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Characteristics of pediatric blood stream infections - An analysis of bacteriological profile and antimicrobial susceptibility pattern in a tertiary care centre from North-East India

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ABSTRACT

Introduction

Blood-stream infections have a major impact on the morbidity and mortality of pediatric patients in developing countries. Successful outcome of these infections relies on prompt and timely empiric therapy. The etiological agents and their susceptibility pattern change from time to time even in a same hospital, which warrants continuous surveillance of the characteristics of blood stream infections in this age group. This study was undertaken with an objective of determining the bacterial agents implicated in pediatric blood stream infections and characterization of their antimicrobial susceptibility pattern.

Materials and methods

This was a hospital-based retrospective study. All the patients below the age of 18 years from whom blood culture samples were collected on the suspicion of blood-stream infections during the year 2015 were included. Consecutive, patient-specific, non-duplicate isolates were included for analysis. Patient demographics, bacteriological profile and corresponding antimicrobial sensitivity pattern were analyzed. All the analysis were done using MS-Excel 2016 and MedCalc v12.5.0.

Results

A total of 523 blood cultures were received and 91(17.4%) showed growth of clinically relevant microorganisms (89-monomicrobial and 2–polymicrobial). Gram-positive and Gram-negative bacteria constituted 47(50.53%) and 46(49.47%) respectively. Out of 93 isolates, *Staphylococcus aureus*(29.03%), *Acinetobacter baumannii*(20.43%), *Klebsiella pneumoniae*(10.75%), *Pseudomonas spp*.(6.45%) and *Enterococcus spp*.(6.45%) were the most common isolates. Among *Staphylococcus*, 8(29.62%) were MRSA. Gram-positive cocci were susceptible fully to lincosamides and glycopeptides, but higher proportion of resistance was observed for penicillins, aminoglycosides, fluoroquinolones and 3rd gen-cephalopsorins. Gram-negative bacilli exhibited siginificant resistance to almost all group of available antibiotics – penicillins(75-95%), cephalopsorins(50-87%), aminoglycosides(17-63%), fluoroquinolones (28-36%), carbapenems(23-36%) and beta-lactam/betalactamase inhibitor combinations(17-21%). Further stratifications were done for different subsets of pediatric patients viz. neonates, infants, under-5, under-10 and similar analysis was performed.

Conclusion
Majority of the isolates were multidrug resistant. These higher percentages necessitates proper infection control measures and warrants larger stratified studies for appropriate empiric antibiotic choice.
Keywords: Pediatric, Bacteremia, Bloodstream infection, Microbiological profile, Antimicrobial susceptibility

INTRODUCTION

Children remain as one of the most vulnerable population to contract illnesses because of their weak immune barrier [1]. Among pediatric patients, blood stream infections have a major impact on the morbidity and mortality [2]. The mortality rate among pediatric patients with positive blood cultures ranges from 3% to 40% in various studies and were usually found to be higher in developing countries owing to limited resource settings [2–4].

Prompt diagnosis and timely therapy determines the outcome in these infections. Etiological agents in such infections and their susceptibility pattern change from time to time even in same hospital, which warrants continuous surveillance of the characteristics of blood stream infections in this age group [2,5,6].

Though there are many studies characterizing the blood stream infections in general, there are limited studies focusing on the pediatric age group. The characterization of microbial profile and formulation of hospital specific empirical therapy guidelines for pediatric patients are very essential. Hence, this study was undertaken with an objective of determining the bacterial agents implicated in pediatric blood stream infections and characterization of their antimicrobial susceptibility pattern.

MATERIALS AND METHODS

Study Design

This was conducted as a hospital-based retrospective study in Department of Microbiology. The data from January' 2015 to December' 2015 was collected retrospectively from the blood culture registry.

Inclusion Criteria

All the blood samples sent for culture during the study period, from patients below the age of 18 years were included. Consecutive, patient-specific, non-duplicate isolates were included for analysis.

Culture Method

In our laboratory, conventional (manual) blood culture system was used. All the guidelines recommended by clinical Laboratory Standards Institute was followed during specimen collection, processing and reporting [7]. The antimicrobial sensitivity pattern was tested using Kirby-Bauer Disk diffusion method.

Analysis

Patient demographics, bacteriological profile and corresponding antimicrobial sensitivity pattern were analyzed. All the analysis were done using MS-Excel 2016 and MedCalc v12.5.0.

RESULTS

During the study period a total of 523 blood cultures fulfilling the inclusion criteria were received. Mean age of the patients was 7.37(±7.41) and M:F ratio was 1.92.

Among them, 91(17.4%) showed growth of clinically relevant microorganisms (89-monomicrobial and 2–polymicrobial). The summary of microorganisms isolated is shown in Table 1. Gram-positive and Gram-negative bacteria constituted 47(50.53%) and 46(49.47%) respectively.

Table1. *Summary of organisms obtained from pediatric blood cultures during the study period.*

Organism	No.
Staphylococcus aureus(MSSA)	22
Acinetobacter baumannii	19
Klebsiella pneumoniae	10
CONS	8

Enterococcus spp	6
Pseudomonas aeruginosa	6
Staphylococcus aureus(MRSA)	5
Escherichia coli	5
Corynebacterium spp	3
Non-fermenting GNB (others)	3
Streptococcus pneumoniae	2
Enterobacter spp	1
Proteus mirabilis	1
Citrobacter freundii	1
Streptococcus spp	1
Grand Total	**93**

Out of 93 isolates, *Staphylococcus aureus* (29.03%), *Acinetobacter baumannii* (20.43%), *Klebsiella pneumoniae* (10.75%), *Pseudomonas* spp.(6.45%) and *Enterococcus* spp.(6.45%) were the most common isolates. Among *Staphylococcus aureus* isolates, 8(29.62%) were Methicillin-resistant (MRSA).

Gram-positive cocci were susceptible fully to lincosamides and glycopeptides, but higher proportion of resistance was observed for penicillins, aminoglycosides, fluoroquinolones and 3rd gen-cephalopsorins. Gram-negative bacilli exhibited siginificant resistance to almost all group of available antibiotics – penicillins(75-95%), cephalopsorins (50-87%), aminoglycosides(17-63%), fluoroquinolones (28-36%), carbapenems(23-36%) and beta-lactam/betalactamase inhibitor combinations(17-21%). The antimicrobial susceptibility profile of the gram-positive and gram-negative organisms is shown in Table 2 and 3 respectively.

Table 2*: Antimicrobial susceptibility profile of Gram-positive cocci (in decreasing order of susceptibility)*

Antimicrobial agent	**Sensitivity (%)**
Clindamycin	100
Levofloxacin	100
Vancomycin	100
Linezolid	100
Teicoplanin	100
Chloramphenicol	96.97
Imipenem*	85.71
Gentamicin (120)*	80
Meropenem*	75
Cefotaxime[#]	68.75
Ampicillin*	66.67
Tetracycline	65.79
Ciprofloxacin	61.9
Ceftriaxone[#]	56.67
Ofloxacin	55.56
Erythromycin[#]	48.28
Piperacillin[#]	33.33
Penicillin	15.15

*Applicable only for *Enterococcus* spp.

[#]Applicable only for *Staphylococcus* spp.

Table 3: *Antimicrobial susceptibility profile of Gram-negative bacilli (in decreasing order of susceptibility)*

Antimicrobial agent	Sensitivity (%)
Amikacin	83.33
Piperacillin+tazobactam	83.33
Cefoperazone+Sulbactam	79.17
Meropenem	77.27
Levofloxacin	72.73
Ofloxacin	64.86
Imipenem	64.29
Ciprofloxacin	63.64
Cefoperazone	50
Gentamicin	36.67
Cefotaxime	25
Piperacillin	24
Ceftazidime	19.44
Ceftriaxone	13.51
Ampicillin	5
Norfloxacin	0

Further stratifications were done for different subsets of pediatric patients viz. neonates, infants, under-5, under-10 and presented in Table 4.

Table 4: *Summary of organisms obtained from pediatric blood cultures during the study period stratified to age groups.(A) Neonates, 1month to 1 year and 1 to 5 years (B) 6 to 10 years and more than 10 years*

Table 4 A.

Neonates (n=23)	1 month to 1 year (n=15)	1 to 5 years (n=10)
Klebsiella pneumoniae 7 (30.43%)	*Staphylococcus aureus(MSSA)* 3 (20%)	*Staphylococcus aureus(MSSA)* 3 (30%)
Acinetobacter baumannii 4 (17.39%)	*Streptococcus pneumoniae* 2 (13.33%)	*Acinetobacter baumannii* 2 (20%)
Staphylococcus aureus(MSSA) 3 (13.04%)	*Staphylococcus aureus(MRSA)* 2 (13.33%)	*Staphylococcus aureus(MRSA)* 1 (10%)
Pseudomonas aeruginosa 2 (8.7%)	*CONS* 2 (13.33%)	*Escherichia coli* 1 (10%)
Staphylococcus aureus(MRSA) 2 (8.7%)	*Corynebacterium spp* 1 (6.67%)	*Enterococcus spp* 1 (10%)
Enterococcus spp 2 (8.7%)	*Acinetobacter baumannii* 1 (6.67%)	*CONS* 1 (10%)
CONS 1 (4.35%)	*Escherichia coli* 1 (6.67%)	*Corynebacterium spp* 1 (10%)
Citrobacter freundii 1 (4.35%)	*Streptococcus spp* 1 (6.67%)	
Corynebacterium spp 1 (4.35%)	*Klebsiella pneumoniae* 1 (6.67%)	
	Proteus mirabilis 1 (6.67%)	

Table 4B:

6 to 10 years (n=9)	> 10 years (n=36)
Staphylococcus aureus (MSSA) 4 (44.44%)	*Acinetobacter baumannii* 12 (33.33%)
Staphylococcus aureus (MRSA) 2 (22.22%)	*Staphylococcus aureus(MSSA)* 6 (16.67%)
Pseudomonas aeruginosa 1 (11.11%)	*Escherichia coli* 3 (8.33%)
Klebsiella pneumoniae 1 (11.11%)	*Enterococcus spp* 3 (8.33%)
CONS 1 (11.11%)	*Pseudomonas aeruginosa* 3 (8.33%)
	CONS 3 (8.33%)
	NF GNB 3 (8.33%)
	Klebsiella pneumoniae 1 (2.78%)
	Enterobacter spp 1 (2.78%)
	Staphylococcus aureus (MRSA) 1 (2.78%)

DISCUSSION

Septicaemia remains as one of the major cause of pediatric morbidity and mortality, inspite of advanced diagnostic modalities and treatment. The causative agents and their antibiotic susceptibility profile varies from time to time and from place to place. Therefore, the knowledge of current bacteriological profile prevalent in the hospital plays a major role in management of such infections.

In our study, the positivity rate of blood culture among included cases was found to be 17.4% which was similar to studies done in recent times by Negussie *et al*, Schaffner *et al* and Tariq [1,2,8]. But few studies have reported lesser positivity rate when compared to the current study.[9,10]

In the current study, *Staphylococcus aureus* was the most common organism isolated and it remained as one of the most common agent even after stratifying for different age groups except for the neonatal age group. In our study, the distribution of gram positive and gram negative bacterial pathogens were found to be similar. However, most of the similar studies reported higher isolation of gram negative rods [1,2,8–10].

The antimicrobial susceptibility profile analysis showed higher incidence of multidrug resistant pathogens which was seen similar to the recent studies conducted on pediatric population. This warrants judicious use of antibiotics and monitoring of the trend changes [2,4,8,10].

CONCLUSION

The current study shows the prevailing higher incidence of multidrug resistant pathogens among pediatric blood stream infections which can alter the outcome drastically in these patients. Timely and appropriate management depends upon the continuous monitoring of the causative agents. Robust infection control practices and antibiotic stewardship programmes are prime need of the hour.

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