Bacteriological Profile of Septicemia and the Risk Factors in Neonates and Infants in Sikkim

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ABSTRACT

Background: Bacterial infections remain an important cause of pediatric mortality and morbidity. It might be possible to reduce these factors by early diagnosis and proper management. **Aim:** The aim of the study was to analyze the bacteriological profiles with their antibiogram, and to register the risk factors for septicemia in neonates and infants. Setting and design: This observational cross-sectional study was conducted in a tertiary care teaching hospital at Gangtok, Sikkim, India, and included clinically suspected cases of septicemia in neonates and infants. **Materials and Methods:** Blood culture reports were studied in 363 cases of clinically suspected septicemia in neonates and infants, using the standard technique of Mackie and McCartney. The antibiotic sensitivity was performed by Kirby–Bauer's disc diffusion method. Risk factors for sepsis in the children were registered. **Results:** Blood culture was positive in 22% of cases. Gram-negative septicemia was encountered in 61% of the culture-positive cases. *Pseudomonas* and *Enterobacter species* were the predominant pathogens amongst gram-negative organisms. Most gram-negative organisms were sensitive to Amikacin, Ciprofloxacin, and Co-trimoxazole. The most common gram-positive organism isolated was *Staphylococcus aureus* (97%). More than 70% of Staphylococci isolated were resistant to Penicillin, but were sensitive to Clindamycin (70%) and Vancomycin (40%). The most important risk factors of septicemia in our study population were preterm birth (31%), followed by respiratory distress (5%) and low birth weight (4%). **Conclusion:** As the cultures showed variable antibiogram with complicated patterns of resistance, culture and sensitivity test should be performed in all cases of septicemia.

Key words: Developing countries, Infant, Neonate, Septicemia

INTRODUCTION

Septicemia constitutes an important cause of morbidity and mortality in the pediatric age group. Blood cultures are not always positive in neonatal septicemia. A combination of clinical, hematological and other microbiological evidence (colony morphology, Gram staining, biochemical properties and sensitivity in the antibiogram) should be used when diagnosing neonatal septicemia. Knowledge of pathogens causing infections in young infants is essential for designing community-based management strategies.[1,2]

Septicemia is a common cause of morbidity and mortality in neonates and children. Numerous risk factors have been identified both in the neonates and children that make them susceptible to infections,[3] which points to the need for bacteriological monitoring in the pediatric wards.[4] The varying microbiological pattern of septicemia in children warrants the need for an ongoing review of the causative organisms and their antimicrobial susceptibility pattern.[5] As gram-negative, multidrug-resistant organisms were the main cause of septicemia in children, great caution is required in selection of antibiotic therapy.[6]

Furthermore, facilities for bacterial culture are not available in most peripheral health facilities in developing countries and neither are pediatricians. Early diagnosis and proper management of neonatal septicemia could bring down the morbidity and mortality substantially. Little is known about the prevalence and incidence of septicemia in the neonates and infants in Sikkim. Hence, the present study was undertaken to study the bacteriological profile and the antimicrobial sensitivity pattern of septicemia in neonates and infants. To the horizon of our knowledge there has been no study done in this field in the state of Sikkim.

Access this article online

Quick Response Code:

Website: www.jgid.org

DOI: 10.4103/0974-777X.77295

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MATERIALS AND METHODS

Study period: January 15, 2007 to January 14, 2008.
Study population: This observational cross-sectional study was carried out at a tertiary care 500 bedded teaching hospital at Gangtok, Sikkim (India) having regular OPD and In-patients department with full-fledged medical and surgical ICU, PICU, and NICU. The study included 363 cases of clinically suspected septicemia in neonates and infants. Signs and symptoms of sepsis included: temperature instability, feeding difficulties, respiratory distress, jaundice, convulsions, and autonomic disturbances. The main outcome measures were microbiologic spectrum of blood cultures and the following risk factors: prematurity (<37 weeks), low birth weight (<2500 g), respiratory distress, and neonatal jaundice.

Data collection procedure: Institutional ethics committee approved the study. All the caregivers of the patients were explained about the purpose of the study and were ensured strict confidentiality. Written informed consents were taken from each of the caregivers of the children prior to the study. Following Helsinki Declaration on research bioethics, the participants and their caregivers were given the options not to participate in the study if they wished. The standard microbiological methods were followed in this study during blood culture and antibiotic sensitivity test. Blood samples were collected with all aseptic precautions for culture and sensitivity studies following universal precautions. Blood cultures were processed using the standard technique described by Mackie and McCartney[7] and the antibiotic sensitivity was performed by Kirby Bauer's disc diffusion method, as recommended in the National Committee for Clinical Laboratory Standards (NCCLS) guidelines. The aerobic isolates were studied. Gram staining was performed and organisms were identified based on their colony characteristics and biochemical properties.

Statistical analysis using microsoft excel

The data analysis involved transcription, preliminary data inspection, content analysis, and interpretation. Percentages were used in this study to analyze epidemiological variables.

RESULTS

In our study, 363 blood samples were collected from neonates and infants who were admitted with signs and symptoms of sepsis. Out of these, 363 clinically suspected cases of septicemia, 249 (69%) were term and 114 (31%) were preterm babies. The age of onset of septicemia was quite variable in the children in our study. Clinical suspected septicemia was observed in 203 neonates (56%), in 112 infants (31%) from 29 days to12 months of age, and 48 infants (13%) above 12 months of age. The most important risk factor of suspected septicemia in our study population was preterm birth (31%), followed by respiratory distress (5%), low birth weight (4%), and neonatal jaundice (4%). Overall, in the clinically suspected cases of septicemia in our study population a blood culture positivity rate was observed to be 22% of 363 infants [Table 1].

The most common gram-positive organism isolated was *S. aureus* (97%). Only a single isolate of *Coagulase negative Staphylococci* was found (among the children from 29 days of age up to12 months). The most common gram negative organism were the *Enterobacter* species (25%) followed by the *Pseudomonas* species (20%) [Table 2].

The risk of specific infections was related to the age of the child. Only in neonatal cases *Klebsiella, Citrobacter,* and *Acinetobacter* species were isolated. *Escherichia coli* and *Coagulase negative Staphylococci* were isolated from cases below one year, whereas *Salmonella* species were isolated only from two cases after infancy as a causative organism in septicemia [Table 2].

Table 1: Clinical and demographic characteristics of children with septicemia

Variables	Onset of septicemia			Total
	Birth to ≤28 days	29 days to ≤12 months	12 months and above	
Gestational age				
Term	139	75	35	249
Preterm	64	37	13	114
Respiratory distress	12	08	0	20
Low birth weight	16	0	0	16
Neonatal jaundice	13	0	0	13
Culture positive	51	11	18	80

Table 2: Distribution of bacterial isolates

	Organisms isolated	No. of cases		
		Birth to ≤28 days	29 days to ≤12 months	12 months and above
Gram positive	*Staphylococcus aureus*	21	07	02
	Coagulase negative staphylococci	0	01	0
Gram negative	*Enterobacter* species	08	01	03
	Pseudomonas species	05	01	04
	Citrobacter species	05	0	0
	Klebsiella species	05	0	0
	Escherichia coli	01	01	0
	Bacillus species	05	0	06
	Acinetobacter species	01	0	0
	Salmonella species	0	0	02
Total isolates		51	11	18

From the antibiotic sensitivity pattern, It is clear that 70% of *Staphylococci* isolated were resistant to Penicillin. The most effective antibiotic against the *Staphylococcal* isolate was Clindamycin (70%) followed by Vancomycin (40%). The single isolate of *Coagulase negative Staphylococci* was sensitive to Clindamycin and Vancomycin. [Table 3]

Most of the gram-negative bacteria were sensitive to Ciprofloxacin except one isolate of *Klebsiella*. Co-trimoxazole was 100% sensitive in *E. Coli* and *Salmonella* isolates, but resistant in *Klebsiella*. All the *Citrobacter* isolates were sensitive to Amikacin, Ciprofloxacin, and Ofloxacin. Amikacin was effective for all the isolates of *Klebsiella* species, *Citrobacter* species, and *E. coli*. [Table 4]

DISCUSSION

For the effectual management of septicemia cases, study of bacteriological profile along with the antimicrobial sensitivity pattern plays a noteworthy role. Out of the 363 clinically suspected cases of sepsis in our study, 80 were culture positive with a blood culture positivity rate of 22%. Gram-negative septicemia was encountered in 61% of the culture positive cases.

Table 3: Sensitivity pattern of the gram positive isolates

Antibiotics	*Staphylococcus aureus (n=30)* Percentage sensitive (%)	*Coagulase negative Staphylococcus* (*n*=1) Percentage sensitive
Amoxycillin	08 (26.6)	0
Oxacillin	07 (23.3)	0
Doxycyclin	11 (36.6)	-
Penicillin	09 (30)	0
Clindamycin	21 (70)	1 (100)
Erythromycin	11 (36.6)	-
Vancomycin	12 (40)	1 (100)

N.B. (-) means that it has not been tested; Figures in parentheses are in percentage

A high blood culture positivity rate in septicemic children (56%) had been reported by Sharma *et al*.[8] However, a lower positivity rate (36%) was observed by Mondal *et al*,[9] which was comparable with the present study. Chow *et al*, had reported that 26% of all neonatal septicemias were caused by anerobes.[10] A low blood culture isolation rate in this study might be due to several reasons, like administration of antibiotics before blood collection or anerobic bacteraemia.

Mathur *et al*, observed that gram-negative species were found in 87% of neonates. *Klebsiella* species and *Enterobacter* species were the predominant gram-negative species. Of gram-positive species, *S. aureus* was mainly isolated (79.06%). *Salmonella* species were isolated in 2% of cases (comparable to our findings).[11]

The antimicrobial sensitivity pattern differs in different studies as well as at different times in the same hospital in Indian and overseas studies.[12-14] This is mainly a result of indiscriminate use of antibiotics. In our study, we observed that penicillin resistance was found in 70% of the *S. aureus* strains and the single *Coagulase negative staphylococci* (CoNS) strain. Similar high rate of penicillin resistance against *S.aureus* (95%) and CoNS (90%) was seen in a study conducted in Lucknow.[4] In our study, *S. aureus* showed a sensitivity of 70% to Clindamycin and 40% to Vancomycin. Most of the gram-negative organisms were sensitive to Amikacin, Ciprofloxacin, and Co-trimoxazole. Multiple drug resistance was seen in *Enterobacter, E.coli, Klebsiella, and Salmonella* species.

A systematic review from the literature for studies from developing countries find that most hospital infections in the first week of life are due to gram-negative pathogens, namely *Klebsiella* species (25%), *E. coli* (15%). Strains of *Staphylococcus aureus* (18%) and *Group B streptococci* (GBS) were relatively uncommon (7%), although regional

Table 4: Sensitivity pattern of the gram-negative isolates (percentage sensitive)

Antibiotics	*E. coli* (*n*=2)	*Klebsiella* (*n*=5)	*Salmonella* (*n*=2)	Citro (*n*=6)	Entero (*n*=12)	Acineto (*n*=1)	*Bacillus* (*n*=11)	*Pseudo* (*n*=10)
Ceftriaxone	0	100	-	33.3	0	-	63.6	66.6
Ampicillin	0	0	0	16.6	0	0	54.5	25
Amikacin	100	100	0	100	66.6	-	36.3	25
Ceftazidime	0	20	100	16.6	-	-	45.4	30
Ciprofloxacin	100	80	100	100	100	-	100	100
Cotrimoxazole	100	0	100	-	-	-	-	-
Cefuroxime	-	-	0	-	0%	100	81.8	14.28
Gentamicin	0	0	0	-	-	-	54.5	-
Ofloxacin	-	-	-	100	58.3	100	27.3	-
Erythromycin	-	-	-	-	-	0	-	-
Doxycycline	-	-	-	-	-	0	-	-
Ticarcillin	-	-	-	-	-	-	-	33.3

N.B. (-) means that it has not been tested differences existed. After the first week of life, *S. aureus* (14%), *GBS* (12%), *Streptococcus pneumoniae* (12%), and nontyphoidal *Salmonella* species (13%) were most frequent. *S. pneumoniae* (27%) was the most common during the postneonatal period.[2]

Infections are the single largest cause of neonatal deaths globally. According to National Neonatal Perinatal Database (2002-03), the incidence of neonatal sepsis in India was 30 per 1000 live-births; *Klebsiella pneumoniae* and *Staphylococcus aureus* were the two most common organisms isolated.[15]

There is neither any routine for analyzing blood cultures in suspected septicemia nor for antibiotic treatment of neonates/infants with suspected sepsis in our centre.

We have conducted this study to describe the antibiotic susceptibility pattern to propose our "Hospital Infection Committee" to formulate a revised standard operating procedure.

The strength of this study lies in describing patterns of microbiological behavior from an area where this is not routinely done. This study presented an analysis of septicemia in a tertiary healthcare center in northeastern India.

CONCLUSION

Local microbiological databases suggesting the best choice of antibiotics for different age groups are important for the local physicians when treatment of the septic infant has to be initiated before the result of the blood culture is known. The authors suggest that a local dynamic database has to be established. This should contain relevant data on the positive blood cultures.

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How to cite this article: Tsering DC, Chanchal L, Pal R, Kar S. Bacteriological profile of septicemia and the risk factors in neonates and infants in Sikkim. J Global Infect Dis 2011;3:42-5.

Source of Support: Nil. **Conflict of Interest:** None declared.