Bacteriological Profile and Antimicrobial Sensitivity Pattern of Blood Culture Isolates

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ABSTRACT

BACKGROUND

Blood stream infections are the leading cause of morbidity and mortality in children in developing countries. Blood culture remains the golden reference standard for the laboratory diagnosis of bloodstream infections (BSIs) and helps in the prevention of emergence of multidrug resistant bacterial strains which poses a major challenge in the management of bacteraemia. Knowledge about the bacteriological profile and antimicrobial susceptibility patterns in the local unit helps the clinician in rationalizing the empirical treatment protocols and optimizing the duration of therapy.

METHODS

A hospital based retrospective observational study was carried out by reviewing the records of 318 blood cultures received from children aged 1 month to 12 years admitted with clinically suspected sepsis at Institute of Child Health, Niloufer Hospital for Women and Children, Hyderabad over a 4 month period (April 2019 - August 2019). Blood samples were collected under aseptic conditions, identification of isolates and their antibiotic sensitivity pattern was done by disc diffusion method as per CLSI standards 2019.

RESULTS

During the study period, among the 318 blood cultures studied, 105 (33 %) samples showed positive cultures. Out of the positive cultures, 57 (54.3 %) samples showed growth of Gram-positive bacteria and 48 (45.7 %) samples showed growth of Gram-negative bacteria. *Klebsiella* spp [30 (28.5 %)] were the most common bacteria isolated followed by Coagulase negative *Staphylococcus* 28 (26.7 %), *Staphylococcus epidermidis* 18 (17.1 %), *Pseudomonas aeruginosa* 12 (11.4 %), *Enterococcus* species 6 (5.7 %), *Staphylococcus aureus* 3 (2.8 %), *Acinetobacter* species 4 (3.8 %), and each one isolate of *E. coli*, *Citrobacter* species and *Streptococcus pyogenes*. The antibiotic sensitivity patterns have shown a high degree of resistance to the Cephalosporins among the Gram-negative cultures and high sensitivity pattern to Carbapenems and Fluoroquinolones.

CONCLUSIONS

The present study emphasizes the need for continuous scrutiny and surveillance for the most common pathogens isolated in children with blood stream infections along with antibiotic sensitivity pattern in paediatric units for formulating rationalized antibiotic treatment protocols and infection control strategies for prevention of septicaemia in children.

KEYWORDS

Antimicrobial Susceptibility, Blood Stream Infection, Blood Culture

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BACKGROUND

In children, blood stream infections are very frequent and account for one of the leading causes of morbidity and mortality.[1] Blood culture is the golden reference standard for an accurate diagnosis of blood stream infections and has high positive predictive value.[2] The incidence of blood stream infections in paediatric age varies widely and 20 – 50 % positivity has been reported by many workers.[3] The major challenge in management of septicaemia in children is formulation of empirical antibiotic treatment policy which should be unit - specific and based on the prevalent pathogens and their antibiotic sensitivity pattern.[4]

A negative blood culture though rules out bacteremia, it prompts on the need for further investigation of other infectious or non - infectious etiologies or cessation of unnecessary empirical antimicrobial therapy.[5] The main objectives of the present study is to determine the bacteriological profile and antimicrobial susceptibility patterns among the clinically suspected septicemic paediatric patients admitted at our hospital. This emphasizes the need for antibiotic stewardship.

METHODS

The study was a hospital based retrospective observational study conducted in the Department of Paediatrics in Institute of Child Health, Niloufer Hospital for Women and Children. Medical records of 318 children in the age group of 1 month to 12 years admitted with clinical features of septicaemia were studied.

Study Period

April 2019 to August 2019.

Inclusion Criteria

Children in the age group of 1 month to 12 years admitted with clinical features of septicaemia.

Exclusion Criteria

Children above the age group of 12 years and below the age group of 1 month.

Study Procedure

A blood culture sample was collected under aseptic precautions from all the children included in the study group. Blood sample from each suspected patient was drawn and was inoculated into brain heart infusion (BHI) broth with the blood to broth ratio of 1 : 10 and incubated at 37° C for 24 hrs, 48 hrs, and 7 days. Daily turbidity of BHI broth was observed, if BHI broth is turbid blind subcultures were done on Chocolate Agar, Blood agar and MacConkey agar. The agar plates were analysed for bacterial growth after 24 hrs of incubation under aerobic conditions at 37° C.

Based on the morphological appearance of the colony significant isolates were identified. Other biochemical tests like gram staining reactions, catalase test, coagulase test, and oxidase test were further done. If there was no growth on subculture even after 7 days of aerobic incubation at 37° C, samples were considered negative. Testing for Antibiotic susceptibility was done by Kirby Bauer Disc diffusion method on Muller Hinton according to CLSI guidelines 2019. Antibiotics amikacin (30 µg), ciprofloxacin (CIP 5 µg), trimethoprim – sulfamethoxazole / cotrimoxazole (COT30 µg), ceftriaxone (CTX / CTR 30 µg), ceftazidime (CAZ 30 µg), piperacillin - tazobactam (PIT 100 / 10 µg), imipenem (IPM 10 µg), meropenem (MRP 10 µg), from HiMedia Laboratories, India were tested for susceptibility in the study.

Interpretations of antibiotic susceptibility were done as per the guidelines of interpretative zone diameters of CLSI. Organisms used as controls for antibiotic sensitivity were Escherichia coli ATCC 25922, *Staphylococcus aureus* ATCC 25923, and *Pseudomonas aeruginosa* ATCC 27853.

Laboratory confirmed Blood stream infection was considered when a bacterial pathogen was isolated from blood culture specimens.

Data Analysis

The data recorded was entered into Microsoft excel spread sheet and data analysis was performed using Statistical package for Social Sciences (SPSS) Software version 16. The significance of relation between various parameters is analysed by chi square test and statistical significance was considered for p value < 0.05.

Ethical Consideration

Prior approval was taken from the institutional ethics committee of Institute of child health, Niloufer hospital for women and children, Hyderabad before initiation of this study.

RESULTS

Out of 318 blood samples collected for blood culture in the present study, 105 (33 %) were culture positive. With respect to age blood culture positivity was found to be higher in children < 2 years (60.95 %) followed by in children > 5 years (20.95 %) and in 1 – 5 years (18.09 %). (Table 1). The overall positive rate was relatively higher in males (60 %) as compared to females (40 %) (Table 2).

The predominant isolated pathogens were Gram positive cocci, 57 (54.3 %). Among the recovered isolates, Coagulase - negative Staphylococci (CoNS) (other than *S. epidermidis*), was found to be the most common accounting for 26.7 %, followed by *Staphylococcus epidermidis* with an isolation rate of 17.1 %.

Among the Gram - negative isolates identified, *Klebsiella* was the predominant isolate, followed by *Pseudomonas aeruginosa*, *Acinetobacter* species with an isolation rate of

28.5 %, 11.4 %, 6.8 % respectively (Table 3). Among the Gram - negative isolates, higher degree of resistance was shown to Cephalosporins whereas Carbapenems and Fluoroquinolones had high sensitivity pattern (Table 4).

Age (years)	Culture Positive	
	Number	Percentage
< 2	64	60.95
2 – 5	19	18.09
> 5	22	20.95
Total	**105**	**100**

Table 1. Age Wise Distribution of Blood Culture Positives

Age	Male (63)	Female (42)
< 2 years	39	25
2 – 5 years	13	6
> 5 years	11	11

Table 2. Sex Wise Distribution of Blood Culture Positives

Isolates	Frequency of Isolates (%)
Coagulase negative *Staphylococcus*	28 (26.7 %)
Staphylococcus epidermidis	18 (17.1 %)
Staphylococcus aureus	3 (2.8 %)
Streptococcus pyogenes	1 (0.95 %)
Enterococcus species	6 (5.7 %)
Klebsiella species	30 (28.5 %)
Pseudomonas aeruginosa	12 (11.4 %)
Escherichia coli	1 (0.95 %)
Citrobacter species	1 (0.95 %)
Acinetobacter species	4 (3.8 %)

Table 3. Distribution of Frequency of Various Bacterial Isolates

Antibiotic	*Klebsiella* Sps	Pseudomonas Sps
Ciprofloxacin	22 (73.3 %)	10 (83.3 %)
Amikacin	20 (66.7 %)	7 (58.35 %)
Meropenem	25 (83.3 %)	12 (100 %)
Piperacillin - Tazobactam	14 (46.7 %)	9 (75 %)
Amoxiclav	7 (23.3 %)	-
Cotrimoxazole	21 (70 %)	-
Ceftriaxone	8 (26.7 %)	-
Ceftazidime	-	4 (33.3 %)
Aztreonam	-	9 (75 %)

Table 4. Antibiotic Sensitivity of Bacterial Pathogens

DISCUSSION

Delay in the intervention of septicaemia can be fatal. Thus, early identification of the etiological agents with determination of their antibiotic susceptibility pattern warrants the clinician in initiating appropriate therapy, which further decreases the emergence of resistance and improves better survival.[6] The present study imparts information about the bacteriological profile of blood culture isolates causing bacteraemia along with their antimicrobial susceptibility pattern that plays a crucial role in effective management of septicaemic cases. The blood positivity rate of this study was 33 %, which was similar to the previous study done by Sharma M.[7] In contrast, low culture positive rate was reported by Arora U et al[8] whereashigh culture positive rate 43.78 % by Prabhu et al.[4]

In this study, culture positive rate in males 63 (60 %) is higher compared to female patients 42 (40 %). This finding was consistent with the findings by Sharma Met al[7], Zosangliani et al,[9] Karki S et al.[10] The frequency of Gram positive and Gram - negative bacteria isolated from blood culture in the present study was 54.3 % and 45.7 % respectively. These findings are analogous to studies done in Manipur (64.7 % versus 35.3 %),[9] Mangalore (64.19 % vs (34.56 %),[4] Cameroon (56.2 % versus 43.8 %) [11] and Tanzania (82.1 % vs 17.9 %).[12] In contrast to the present finding, higher incidence of Gram - negative bacteria was reported by other studies done in Lahore (50.1 % vs 47.5 %)[13] and Uganda (58% vs 42 %).[14] There is a varied incidence of Bloodstream infections varied among different age groups. Higher incidence of patients was at the lower extreme of ages in this study, which was comparable to studies carried out by Zosangliani et al,[9] Pradhan et al.[15]

Among the gram - positive cocci, Coagulase negative *Staphylococcus* and *S. epidermidis* were predominately isolated with total isolation rate of 43.8 % which correlates with a study by Hadi et al.[16] Coagulase negative *Staphylococcus* is considered as most common skin commensal and their presence in blood culture is considered as contamination due to improper aseptic technique of blood collection. In our study, among gram negative organisms, maximum positive cases with a preponderance of *Klebsiella* 28.5 % is observed. This finding was similar to a study from Jharkhand.[17]

The antibiotic sensitivity patterns have shown a high degree of resistance to the Cephalosporins among the Gram - negative isolates and high sensitivity to Carbapenems and Fluoroquinolones. This high level of resistance to the Cephalosporins could be attributed to their large - scale use for management of febrile illness in both inpatients and outpatients. Among the Gram negative isolates, different patterns of sensitivities seen in different studies, Imipenem and Ciprofloxacin for *Klebsiella* species have shown high sensitivity in present study which was correlating with other studies by Hadi et al,[16] Japoni et al.[18]

CONCLUSIONS

The present study emphasizes the need for continuous scrutiny, and surveillance for the most common pathogens isolated in children with blood stream infections, along with antibiotic sensitivity pattern in paediatric units, for formulating rationalized antibiotic treatment protocols, and infection control strategies for prevention of septicaemia in children and prevention of emergence of drug resistance.

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