Original article

Isolation, Identification and Antibiotic Sensitivity Patterns of Bacteria in Early Onset and Late Onset Neonatal Septicemia at A Tertiary Care Hospital

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Abstract

This is a descriptive type of cross sectional study which was done to find out the causative organisms and their antibiotic sensitivities in the Department of Microbiology of Rajshahi Medical College Hospital, Rajshahi during the period of July 2014 to June 2015. A total of 116 blood samples were taken aseptically from the suspected neonatal septicemic patients which were then inoculated in Brain heart infusion broth. Isolation, identification and antibiotic sensitivity pattern of Bacteria were done by standard microbiological methods. 33(28.4%) cases were found to be culture positive among 116 cases. Among 33 culture positive cases EONS was 19 (57.57%) and LONS was 14 (42.42%). The isolated causative organisms of EONS were 10 (52.6%) by *Staphylococcus aureus,* 1 (5.3%) by *Streptococcus pneumoniae,* 7 (36.8%) by *E.coli* and 1 (5.3%) by *Klebsiella pneumoniae.* On the other hand, causative agents of LONS were 7(50%) by *Staphylococcus aureus,* 2 (14.3%) by *Streptococcus pneumoniae,* 3 (21.4%) by *E.coli,* 1 (7.1%) by *Klebsiella pneumoniae* and 1 (7.1%) by *Pseudomonas aeruginosa*. All the cases of Gram positive and Gram negative organisms were highly sensitive to meropenem, amikacin, gentamicin and ciprofloxacin. Gram positive bacteria were found to be particularly sensitive to vancomycin. They were moderately sensitive to ceftazidime, amoxicillin but were completely resistant to ampicillin. This study revealed the predominance of Staphylococcus aureus and E.coli as causative organisms in both EONS and LONS and these organisms are markedly sensitive to meropenem, amikacin, gentamicin and ciprofloxacin.

Keyword: Early onset neonatal septicemia (EONS), late onset neonatal septicemia (LONS), causative agents, antibiotic sensitivity pattern.

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Introduction

Neonatal septicemia is one of the important cause of morbidity and mortality of neonates. It is responsible for 30-50% of the total neonatal death in developing countries. It is estimated that up to 20% of the neonates develop septicemia and approximately 1% die of septicemia related causes.[1] However neonatal septicemia is the second leading cause of neonatal death in Bangladesh.[2] Neonates are vulnerable to developing septicemia due to factors such as low immunity, prematurity, low birth weight, respiratory infections and maternal infections.[3]

According to the age of onset, neonatal septicemia is divided into two classes: (i) Early-onset neonatal septicemia (EONS) and (ii) Late-onset neonatal septicemia (LONS). Usually, the onset of sepsis within the first 72 hours of life is referred to as EONS, while the onset of sepsis after 72 hours but within the first

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28 days of life is referred to as LONS. It is anticipated that organisms acquired before and during delivery (or maternal-fetal infection) are mainly responsible for EONS, while organisms acquired after delivery from the environment are responsible for LONS.[4]

There are many differences in epidemiological data among the developed and developing countries regarding incidence, risk factors, pattern and antibiotic sensitivity in neonatal septicemia. Most commonly isolated bacteria are Klebsiella pneumoniae, Escherichia coli, Enterobacter, Pseudomnonas aeruginosa, Staphylococcus aureus, Streptococcus spp, Citrobacter and Coagulase negative Staphylococcus (CONS).[5,6.]

In Bangladesh, a few studies have reported on causative organisms of neonatal septicemia and their antibiotic sensitivity pattern.[7-9] The spectrum of organisms that causes neonatal septicemia changes over time and varies from region to region. Neonatal septicemia is a life-threatening condition in which inadequate management leads to high mortality rate. Surveillance is needed to identify common pathogens of neonatal septicemia as well as to evaluate the antibiotic sensitivity pattern of the pathogens. This study was undertaken to identify the causative organisms of early and late onset neonatal septicemia with their antibiotic susceptibility.

Materials and Methods

This is a descriptive type of cross-sectional study which was conducted in the Department of Microbiology in Rajshahi Medical College. Sample collection was done from the Paediatrics Department, Rajshahi Medical College Hospital, Rajshahi. The study period was from July 2014 to June 2015 after the approval of protocol by the Rajshahi Medical College Ethics Committee.

Consecutive 116 cases of suspected neonatal septicemia patients admitted in the Pediatrics Department were purposefully selected for the study. These cases were divided into two groups: EONS (< 72 hours) and LONS (>72 hours to 28 days). Inclusion criterias included age of the patients should be up to 28 days with presence of clinical symptoms such as fever, convulsion, reluctant to feed, abdominal distension and dyspnoea. The exclusion criterias were extreme low birth weight baby (<1kg), extreme pre-mature baby (<28 weeks of gestational age), babies with pneumonia, meningitis and those who received antibiotic prior to admission.

Initially informed written consent from parents was taken. About 2-3 ml of blood was taken aseptically from each patient. He local site (anticubital vein or dorsal vein) was clean with 70% alcohol and povidone iodine (1%), followed by 70% alcohol again. About 2-3 ml of blood was withdrawn using disposable syringe and collected blood samples were inoculated in a brain heart infusion broth separately and incubated at 37^0C for up to 7 days later subcultured on blood agar and Mac Conkey's agar media was done. Final identification of the causative organisms was performed by Gram staining and specific biochemical tests.

The antibiotic sensityvity testing of the causative organisms was done using Kirby-Bauer disk diffusion method on Mueller Hinton agar as per Clinical Laboratory Standards Institute (CLSI) guidelines.[10] Antibiotic discs used for Gram negative bacilli were ampicillin, amoxicillin, ceftazidime, amikacin, ciprofloxacin, gentamicin and meropenem; and while for Gram positive cocci vancomycin was along with above mentioned antibiotics.

Results

Clinically suspected 116 patients of neonatal septicemia were included in this study. The blood samples were collected and tested for isolation, identification of bacteria and their sensitivity pattern. The results are as follows:

Table-I: Table shows the results of blood culture according to different age group: (n=116)

Age of onset	Culture positive (n=33)	Culture negative (n=83)	Total
EOS (<72 hrs)	19(57.57%)	33(39.75%)	52
LOS (>72 hrs)	14(42.42%)	50(60.24%)	64
Total	**33**	**83**	**116**

Among 33 culture positive cases early onset neonatal septicemia was 19(57.57%) and late onset neonatal septicemia was 14(42.42%). Among 83 culture negative cases early onset neonatal septicemia was 33(39.75%) and late onset neonatal septicemia was 50(60.24%).

Table-II: Distribution of identified bacteria in relation to onset of neonatal septicemia:

Isolates	EOS (n=19) %	LOS (n=14) %
Staphylococcus aureus	10(52.6)	7(50)
Steptococcus pneumonie	1(5.3)	2(14.3)
Escherichia coli	7(36.8)	3(21.4)
Klebsiella pneumonia	1(5.3)	1(7.1)
Pseudomonas aeruginosa	0	1(7.1)
Total	**19**	**14**

Early onset neonatal septicemia was 19(57.57%) among them 10(52.6%) caused by *Staphylococcus aureus,* 1(5.3%) by *Streptococcus pneumoniae,* 7(36.8%) by *E.coli*, 1(5.3%) by *Klebsiella pneumoniae.* On the other hand, late onset neonatal septicemia was 14(42.42%)

among them 7(50%) caused by *Staphylococcus aureus,* 2(14.3%) by *Streptococcus pneumoniae,* 3(21.4%) by *E.coli,* 1(7.1%) by *Klebsiella pneumoniae,* 1(7.1%) by *Pseudomonas aeruginosa*.

Table-III: Antibiotic sensitivity pattern of bacteria in neonatal septicemia:

Antibiotics	*S. aureus* (n=17)	*S. pneumonie* (n=3)	*E. coli* (n=10)	*K. pneumoniae* (n=2)	*P. aeruginosa* (n=1)
Ampicillin	0	0	0	0	0
Amoxicillin	4(23.5%)	0	1(10%)	0	0
Amikacin	16(94.1%)	3(100%)	9(90%)	2(100%)	1(100%)
Gentamicin	16(94.1%)	3(100%)	9(90%)	2(100%)	1(100%)
Ciprofloxacin	14(82.3%)	2(66.6%)	9(90%)	1(50%)	1(100%)
Vancomycin	16(94.1%)	3(100%)	-	-	-
Ceftazidime	10(58.8%)	1(33.3%)	6(60%)	1(50%)	0
Meropenem	17(100%)	3(100%)	10(100%)	2(100%)	1(100%)

Staphylococcus aureus sensitivity against different antibiotics were amoxicillin (23.5%), amikacin (94.1%), gentamicin (94.1%), ciprofloxacin (82.3%), vancomycin (94.1%), ceftazidime (58.8%), meropenem (100%) but all were resistant to ampicillin. While *Streptococcus pneumoniae* showed 100% sensitivity to amikacin, gentamicin, vancomycin and meropenem, 66.6% to ciprofloxacin and 33.3% to ceftazidime but all were resistant to ampicillin and amoxicillin. *Escherichia coli* showed sensitivity to meropenem (100.0%), gentamicin (90.0%), amikacin (90.0%), ciprofloxacin (90.0%), ceftazidime (60.0%) and amoxicillin (10.0%). But all were resistant to ampicillin. 100% sensitivity to amikacin, gentamicin and meropenem were seen in *Klebsiella pneumoniae*; while 50% sensitivity to ciprofloxacin and ceftazidime but were resistant to ampicillin and amoxicillin (Table-III). *Pseudomonas aeruginosa* was 100% sensitive to amikacin, gentamicin, ciprofloxacin and meropenem but 100% resistant to amoxicillin, ampicillin, and ceftazidime.

Discussion

Neonatal septicemia is a life-threatening emergency and any delay in the treatment may be fatal. It can be minimized by periodic epidemiological survey of etiological agents and their antibiotic sensitivity patterns.[11-13] In this study showed that 116 blood samples, 33(28.4%) cases yielded growth of both Gram positive and Gram negative bacteria which was quiet similar with the study of Shrestha *et al* and Jain *et al.* in Nepal, Desai *et al.* in South India, Tsering *et al.* in Sikkim of India and Kochhar *et al.* in Kenya in which isolation rate were 30.8%, 28.3%, 32%, 23% and 23% respectively.[14-17,18]

In our study early onset neonatal septicemia was 19(57.57%) and late onset neonatal septicemia was 14(42.42%). Our study is showed similarity to the study of Mustafa *et al.* from India reported that early onset neonatal septicemia was 36(58%) and late onset neonatal septicemia was 26(42%).[19] Hiral *et al.* from Gujrat reported that early onset neonatal septicemia 38(44.2%) and late onset neonatal septicemia 73(55.72%) which is different from our study.[20] This variation of isolation in early onset neonatal septicemia and late onset neonatal septicemia depends on the various factors including hygiene during delivery and resuscitation of baby, child care facilities, maternal vaginal flora, and maternal nutrition.

The most frequent organism of our study was *staphylococcus aureus* in both early onset neonatal septicemia 10(52.6%) and late onset neonatal septicemia 7(50%). Our study showed similarity to the study of Sharma *et al.,* 2013 from Kanpur, India reported that 31(40.26%) early onset neonatal septicemia and 20(35.33%) late onset neonatal septicemia caused by *Staphylococcus aureus.*[21] Lower isolation of *Staphylococcus aureus* was reported by Boma *et al.* from Port Hartcourt, Nigeria. Where they found 18(15%) early onset neonatal septicemia and 15(30.9%) late onset neonatal septicemia caused by *Staphylococcus aureus.*[22]

E.coli was the second most common organisms in our study causing 7(36.8%) early onset neonatal septicemia and 3(21.4%) late onset neonatal septicemia. Our study showed similarity to the study of Mustafa *et al.,* 2014 from India reported that 10(27.7%) early onset neonatal septicemia and 4(15.4%) late onset neonatal septicemia caused by *E.coli.*[19] Lower isolation also reported by Kochhar *et al.,* 2011 from Kenya. Where they found 1(1.1%) early onset neonatal septicemia and 1(1.17%) late onset neonatal septicemia caused by *E.coli.*[18]

In our study 1(5.2%) early onset neonatal septicemia and 2(14.2%) late onset neonatal septicemia caused by *Streptococcus pneumoniae*. No enough data was available for comparison our study. Different data was available that was reported by Boma *et al.* from Nigeria. Where they found 1(1.1%) early onset neonatal septicemia and 0% late onset neonatal septicemia caused by *Streptococcus pneumoniae*[22]. In our study 1(5.2%)

early onset neonatal septicemia and 1(7.1%) late onset neonatal septicemia caused by *Klebsiella pneumoniae.* Our study showed similarity to the study of Kochhar *et al.* from Kenya reported that 7(7.4%) early onset neonatal septicemia and 7(12.1%) late onset neonatal septicemia caused by *Klebsiella.*[18] Another study also observed by Sharma *et al.,* 2013 from Kanpur, India. Where they found 18(23.38%) early onset neonatal septicemia and 19(31.67%) late onset neonatal septicemia caused by *Klebsiella pneumoniae.*[21]

In our study only 1(7.1%) late onset neonatal septicemia caused by *Pseudomonas aeruginosa.* This study was relatable to the study of Mustafa *et al.* from India reported that 3(11.5%) late onset neonatal septicemia caused by *Pseudomonas aeruginosa.*[19] Different study was reported by Kochhar *et al.,* from Kenya, where they found 1(1.1%) early onset neonatal septicemia and no late onset neonatal septicemia caused by *Pseudomonas.*[18] This variation in organisms may be due to geographical variation, literacy, different life condition.

Now a day's antibiotic resistance of the microorganisms is a global problem. Reports of multi drug resistant bacteria causing neonatal sepsis in developing countries are increasing. In our study sensitivity pattern of antibiotic in case of *Staphylococcus aureus* and *E.coli* were consistent with the study of Khan *et al.* in Pakistan where *Staphylococcus aureus was* sensitive to meropenem (92.85%), vancomycin (100%), ceftazidime (57.14%) & *E.coli* was sensitive to amikacin(80.55%), meropenem (97.2%), ciprofloxacin (77.7%) and ceftazidime (61.1%).[23] But in a study by Rizwan *et al.* in Dhaka Bangladesh observed that *Staphylococcus aureus* was completely percent resistant to ciprofloxacin, gentamicin, ceftazidime and meropenem which is do not compare to our study.[24] Different sensitivity of *E.coli* was observed by Hannan *et al.* from Pakistan and their observation was 100% resistant to amikacin, ciprofloxacin and ceftazidime and Hiral *et al.* in Gujrat observed that 12.5% sensitive to gentamicin, 6.25% to amikacin.[25,20]

In our study *Streptococcus Pneumoniae* showed 100% sensitive to amikacin, gentamicin, vancomycin, ciprofloxacin, and meropenem, 33.3% to ceftazidime, but completely resistant to amoxicilin and ampicillin which is nearly similar to the study of Rizwan *et al.* in Dhaka Bangladesh observed that *Streptococcus pneumoniae* showed 100% sensitive to gentamicin, ciprofloxacin, amikacin, meropenem and 100% resistant to ceftazidime and ampicillin.[24] Different sensitivity rate was observed by Sharma *et al.* from India where 75% *Streptococcus pneumoniae* was sensitive to ampicillin, 50% to amikacin.[22]

Klebsiella showed in this study 100% sensitivity to amikacin, gentamicin and meropenem but complete resistant to ampicillin, amoxicillin followed by ciprofloxacin and ceftazidime. Antiobiotic sensitivity of *klebsiella pneumonia* in this study was nearly similar to the report of Khan *et al.* in Pakistan reported that 17.6% sensitive to ampicillin, 94.12% to meropenem, 64.7% to ceftazidime.[23] Mustafa *et al.* in India reported 9% sensitivity to ampicillin, 100% to meropenem, 54% to ceftazidime[19]. Shrestha *et al.* from Nepal reported 100% sensitive to amikacin and gentamicin of *klebsiella pneumonia.*[14] Lower rate of sensitivity was observed by Hiral *et al*. from Gujrat where sensitivity to gentamicin was 20.12%, to amikacin 26% Sharma *et al.* from India reported 20% sensitivity to amikacin, 30% to ciprofloxacin and 100% percent resistant to gentamicin of their *Klebsiella.*[20,26]

Pseudomonas aeruginosa showed in this study cent percent sensitive to amikacin, gentamicin, ciprofloxacin but cent percent resistant to ampicillin, amoxicillin, ceftazidime This study was similar to the report of Shrestha *et al.* in Nepal which observed that *Pseudomonas aeruginosa was* 100% sensitive to amikacin, ciprofloxacin, gentamicin and Khan *et al.* in Pakistan observed that 16.8% sensitive to ampicillin, 91.6% to meropenem, and 83.3% to ciprofloxacin.[14,23]

Dissimilarity was observed by Hiral *et al.* in Gujrat where gentamicin and amikacin 12.5%, ciprofloxacin 27.37% sensitive and Sharma *et al.* in India observed that amikacin, gentamicin, ciprofloxacin were 50% sensitive.[20,26]

All dissimilarities of antibiotic sensitivity pattern in the above-mentioned studies may be due to geographical variations and frequent use of antibiotics in the management of neonatal infections in hospital which is responsible to emergence of resistant strains.[27-30] In a view that antibiotic sensitivity pattern differ in studies and different times so the strategies of antibiotic use in neonates should be reviewed periodically.[31]

Conclusion

It may be concluded that a good number of neonatal septicemia cases are found in this locality. Number of early onset neonatal septicemia is more than the late onset neonatal septicemia. The predominant agents are *Staphylococcus aureus* and *E.coli* in both early onset and late onset neonatal septicemia. They are highly sensitive to, amikacin, gentamicin and meropenem. Vancomycin is highly sensitive against gram positive bacteria. Due to limitations of lab facilities we could not perform culture of anaerobic bacteria. So further study should be done with a large sample sizes and utilizing the advanced technologies.

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