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Determination of the Causative Agents of Bacteremia in Children under 5 Years and their Susceptibility Pattern to the Antibiotics

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Abstract- *Objective:* To determine the causative agents of bacteremia in children under 5 years and their susceptibility to the commonly used antibiotics.

Methods: This was a cross-sectional study on children (aged from 1 day to 5 years) admitted to the paediatric ward. The patients included all newborn babies and children admitted with fever and suspected of having sepsis. All the included children were clinically diagnosed for septicemia following strict aseptic precautions and the blood sample was taken. Blood culture were done by standard method.

Results: The overall incidence of bacteremia was 23.1%. The incidence of bacteremia was higher among the chidren of age group 13-60 month (38.1%) than <1 month (23.4%) and 1-12 month (12.5%). The male (25.8%) children were affected than females (19.6%).

Keywords: *bacteremia, incidence, children, bacterial isolates.*

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Determination of the Causative Agents of Bacteremia in Children under 5 Years and their Susceptibility Pattern to the Antibiotics

Dr. Abhineet Mehrotra [α] & Dr. Shailendra Mishra [σ]

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Results: The overall incidence of bacteremia was 23.1%. The incidence of bacteremia was higher among the chidren of age group 13-60 month (38.1%) than <1 month (23.4%) and 1-12 month (12.5%). The male (25.8%) children were affected than females (19.6%). The *Klebsiella species* organism was the most common organism which was 44.4% followed by *Staphylococcus. Aureus* (14.8%) and *Coagulase Negative staphylococci (CONS)* (11.1%). The percentage of other organism was less than 10%. The percentage of gram negative bacterial isolate was among 70.4% of the samples and gram negative was 29.6%.

Conclusion: The resistance of the recovered *Klebsiella* spp. isolates to a number of antimicrobial agents was determined, and a pattern of multi-resistance was observed which may explain the prevalence of these isolates in pediatric bacteremia.

Keywords: bacteremia, incidence, children, bacterial isolates.

I. Introduction

Bacteremia is the presence of viable bacteria in the circulating blood. Bacteria may enter the blood stream giving rise to bacteremia from an existing focus of infection from a site with the commensally flora or by direct inoculation of contaminated materials into the vascular system. These organisms are often cleared from the blood within minutes, so the bacteremia is silent and transient, but if the immune system is overwhelmed or evaded, organisms persist in the blood and bacterimic symptoms would arise. Bacteremia should be distinguished from septicemia in which signs and symptoms of severe diseases are present[1]. Neonates are particularly vulnerable to infections because of their weak immune barrier. Several risk factors have been identified both in the neonates and children which makes them susceptible to infections[2]. Children with septicaemia present with fever, difficulty in breathing, tachycardia, malaise, refusal of feeds or lethargy[3].

Studies of bloodstream infections in children admitted to African hospitals suggest that the prevalence of bacterial bloodstream infections among inpatients with fever or clinical sepsis exceeds that described in wealthier regions[4,5]. Bloodstream infections continue to be the major cause of morbidity and mortality despite advance in antimicrobial therapy and supportive care[6]. Fever in infants younger than 1 year old, especially those younger than 3 months, can signal a serious infection[7].

The aim of this study was to determine the causative agents of bacteremia in children under 5 years and their susceptibility to the commonly used antibiotics.

II. Material and Methods

This was a cross-sectional study approved by the ethical committee of the institute. In this study, 117 blood samples were collected from children (aged from 1 day to 5 years) admitted to the paediatric ward of a teaching hospital in north India. The patients included all newborn babies and children admitted with fever and suspected of having sepsis. Children with fever less than 5 days and with known clinical condition such as malignancies, tuberculosis etc. were excluded from the study. The consent was taken from parent/guardian of each children before enrolling in the study.

A total of 128 children were included in this study. All the included children were clinically diagnosed for septicemia following strict aseptic precautions and the blood sample was taken. One milliliter (neonates) and 5 ml (children) blood were collected, inoculated into 10 ml and 50 ml, respectively of brain heart infusion broth. The culture bottles were incubated at 37°C aerobically and periodic subcultures were done onto Mac Conkey's agar, blood agar and chocolate agar after overnight incubation on day three, day four and finally on day seven[8]. The growth obtained was identified by conventional biochemical tests and the antibiotic sensitivity testing was performed on Mueller-Hinton agar plates by Kirby-Bauer disc diffusion method. Zone

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diameter was measured and interpreted as per the Clinical and Laboratory Standards Institute (CLSI) guidelines as used by Tiwari et al[8]. Bacterial sensitivity was tested for the following antimicrobials: amikacin, amoxicillin clavulanic acid, ampicillin, aztreonam, cefotaxime, ceftazidime, ceftriaxone, cephalexin, cefoxitin, ciprofloxacin, gentamicin, imipenem, meropenem, piperacillin-tazobactam, tobramycin, linezolid and vancomycin.

Methicillin resistance in *Staphylococcus aureus* (MRSA) was tested using Mueller-Hinton agar with 4% NaCl with cefoxitin disc (30 micrograms) by Kirby-Bauer disc diffusion method. A zone size of >22 mm was considered sensitive and < 21 was considered as resistant. Suspected extended-spectrum beta lactamases (ESBLs) producing organisms were confirmed by double disk synergy test[8]. Detection of plasmid-mediated AmpC was done by the AmpC disk test and the isolates showing reduced susceptibility to carbapenems (imipenem and meropenem) were selected for detection of metallo-beta lactamases (MBLs) enzymes by imipenem-EDTA disk method. For quality control of disc diffusion tests ATCC control strains of *E. coli* ATCC 25922, S. *aureus* ATCC 25923 and *P. aeruginosa* ATCC 27853 strains were used. The results were expressed as percentages. Microsoft excel was used for the interpretation of these results.

III. Results

Table-1 presents the percentage of children of Bacteremia according to demographic profile. The overall incidence of bacteremia was 23.1%. The incidence of bacteremia was higher among the chidren of age group 13-60 month (38.1%) than <1 month (23.4%) and 1-12 month (12.5%). The male (25.8%) children were affected than females (19.6%).

The *Klebsiella species* organism was the most common organism which was 44.4% followed by *Staphylococcus. Aureus* (14.8%) and *Coagulase Negative staphylococci (CONS)* (11.1%). The percentage of other organism was less than 10% (Fig.1).

The percentage of gram negative bacterial isolate was among 70.4% of the samples and gram negative was 29.6% (Fig.2).

Table-2 depicts antibacterial resistance pattern of the gram negative blood stream isolates. Klebsiella spp organism was resistance to ampicillin (3), amoxyclav (5), amikacin & gentamycin (2) and one each tocotrimoxazole, ciprofloxacin, cefotaxime& aztreonam. The frequency of other organism resistance to most of drugs was one.The frequency gram positive isolates resistance to most of the drugs was one (Table-3).

IV. Discussion

Who guidelines for management of acute illness in children (Integrated Management of Childhood Illness) recommend use of an appropriate antibacterial drug in addition to an antimalarial drug in children with certain signs of severe illness[9]. Despite considerable progress in hygiene, antimicrobial therapy, and supportive treatment, blood stream infections remain important causes of morbidity and mortality which, may reaches to 20%-30%[10]. Microbiologic culturing of blood is the only available means for diagnosis of these infections and allows for successful recovery of bacteria in 99% in patients with bacteremia of septicemia[11]. An American review covering a 50-years period has show major changes in the etiology of neonatal septicemia[12].

In this study, the incidence of bacteremia was higher among male children. Similar findings had been reported in southern state of India[8]. Some other studies had also reported higher incidence of bacteremia in male children[13, 2]. The incidence of bacteremia was higher among 13-60 month (38.1%) in this study which was contradictory to the studies by Tsering et al[14] and Meremkwer et al.[2] in which incidence of bacteremia was more common among newborns. In this study, the culture positivity rate was found to be 23.1% (23/117). Almost similar rate had been reported in a Indian study in which blood culture positivity rate of 25%[8]. Other studies had also reported similar positivity rate[15, 14].

The percentage of gram negative organism found in this study was similar to other studies also[16,15]. In the present study, the *Klebsiella* species was the commonest isolate associated with bacteremia which was similar to study by Al-Charrakh et al[17]. Many studies have been shown that Gram positive organisms were the mainly *Staphylococcus aureus* as the most frequently isolated bacteria causing bacteremia[18,19].

There was varying number of the gram negative and positive organisms resistance to different drugs in this study. Prabhu et al[20] reported that the gram negative organisms showed maximum resistance to ampicillin. However, Tiwari et al[8] reported that the gram positive organisms showed 77.78% resistance to penicillin but were 100% sensitive to linezolid and vancomycin. Among the 6 *Staphylococcus aureus*, 2(33.33%) were detected as Methicillin resistant *Staphylococcus aureus* (MRSA).

One of the limitation of this study is lesser sample size. Studies on larger sample size is recommended for better interpretation of the results. The studies on the community acquired blood stream infections is also needed at present.

V. Conclusion

The resistance of the recovered *Klebsiella* spp. isolates to a number of antimicrobial agents was determined, and a pattern of multiresistance was observed which may explain the prevalence of these isolates in pediatric bacteremia.

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Table 1 : Percentage of children of Bacteremia according to demographic profile

	No. of children assessed	Bacteremia	
		No.	%
Age group			
<1 month	64	15	23.4
1-12 months	32	4	12.5
13-60 month	21	8	38.1
Gender			
Male	66	17	25.8
Female	51	10	19.6
Total	**117**	**27**	**23.1**

Table 2 : Antibacterial resistance pattern of the gram negative blood stream isolates

Antibiotics	Klebsiella spp (n=12)		E.coli (n=2)		Pseudomonas aeruginosa (n=2)		Acinetobacter baumanii (n=1)		S.typhi (n=2)		Citrobacter freundii (n=1)	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Ampicillin	3	25.0	1	50.0	NT	-	NT	-	2	100.0	1	100.0
Amoxyclav	5	41.7	0	0.0	NT	-	NT	-	1	50.0	0	0.0

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Amikacin	2	16.7	1	50.0	1	50.0	0	0.0	0	0.0	1	100.0
Cotrimoxazole	1	8.3	1	50.0	NT	-	0	0.0	1	50.0	0	0.0
Gentamycin	2	16.7	0	0.0	1	50.0	1	100.0	0	0.0	0	0.0
Tobramycin	NT	-	NT	-	1	50.0	0	0.0	NT	-	NT	-
Ciprofloxacin	1	8.3	0	0.0	2	100.0	1	100.0	1	50.0	1	100.0
Cefotaxime	1	8.3	1	50.0	NT	-	NT	-	1	50.0	0	0.0
Ceftriaxone	2	16.7	0	0.0	NT	-	NT	-	0	0.0	0	0.0
Ceftazidime	NT	-	NT	-	0	0.0	1	100.0	NT	-	NT	-
Aztreonam	1	8.3	0	0.0	0	0.0	0	0.0	NT	-	0	0.0
Imipenem	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0

NT-Not Tested

Table 3 : Antibacterial resistance pattern of gram positive blood stream isolates

Antibiotics	Staphylococcus aureus (n=4)		CONS (n=3)	
	No.	%	No.	%
Penicillin	2	50.0	1	33.3
Amoxyclav	1	25.0	1	33.3
Cefoxitin	1	25.0	2	66.7
Erythromycin	2	50.0	1	33.3
Linezolid	1	25.0	0	0.0
Vancomycin	0	0.0	1	33.3

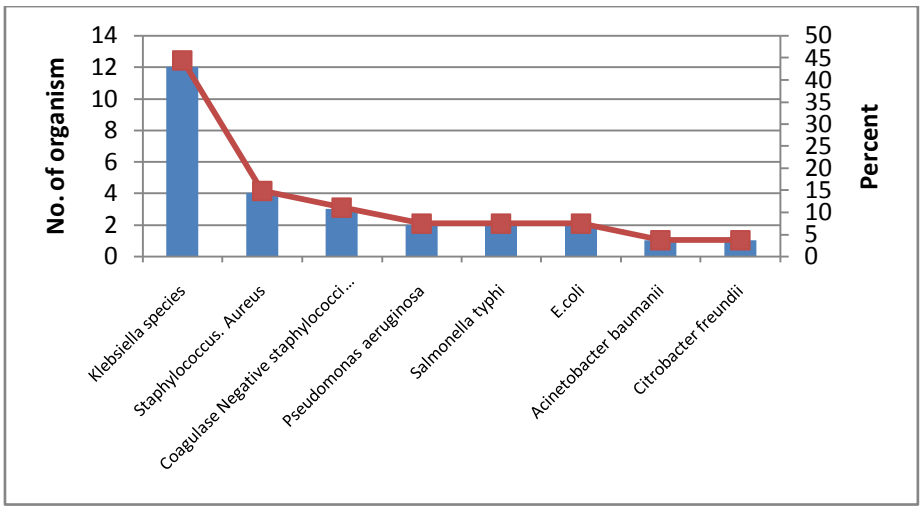

Figure 1 : Distribution of organisms isolated from blood culture

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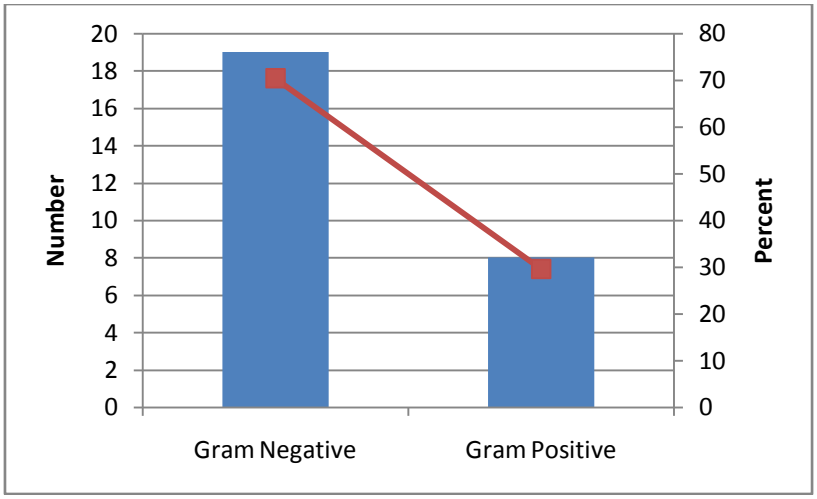

Figure 2 : Prevalence of gram negative and gram positive bacterial isolates

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