isolates other than non-fermenters

Antibiotics	*Klebsiella* spp. (n=55)	*E. coli* (n=39)	*Citrobacter* spp. (n=27)	*Enterobacter* spp. (n=8)	*P. aeruginosa* (n=107)	*Acinetobacter* spp. (n=73)
Ciprofloxacin	30 (54.5%)	21(53.8%)	15 (55.6%)	7 (87.5%)	57 (53.3%)	42 (57.5%)
Gentamicin	17 (30.9%)	16 (41.0%)	9 (33.3%)	3 (37.5%)	49 (45.8%)	34 (46.6%)
Amikacin	25 (45.5%)	19 (48.7%)	13 (48.1%)	5 (62.5%)	50 (46.7%)	34 (46.6%)
Trimethoprim-sulfamethoxazole	13 (23.6%)	10 (25.6%)	6 (22.2%)	1 (12.5%)	NA	28 (38.4%)
Ampicillin	3 (5.5%)	2 (5.2%)	1 (3.7%)	0	NA	NA
Amoxicillin-clavulanate	7 (12.7%)	11 (28.2%)	5 (18.5%)	1 (12.5%)	NA	NA
Piperacillin-tazobactam	37 (67.3%)	25 (64.1%)	20 (74.1%)	8 (100%)	97 (90.7%)	53 (72.6%)
Cefuroxime	2 (12.7%)	9 (23.1%)	5 (18.5%)	2 (25.0%)	NA	NA
Cefepime	12 (21.8%)	22 (28.2%)	10 (37.0%)	3 (37.5%)	42 (39.3%)	24 (32.9%)
Cefotaxime	13 (23.6%)	9 (23.1%)	5 (18.5%)	2 (25.0%)	NA	NA
Ceftazidime	NA	NA	NA	NA	28 (26.2%)	23 (31.5%)
Imipenem	51 (92.7%)	34 (87.2%)	24 (88.9%)	8 (100%)	94 (87.9%)	61 (83.6%)
Meropenem	40 (72.7%)	28 (71.8%)	22 (81.5%)	8 (100%)	75 (70.1%)	55 (75.3%)
Tetracycline	27 (49.1%)	20 (51.3%)	13 (48.1%)	3 (37.5%)	NA	39 (53.4%)
Aztreonam	NA	NA	NA	NA	19 (17.8%)	NA

Carbapenems were the most effective drugs against Enterobacter spp. (100%), Klebsiella spp. (92.7%), Citrobacter spp. (88.9%) and E. coli (87.2%).They were also sensitive to piperacillin-tazobactam and ciprofloxacin while other antibiotics, including cephalosporins, were less useful for this group of bacteria. P. aeruginosa and Acinetobacter spp. were mostly sensitive to piperacillin-tazobactam (90.7%), imipenem (87.9%) and meropenem (75.3%). Aztreonam was the least effective drug showing only 17.8% sensitivity against P. aeruginosa (Table 3).

DISCUSSION

The rate of bloodstream infections in children is about 20–50% in developing countries.[1] In the present study, the incidence of bacteraemia was found to be 17.3%, similar to Murty and Gyaneshwari (18.7%).[10] Prabhu et al (44%)[1] and Motayo et al (31.1%)[11] reported higher rate of blood culture positivity in children. The lower incidence in the present study may also be due to better infection control practices like periodic change of vascular catheters. The majority of bacterial isolates in the present study were obtained from the neonatal age-group (62.6%) as compared to infants and older children. The weaker immune system in neonates explains this high rate of isolation. High positivity (52.6 - 64%) in neonates has been reported by several workers.[10,12] In the current study, gram negative isolates (59.5%) outnumbered gram positive bacteria (40.5%), with *P. aeruginosa* and *S. aureus* as the most frequent organisms in all age-groups. The predominance of gram negative organisms has been reported by many authors and reflects the current trend in bacteriology of bloodstream infections in children.[13,14] Linezolid and vancomycin were found to be 99.1-100% effective against all gram positive cocci, followed by rifampicin (95.5%) and doxycycline (93.7%). Several studies have reported nearly 100% sensitivity to vancomycin and linezolid, as these are reserve drugs for gram positive infections.[15,16] Most of the *Enterobacteriaceae* members were multidrug resistant. Ampicillin and amoxicillin-clavulanate were the least effective drugs while imipenem was the most effective, followed by meropenem and piperacillin-tazobactam. In case of *P. aeruginosa* and *Acinetobacter* spp., high resistance was noted against cephalosporins, including the fourth generation, cefepime, and aztreonam. The high level of resistance could be due to extended spectrum β-lactamase (ESBL) expression in bacteria. Reduced efficacy of ciprofloxacin and aminoglycosides was also seen. Similar findings have been reported in many Indian studies.[17-19] In our country, the indiscriminate and over-the counter use of drugs has promoted the emergence of multidrug resistant strains. This not only makes treatment of severe infections like sepsis difficult, but also prolongs hospital stay and increases morbidity and mortality.

CONCLUSION

Regular surveillance of the pathogens causing sepsis and bacteraemia in children, as well as their changing antimicrobial susceptibility profile, is important. The incidence of neonatal sepsis may be reduced by implementing strict infection control measures and exclusive breastfeeding. Judicious use of antibiotics, according to standard policy and susceptibility profile is warranted.

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