

## ORIGINAL ARTICLE

# Bacteriological Profile and Antibiotic Sensitivity of Neonatal Septicemia Admitted in Neonatal Intensive Care Unit (NICU) of Dhaka Shishu Hospital

Md. Mosharaf Hossain<sup>1</sup>, Mir Mohammad Yusuf<sup>2</sup>, Md. Kamrunzaman<sup>3</sup>, Maksudur Rahman<sup>4</sup>, Md. Jahangir Alam<sup>5</sup>

### Abstract

**Background:** *Septicemia in neonates refers to bacterial infection documented by positive blood culture in the first four weeks of life and is one of the leading causes of neonatal mortality and morbidity.*

**Objective:** *To isolate and identify the bacterial etiologic agents responsible for neonatal sepsis and to determine the susceptibility pattern of isolates in A NICU of Dhaka Shishu (Children) Hospital.*

**Methods:** *This is a prospective observational study conducted in the NICU from July 2018 to December 2018. Two hundred ninety blood samples were collected and processed from patients in accordance with standard protocols. Antibiotic susceptibility of the isolates was done.*

**Results:** *Blood culture reports were positive in 9.31% cases. Among the culture positive cases, there were 65.5% males and 34.5% females. Early onset sepsis was present in 74.8% and late onset sepsis was observed in 25.2% of the cases. Best overall sensitivity among Gram negative (Acinetobacter, Klebsiella, Pseudomonas) isolates was to netilmycin (61%), followed by ceftazidim (57%) and amikacin (56%). Gram positive (Staphylococci, streptococci) isolates had sensitivity of 50% to levofloxacin, 50% to ceftriaxon.*

**Conclusion:** *Gram negative organisms are the leading cause of neonatal sepsis in this study and most of them are resistant to multiple antibiotics. Therefore the results of this study suggest that, surveillance of antimicrobial resistance in our hospital is necessary.*

**Key words:** *Antimicrobial resistance, antibiotics, neonatal septicemia.*

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1. Assistant Professor, Department of Pediatric Respiratory Medicine, Bangladesh Institute of Child Health (BICH), Dhaka Shishu (Children) Hospital, Dhaka.
  2. Assistant Professor, Department of Critical Care Pediatric, Bangladesh Institute of Child Health (BICH), Dhaka Shishu (Children) Hospital, Dhaka.
  3. Assistant Professor, Department of Pediatric Respiratory Medicine, Bangladesh Institute of Child Health (BICH), Dhaka Shishu (Children) Hospital, Dhaka.
  4. Associate Professor, Department of Neonatology, Bangladesh Institute of Child Health (BICH), Dhaka Shishu (Children) Hospital, Dhaka.
  5. Professor and Head, Department of Pediatric Respiratory Medicine, Bangladesh Institute of Child Health (BICH), Dhaka Shishu (Children) Hospital, Dhaka.

**Correspondence to:** Dr. Md. Mosharaf Hossain, Assistant Professor, Department of Pediatric Respiratory Medicine, Bangladesh Institute of Child Health (BICH), Dhaka Shishu (Children) Hospital, Dhaka. Cell: 01710973500, E-mail: mosharafhossainb1966@gmail.com

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## Introduction

Septicemia in neonates refers to generalized bacterial infection documented by positive blood culture in the first four weeks of life<sup>1</sup> and is one of the leading causes of neonatal mortality and morbidity in Bangladesh.<sup>2-4</sup> Neonatal septicemia continues to be a major problem for neonates in neonatal intensive care units around the world.<sup>5</sup> There could be various reasons for neonatal mortality but septicemia continues to be a major cause of neonatal mortality and morbidity worldwide. Incidence varies from country to country, but it is much higher in developing countries than in developed nations.<sup>6</sup> According to World Health Organization (WHO) estimates, there are about 5 million neonatal deaths a year, with 98% occurring in developing countries.<sup>7</sup> Neonatal sepsis is broadly divided into two types according to age of onset: Early onset sepsis (<72 hrs) and late onset sepsis (≥72 hrs-28 days). Early onset sepsis is acquired during fetal life, delivery, or at the nursery.<sup>8</sup> Neonatal sepsis is caused by a variety of Gram positive as well as Gram negative bacteria, and sometimes yeasts.<sup>5</sup> The spectrum of organisms that causes neonatal sepsis changes over times and varies from region to region. This is due to the changing pattern of antibiotic use and changes in lifestyle.<sup>9</sup> Periodic evaluation of organisms responsible for neonatal sepsis is essential for the appropriate management of neonates. Therefore, this study was undertaken to determine the profile and antibiotic sensitivity patterns of aerobic isolates from blood cultures of neonates in a tertiary care hospital in Dhaka Shishu (Children) Hospital, Dhaka, Bangladesh.

## Materials and Methods

An analysis was conducted on all blood culture reports obtained between July 2018 and December 2018 from newborns admitted to the Department of Neonatal Intensive Care Unit (NICU) of Dhaka Shishu (Children) Hospital, Dhaka. Blood culture was done for all neonates suspected to have septicemia. Blood culture sample included a single sample collected from a peripheral vein or artery under aseptic conditions. The local site was cleansed with 70% alcohol and povidone iodine (1%), followed by 70% alcohol again. Blood cultures were done. Approximately, 3 ml of blood was inoculated into the broth and incubated at 37°C. Subcultures were done on sheep blood agar and MacConkey agar at the earliest visual detection of turbidity. Isolate was identified by their characteristic appearance on their respective media, Gram staining and confirmed by the pattern of biochemical reactions using the standard method.<sup>10</sup> Members of the family enterobacteriaceae were identified by indole

production, H<sub>2</sub>S production, motility test, urease test, oxidase, carbohydrate utilization tests, and other tests. For Gram-positive bacteria, coagulase, catalase, bacitracin and optochin susceptibility tests and other tests were used. Blood culture broth that showed no microbial growth within seven days was reported as culture negative, only after result of routine subculture on blood, MacConkey, and chocolate agar.<sup>10</sup>

Antimicrobial susceptibility testing was performed for all blood culture isolates as recommended.<sup>11</sup> The drugs were in the following: levofloxacin, chloramphenicol, ceftriaxon, ceftazidime, ciprofloxacin, erythromycin, co-trimoxazole, amikacin, netilmicin, imipenem, piperacillin/tazobactam, azithromycin and meropenam. The discs were obtained from Department of Microbiology, Dhaka Shishu (Children) Hospital.

## Results

During the study period, a total of 290 newborns with clinical sepsis were admitted. Blood culture reports were positive in 27 cases (9.31%). Among the culture positive cases, there were 65% male and 35% female neonates with the male to female ratio of 1.9:1. Early onset sepsis cases were found to be three times higher than late onset sepsis.

Out of 27 cases, 74.8% had early onset sepsis and 25.2% had late onset sepsis. Detailed aetiology of the 27 isolates is provided in Table I. These included Gram-negative bacilli (25/27, 92.59%) and Gram-positive cocci (2/27, 7.40%). *Acinetobacter*, *Klebsiella*, *Pseudomonas* were the most common Gram-negative and *Staphylococci*, *streptococci* were Gram-positive organisms.

**Table I**  
*Microbiological profile of pathogens in the NICU (N-27)*

Gram negative	Number	%
Acinetobacter	7	25.93
Klebsiella	7	25.93
Pseudomonas	4	14.81
E-coli	2	7.41
Citrobacter	2	7.41
Salmonella	2	7.41
Serratia	1	3.70
Gram Positive	1	3.70
Staphylococci Streptococci	1	3.70
Total	27	100

**Table II**  
*Sensitivity profile of Microorganisms in the NICU*

Organisms	Meropenem %	Amikacin %	Netilmycin %	Ceftazidime %	Chloramphenicol %	Ciprofloxacin %	Cotrimoxazole %	Piperacillin %	Ceftriaxone %	Imipenem %	Levofloxacin %
Acinetobacter*	5	11	42	21	5	21	32	16	11	0	21
Klebsiella	38	50	50	0	38	25	50	13	13	38	50
Pseudomonas	13	25	25	25	0	50	0	25	13	25	25
E-coli	50	50	50	50	25	25	25	0	0	25	25
Serratia	100	100	100	100	0	100	100	0	100	100	0
Salmonella	0	0	0	50	50	100	50	0	100	0	50
Citrobacter	100	100	100	100	100	100	100	50	100	0	50
Streptococci	0	0	0	0	0	0	100	50	100	0	100
Staphylococci	50	0	0	0	50	0	0	0	0	50	0

\* Acinetobacter resistant to all in 25% cases

(Table I) show the antibiotic susceptibility pattern in Gram-negative and Gram-positive isolates. Best overall sensitivity among Gram-negative isolates was to netilmycin (61%), followed by ceftazidime (57%) and amikacin (56%). Gram-positive isolates had sensitivity of 50% to levofloxacin and 50% to ceftriaxon (Table II).

### Discussion

The uncertainty surrounding the clinical approach to treatment of neonatal septicemia can be minimized by periodic epidemiological surveys of aetiological agents and their antibiotic sensitivity patterns leading to recognition of the most frequently encountered pathogens in a particular geographical area. For effectual management of septicemia cases, study of bacteriological profile along with the antimicrobial sensitivity pattern plays valuable role.<sup>12,13</sup> Out of the 290 clinically suspected cases of sepsis in our study, 27 were culture positive with a blood culture positivity rate of 9.31%. The incidence of Gram-negative and Gram-positive organisms was 92.59% and 7.40%, respectively. There were 74.8% isolates from early onset septicemia cases, while 25.2% were from late-onset illness. In this study, a male predominance with male to female ratio of 1.9:1 was found in our study, which agrees with previous report.<sup>14</sup> This might be because of the importance given to the male infants and also because of more number of male infants born compared to female infants born.

Culture positivity for aerobic organisms in neonates vary from 25% to 60%.<sup>15-17</sup> In this study, blood culture-positivity rate is 9.31%. This finding is comparable with other reports.<sup>9</sup> However, a high blood culture-positivity rate in septicemia children (56%) had been reported by Sharma et al<sup>18</sup> and Jain et al<sup>19</sup>. A low blood culture isolation rate could be due to administration of antibiotic before blood collection from the primary centers or the possibility of infection with anaerobes. A negative blood culture does not exclude sepsis and about 26% of all neonatal sepsis could be due to anaerobes.<sup>9</sup> The pathogens most often implicated in neonatal sepsis in developing countries differ from those seen in developed countries. Overall, Gram-negative organisms are more common and mainly represented by *Acinetobacter*, *Klebsiella*, *Pseudomonas*, *Escherichia coli*, *Citrobacter*, *Salmonella* and *serratia*. Of the Gram-positive organisms, *Staphylococcus* and *Streptococcus* are most commonly isolated. Gram-negative and Gram-positive septicemia was encountered in 93% and 7% of the culture-positive cases in this study, which is comparable to a study conducted by Agnihotri *et al.*,<sup>1</sup> which reported that Gram-negative and Gram-positive organisms were responsible for 59% and 41% of the septicemia cases, respectively. Similar observations were made by other workers.<sup>4,6</sup> The report of the National Neonatal Perinatal database showed *Klebsiella* as the predominant (29%) pathogen.<sup>15</sup> Both *Klebsiella* spp.(31%) and

*Acinobacter* spp. were the predominant Gram-negative species isolated in this study, which agrees with previous reports.<sup>2,9</sup>

Antibiotic resistance is today a global problem. Reports of multi-resistant bacteria causing neonatal sepsis in developing countries are increasing. The wide availability of over the counter antibiotics and the inappropriate use of broad-spectrum antibiotics in the community may explain this situation. It is difficult to compare antibiotic resistance between countries because the epidemiology of neonatal sepsis is extremely variable.<sup>7</sup> Antibiotic susceptibility pattern was studied for all isolates causing neonatal sepsis. The analysis of drug resistance pattern showed that, among Gram negative isolates, maximum numbers were resistant to ampicillin and lowest to ceftriaxon. Resistance was observed to be against commonly used antibiotics such as ampicillin, amoxiclav and cephalixin. Among Gram positive isolates, high resistance was seen to penicillin, cloxacillin, and amoxiclav. Resistance to *Acinobacter* was seen 21% to all in our study. The greater prevalence resistance to commonly used antibiotics has also been reported by other studies.<sup>2,4</sup>

Among aminoglycosides, netilmycin was found to have an edge over amikacin in Gram-negative septicemia, with sensitivity of 61% and 56% respectively. Similar observations have been made by previous group of workers.<sup>20</sup> In this study, maximum sensitivity was observed in ceftriaxon, levofloxacin and netilmicin. Sensitivity to netilmycin and levofloxacin was much higher than that to other antibiotics, but these two drugs should not be used indiscriminately and be kept as a reserve drugs, otherwise resistance to these drugs may develop, thereby threatening the treatment.

### Conclusion

It is evident from this study that Gram-negative organisms are the leading cause of neonatal sepsis in this study, and most of them are resistant to multiple antibiotics. Therefore, suggest that surveillance of antimicrobial resistance is necessary. Also, an antibiotic policy should be formulated in the hospital. Depending on the antibiotic sensitivity pattern of the isolates, antibiotics should be used to avoid dangers of indiscriminate use of antibiotics.

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