Original Article

Emerging pattern of bacterial isolates causing neonatal sepsis and their antibiotic susceptibility

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Objective: To find the bacterial isolates causing neonatal sepsis and their antibiotic susceptibility patterns.

Methodology: This cross-sectional observational study was done at Department of Pediatrics, Ayub Teaching Hospital, Abbottabad, from June to December 2019. A total of 84 confirmed blood culture positive cases of both genders, aged ≤28 days and admitted with neonatal sepsis were enrolled. Identified organisms were tested against commonly used antibiotics for susceptibility patterns.

Results: Out of a total of 84 neonates, 54 (64.3%) were boys and 30 (35.7%) girls. Most (50; 59.5%) had gram positive bacterial isolates. Most commonly involved gram positive isolates were Staphylococcus aureus (23; 46.0%) while Klebsiella pneumoniae was the commonest gram negative isolate, found in 13 (38.2%) cases. Overall, causative agent isolates showed highest antimicrobial sensitivity patterns for Linezolid (91.5%), Amikacin (90.8%), Clindamycin (89.5%), Piperacillin Tazobactum (84.8%) and Vancomycin (80.6%) while Amoxicillin (80.8%), Ampicillin (79.7%), Cefotaxime (70.7%) and Ceftriaxone (69.9%) had highest rates of resistance.

Conclusion: Staphylococcus aureus, Staplhylococcus epidermidis and Klebsiella pneumonia were the commonest causative agent for neonatal sepsis. Routinely used empirical antibiotics like Cefotaxime, Ceftriaxone, Ampicillin and Amoxicillin had high rates of resistance. (Rawal Med J 202;45:775-779).

Keywords: Neonatal sepsis, causative agent, antibiotic susceptibility.

INTRODUCTION

In South Asian countries, neonatal sepsis is one of the commonest contributors of morbidity and mortality in the neonatal age group. More than 90% of deaths due to neonatal sepsis are reported from developing countries.[1,2] Among developing countries, WHO estimates incidence of neonatal sepsis as 1 to 10 in 1000 live-births.[3] The figures are nearly 3 times burden of neonatal sepsis in Pakistan.[4] Neonatal sepsis is classified as early or late onset sepsis. Early onset sepsis (EOS) is described to occur within 7 days.[5] Diagnosis of neonatal sepsis is challenging considering most cases of neonatal sepsis are coming with non-specific signs and symptoms. Blood culture for the detection of pathogen involved is the best method to confirm the diagnosis.[6] In cases of neonatal sepsis suspected to have bacterial involvement, empirical antibiotic treatment is usually initiated by clinicians.

Microorganisms involved in neonatal sepsis differ in different parts of the world. Even the same region may have variations in terms of involvement of responsible pathogens. In Pakistan, gram-negative bacteria are involved in 70% neonatal sepsis.[7,8] With the passage of time, microorganisms in neonatal sepsis are known to replace each other so it is essential to find out susceptibility patterns of most commonly used antibiotics against most commonly involved pathogens. This study was aimed to find the bacterial isolates involved in neonatal sepsis and their antibiotic susceptibility patterns.

METHODOLOGY

This cross-sectional observational study was done

at Department of Pediatrics, Ayub Teaching Hospital, Abbottabad, from June to December 2019. Approval of Institutional Ethics Committee was acquired and Informed consent from parents or guardians of all the participants was taken. A total of 84 confirmed blood culture positive cases of both genders, aged ≤28 days and admitted with neonatal sepsis were enrolled. Those who received oral or injectable antibiotics in the past or whose mothers had received any kind of narcotic analgesic during labor, all preterm neonates (gestational age <37 weeks) or with congenital heart disease were excluded.

Before the initiation of the empirical antibiotic therapy, five ml blood sample was taken under strict aseptic conditions and sent to institutional laboratory for culture and sensitivity. All blood cultures were performed adopting standard bottle for inoculation and incubation period of 5 days. Sub-cultures were done on MacConkey Agar, Chocolate Agar and Blood Agar while incubation was done at 37^{o}C aerobiology. Gram staining was done for the identification of the isolated organisms. Identified organisms were confronted to commonly used antibiotics for susceptibility patterns using Kirby Baur Disc diffusion technique. All the study information was recorded on a specially designed template.

Statistical Analysis: Statistical analysis was performed using SPSS version 26. Gender, types of neonatal sepsis, groups and types of causative bacterial isolates, their sensitivity and resistance patterns are described as frequency and percentages.

RESULTS

Out of 84 neonates, 54 (64.3%) were boys and 30 (35.7%) girls, representing a boys to girls ratio of 1.7:1. EOS was noted in 42 (50.0%) cases while late onset sepsis (LOS) was also found in 42 (50.0%). Overall, staphylococcus aureus was the most commonly found microorganism, noted in 23 (27.4%) followed by staphylococcus epidermidis 18 (21.4%). Table 1 shows most gram positive and gram negative isolates.

Table 1. Types of bacterial isolates involved among neonates (n=84).

Types of Bacteria		Number (%)
Gram Negative (n=34)	Acinetobacter baumannii	4 (11.8%)
	Citrobacter	2 (5.9%)
	Enterococcus faecalis	4 (11.8%)
	Escherichia coli	4 (11.8%)
	Klebsiella pneumoniae	13 (38.2%)
	Pseudomonas	5 (14.7%)
	Stenotrophomonas maltophilia	2 (5.9%)
Gram Positive (n=50)	MRSA	5 (10.0%)
	Staphylococcus aureus	23 (46.0%)
	Staphylococcus epidermidis	18 (36.0%)
	Streptococcus faecalis	3 (6.0%)
	Viridans streptococci	1 (2.0%)

Table 2. Gram Negative bacterial isolates and their antimicrobial sensitivities.

Bacterial Isolate	Most Sensitive Antibiotic	Sensitivity (%)	Most Resistant Antibiotic	Resistance (%)
Acinetobacter baumannii	Piperacillin Tazobactum	50.0%	Ampicillin	100%
	Cefoperazone salbactum	50.0%	Amoxicillin	100%
	Amikacin	25.0%	Cefotaxime	75.0%
	Ciprofloxacin	25.0%	Ceftriaxone	75.0%
Citrobacter	Ciprofloxacin	100.0%	Colistin	100.0%
	Amikacin	100.0%	Ceftriaxone	50.0%
	Meropenem	100.0%	Gentamycin	50.0%
	Piperacillin Tazobactam	100.0%	Vancomycin	50.0%
Enterococcus faecalis	Clindamycin	75.0%	Doxycyclin	100.0%
	Amikacin	75.0%	Ampicillin	75.0%
	Linezolid	75.0%	Amoxicillin	75.0%
	Ciprofloxacin	50.0%	Vancomycin	75.0%
Escherichia coli	Gentamycin	75.0%	Cefotaxime	75.0%
	Amikacin	75.0%	Ampicillin	75.0%
	Ciprofloxacin	50.0%	Amoxicillin	75.0%
	Linezolid	50.0%	Ceftriaxone	75.0%
Klebsiella pneumoniae	Amikacin	100.0%	Ampicillin	92.3%
	Meropenem	100.0%	Amoxicillin	92.3%
	Ciprofloxacin	76.9%	Ceftriaxone	92.3%
	Gentamycin	38.5%	Cefotaxime	92.3%
Pseudomonas	Ceftazidime	80.0%	Piperacillin Tazobactum	80.0%
	Ceftriaxone	80.0%	Amikacin	60.0%
	Ciprofloxacin	80.0%	Gentamycin	60.0%
	Meropenem	80.0%	Ampicillin	40.0%
Stenotrophomonas maltophilia	Ciprofloxacin	100.0%	Doxycyclin	100.0%
	Levofloxacin	100.0%	Ceftriaxone	94.4%
	Moxifloxacin	50.0%	Ceftizidime	94.4%
			Ampicillin	60.9%

Table 3. Gram positive bacterial isolates and their antimicrobial sensitivities.

Bacterial Isolate	Most Sensitive Antibiotic	Sensitivity (%)	Most Resistant Antibiotic	Resistance (%)
Methicillin-resistant Staphylococcus aureus	Amikacin	100.0%	Amoxicillin	100.0%
	Clindamycin	100.0%	Meropenem	100.0%
	Linezolid	100.0%	Ceftriaxone	100.0%
	Ciprofloxacin	80.0%	Ampicillin	50.0%
Staphylococcus aureus	Clindamycin	95.7%	Ampicillin	60.9%
	Amikacin	95.7%	Amoxicillin	60.9%
	Linezolid	95.7%	Ciprofloxacin	47.8%
	Gentamycin	56.5%	Gentamycin	43.5%
Staphylococcus epidermidis	Amikacin	100.0%	Meropenem	94.4%
	Clindamycin	88.9%	Ampicillin	94.4%
	Linezolid	88.9%	Amoxicillin	94.4%
	Gentamycin	77.8%	Ciprofloxacin	50.0%
Streptococcus faecalis	Vancomycin	100.0%	Ciprofloxacin	100.0%
	Linezolid	100.0%	Gentamycin	100.0%
	Ampicillin	66.7%	Clindamycin	66.7%
	Ceftriaxone	33.3%	Amoxicillin	33.3%
Viridans streptococci	Ciprofloxacin	100.0%	Ampicillin	100.0%
	Clindamycin	100.0%	Amoxicillin	100.0%
	Vancomycin	100.0%		
	Meropenem	100.0%		

Fig. Overall patterns of sensitivity (%) and resistance (%) among antibiotics in the present study.

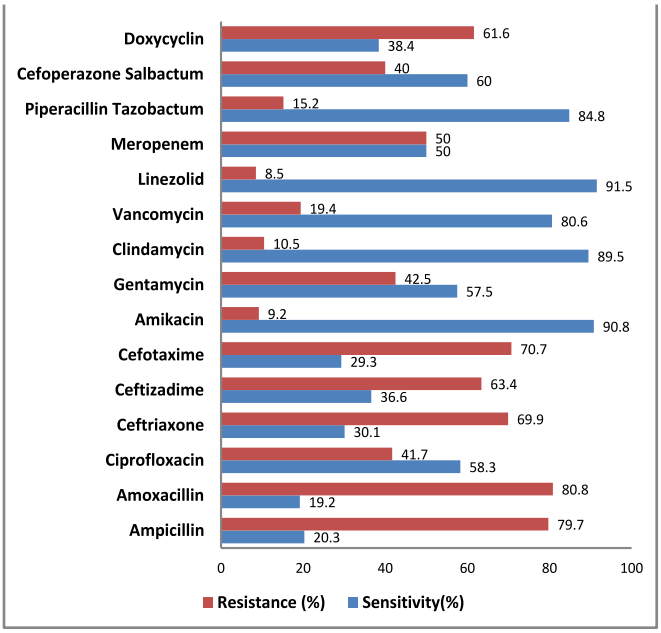

Table 2 and 3 show sensitivity and resistance patterns of bacterial isolates found and commonly used antibiotics. Overall, causative agent isolates showed highest antimicrobial sensitivity patterns for Linezolid (91.5%), Amikacin (90.8%), Clindamycin (89.5%), Piperacillin Tazobactum (84.8%) and Vancomycin (80.6%) while Amoxicillin (80.8%), Ampicillin (79.7%), Cefotaxime (70.7%) and Ceftriaxone (69.9%) were found to have highest rates of resistance (Fig.).

DISCUSSION

In the present study, majority of the neonates were noted to be male. Many regional and international studies have highlighted male predominance among cases of neonatal of septicemia.[7-10] The exact cause behind the male predominance is not understood but it could have been due to gender related factors. Synthesis of γ-globulins is synchronized through X–linked immune-regulatory genes and as we know male gender has 1 X chromosome, this could be one important factor why male neonates have increased chances of neonatal sepsis.[11] In the current study, equal proportion of neonates was found to have EOS (50.0%) and LOS (50.0%). Samaga from India recorded similar findings where they noticed 48.9% of the neonates to have EOS and 51.1% had LOS.[12] Our results are different to what Hussain et al found in a previous local study from Peshawar where they noted 29.6% cases as EOS while LOS was recorded among 70.4%.[7] On the other hand, Basheer et al from Lahore noted 76.0% of the cases to belong to EOS while remaining 24.0%were cases of LOS. Sawhney et al from Haryana, India observed 57.2% cases to be EOS while LOS was seen in 42.8% neonates.[8,10]

Hussain et al found 73.0% cases of neonatal sepsis to have involvement of gram positive bacteria whereas E. coli was responsible for 64.7% of the cases in totality.[7] In Pakistan, E. Coli is considered to be the commonest organism, responsible for more than half cases of neonatal sepsis in Pakistan.[7,8,13] Sindh and Punjab provinces also reported that gram negative bacteria are more prevalent among cases of neonatal sepsis.[14,15]

Other commonly found microorganisms have been Staphylococcus aureus and Klebseilla pneumonia by other local researchers.[13-15] We noted Staphylococcus aureus to be the most frequent causative agent, responsible for 46.0% cases while Klebsiella pneumoniae and Staphylococcus epidermidis were responsible for 38.2% and 36.0% cases of neonatal sepsis in this study. In Bangladesh,

Klebseilla spp. are found as the commonest causative agent in neonatal sepsis while data from Iran shows Enterobacter as the most common causative agent.[16,17]

We found Linezolid, Amikacin, Clindamycin and Piperacillin Tazobactum to have highest antimicrobial sensitivities while commonly adopted antibiotics like Cefotaxime and Ceftriaxone were found to have high resistance rates. Ampicillin, Cefotaxime or Ceftizadime are commonly used antibiotics among local healthcare facilities but we noted high rates of resistance which demands in reevaluation of the treatment options.

It was a single center study so our findings with regards to causative microorganisms and antimicrobial sensitivity or resistant patterns cannot be generalized. Sample size was not very big as well so more studies involving multiple centers and populations are required to further add to the findings of this study. We were also unable to document that how many cases were referred from other hospitals or community. Further studies should address these issues. The authorities and stake holders should facilitate timely diagnosis and treatment of maternal infections, improvement in delivery system along with proper hygiene and timely referral of suspected neonatal sepsis cases.

CONCLUSION

Staphylococcus aureus, Klebsiella pneumonia and Staplhylococcus epidermidis were found to be the commonest causative agent for neonatal sepsis. Routinely used empirical antibiotics like Cefotaxime, Ceftriaxone, Ampicillin and Amoxicillin were noted to have high rates of resistance.

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