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Original Research Article

A study of bacteriological profile and antibiotic sensitivity of culture proven neonatal sepsis

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ABSTRACT

Background: Neonatal sepsis is the second most common cause of neonatal mortality in India. Early detection and proper treatment of sepsis are important in reducing neonatal mortality. The emergence of antibiotic resistance among pathogens that infect newborns is of great concern. Hence, this study was done to identify the bacterial agents causing neonatal septicemia along with their antibiotic sensitivity pattern.

Methods: This was a prospective study carried out at neonatal intensive care unit of a tertiary care teaching hospital of western Gujarat, India, from October 2018 to August 2020. 2739 neonates were admitted with probable sepsis during the study period. 299 neonates with positive blood cultures were recruited for the study. Antibiotic sensitivity of organisms was noted and compared with other studies.

Results: Out of 299 blood culture proven sepsis, most common organism was Klebsiella pneumoniae, isolated in 98 patients (32.7%), followed by coagulase negative staphylococcus aureus in 90 patients (30.2%). Candida was the third most common organism isolated in 45 (15.1%) patients. Other bacteria isolated were Enterococcus in 33 (11.1%), Staphylococcus aureus in 17 (5.6%), Escherichia coli in 7 (2.3%), Acinetobacter spp in 6 (2%) and Pseudomonas in 3 (1%) patients. Gram positive bacteria were isolated in 140 (46.8%) patients, while, gram negative bacteria and fungus were isolated in 114 (38.2%) and 45 (15%) patients respectively. Klebsiella demonstrated maximum sensitivity to Meropenem (95%) and Piperacillin-Tazobactam (73.1%), while it showed high resistance to ampicillin (97.9%) and Cefoperazone (95.9%). Among non-beta lactam antibiotics, Klebsiella showed maximum sensitivity to colistin (100%) and Vancomycin (80%), while showed high resistance to Aminoglycosides and Quinolones. CONS showed maximum sensitivity to Cefoperazone (81.4%) and Cefotaxim (62.4%), but they showed high resistance to Ampicillin (86.5%) and Meropenem (86.9%). Among non-beta lactam antibiotics, CONS showed maximum sensitivity to Linezolid (100%) and Vancomycin (98%), while showed high resistance to Aminoglycosides and Quinolones.

Conclusions: The most common organism isolated was Klebsiella and it showed high resistance to 1st, 2nd and 3rd line antibiotics (Ampicillin, Aminoglycosides, Cefoperazone and Quinolones). Due to the emergence of antibiotic resistance in NICU, it is important to know antibiotics sensitivity and resistant pattern of various organisms for neonatal sepsis.

Keywords: Antibiotics resistance, Antibiotics susceptibility, Enterococcus, Klebsiella, Neonatal sepsis

INTRODUCTION

Neonatal sepsis encompasses systemic infections of the newborn including septicemia, meningitis and pneumonia.

In India, sepsis is one of the most important causes of neonatal deaths. Neonatal mortality rate in India, as per 2018 data, was 23 per 1000 and in Gujarat, as per 2017 data, it was 21 per 1000 live birth.[1,2]

A wide variety of etiologic agents infect the newborn, including bacteria, viruses, fungi and protozoa. The important bacterial agents responsible for sepsis include gram-negative bacteria like Klebsiella pneumoniae,

Escherichia coli, Citrobacter freundii, Enterobacter aerogenes, proteus mirabilis, Pseudomonas aeruginosa, Acinetobacter calcoaceticus, Salmonella typhi and gram-positive organisms like Staphylococcus species, Streptococcus agalactiae, Streptococcus viridans and Streptococcus pneumoniae.[3]

The emergence of antibiotic resistance among pathogens that infect newborns is of great concern. Hence, this study was done to identify the bacterial agents causing neonatal septicemia along with their antibiotic sensitivity pattern.

METHODOLOGY

This prospective comparative study was conducted at Neonatal Intensive Care Unit (NICU) of a tertiary care teaching hospital of Western Gujarat, India, from October 2018 to August 2020. During the study period, total 2739 neonates were admitted in NICU, out of which 299 neonates, with blood culture positive neonatal sepsis, were included in the study. Written informed consents were obtained from parents. IEC approval was also taken.

Detailed antenatal history, including history of antenatal risk factors for sepsis; such as prolonged rupture of membrane > 24 hours prior to delivery (PROM), foul smelling liquor, maternal fever within 2 weeks of delivery or during labor, prolonged labor and > 3 sterile or single unclean per vaginal examination, were noted. Detailed natal and postnatal history were also noted. Detailed physical examination was done in all neonates. Demographic profile, type of sepsis (early/late onset sepsis) and presentation (non-specific/systemic) were noted. Sepsis screening tests included estimation of C-Reactive Protein (CRP) (> 1 mg/dl), total leukocyte count (TLC) (25000/mm3), micro-ESR (> 15 mm in first hour), low absolute neutrophil counts (as per Manroe's chart for term and Mouzinho chart for very low birth weight neonates) and immature/total neutrophil ratio > 0.2. Confirmation of sepsis was done by blood culture and sensitivity. Blood sample collection was done under full aseptic precautions to avoid contamination. One ml of blood was taken from fresh venipuncture site for blood culture in a bottle containing 5-10 ml of culture media. All samples were incubated at 37 degrees Celsius and observed for 72 hours for growth of micro-organisms. Reporting of micro-organism growth and antibiotic sensitivity was done as per CLSI guidelines. All the data was tabulated in Microsoft excel sheets and appropriate statistical analysis was done. Significance was defined as p value < 0.05.

RESULTS

During the duration of this study, 2739 neonates were admitted in our NICU, out of which 299 neonates had blood culture positive neonatal sepsis (CPNS). Among 299 neonates, 173 (57.8%) were males and 126 (42.2%) females. Total preterm neonates were 105 (35.1%) while full-term neonates were 194 (64.9%). Total 124 (41.5%) neonates were ≥ 2.5kg and 175 (58.5%) were < 2.5kg. Total 187 (62.4%) were delivered by normal vaginal delivery and 112 (37.4%) were delivered by LSCS (Table-1).

Table-1: Distribution of neonates according to demographic and clinical parameters

Parameters	Percentage (%)
Male (N=173)	57.8
Female (N=126)	42.2
NVD (N=187)	62.4
LSCS (N=112)	37.4
Birth weight ≥ 2.5kg (N=124)	41.5
Birth weight < 2.5kg (N=175)	58.5
Term (N=194)	64.9
Pre term (N=105)	35.1

In our study, total 8 different organisms, including gram negative, gram positive and fungal isolates, were found. Out of 299 culture proven sepsis, major isolated bacteria were Klebsiella pneumoniae, in 98 (32.7%), followed by coagulase negative staphylococcus aureus in 90 (30.2%) blood cultures. Candida was the third most common isolate found in 45 (15.1%) cultures. Other bacteria isolated were enterococcus 33 (11.1%), staphylococcus aureus 17 (5.6%), Escherichia coli 7 (2.3%), Acinetobacter spp 6 (2%) and pseudomonas 3 (1%). So, total gram-positive bacteria were isolated in 140 (46.8%), gram negative bacteria in 114 (38.2%) and fungus in 45 (15%) cultures (Table-2).

Within beta lactam antibiotics, Klebsiella demonstrated maximum sensitivity to Meropenem (95%) and Piperacillin-Tazobactam (73.1%), while it showed high resistance to Ampicillin (97.9%) and Cefoperazone (95.9%). Among non-beta lactam antibiotics, Klebsiella showed maximum sensitivity to Colistin (100%) and Vancomycin (80%), while it showed high resistance to Aminoglycosides and Quinolones.

With in beta-lactam antibiotics, CONS showed maximum sensitivity to Cefoperazone (81.4%) and Cefotaxim (62.4%), while it showed high resistance to Ampicillin (86.5%) and Meropenem (86.9%). Among non-beta lactam antibiotics, CONS showed maximum sensitivity to Linezolid (100%) and Vancomycin (98%), while it showed high resistance to Aminoglycosides and Quinolones.

For Escherichia coli, with in beta-lactam antibiotics, maximum sensitivity was shown to Meropenem (100%), Cefotaxim (100%) and Cefoperazone (100%), while high resistance was shown to Ampicillin and Amoxicillin. Among non-beta-lactam antibiotics, Escherichia coli showed maximum sensitivity to Vancomycin (100%), Linezolid, Colistin and Aminoglycosides, while it showed high resistance to Quinolones.

Table-2: Organisms isolated in blood cultures

Organisms isolated in blood culture	Number (n=299)	Percentage (%)
Klebsiella pneumoniae	98	32.7
CONS	90	30.2
Candida	45	15.1
Enterococcus	33	11.1
Staphylococcus aureus	17	5.6
Escherichia coli	7	2.3
Acinetobacter Spp.	6	2
Pseudomonas	3	1

Pseudomonas bacteria were susceptible to all non-beta-lactam antibiotics and showed high resistance to all beta-lactam antibiotics (Table-3a). For enterococcus, within beta lactam antibiotics, maximum sensitivity was shown to Cefoperazone (60%) and meropenem (60%), while there was high resistance to Ampicillin (57.5%) and Amoxicillin (54.8%). Among non-beta lactam antibiotics, Enterococcus showed maximum sensitivity to Aminoglycosides (100%) and Linezolid (93.6%), while it showed high resistance to Quinolones and Vancomycin (58.1%).

For staphylococcus aureus, with in beta-lactam antibiotics, maximum sensitivity was shown to Cefoperazone (76.7%), while high resistance was shown to Ampicillin (82.3%) and Amoxicillin (69.2%). Among non-beta-lactam antibiotics, staphylococcus aureus showed maximum sensitivity to Linezolid (100%), Vancomycin (100%) and amikacin (91%), while it showed high resistance to Quinolones.

For Acinetobacter spp., with in beta-lactam antibiotics, sensitivity was shown to none of the drugs, while high resistance was there for almost all drugs in that spectrum with 100% resistance to Meropenem and Amoxicillin and 83.3% resistance to Ampicillin, Cefotaxim and Cefoperazone. Among non-beta-lactam antibiotics, Acinetobacter spp. showed sensitivity to Vancomycin and Linezolid and high resistance to Aminoglycosides and Quinolones (Table-3b).

DISCUSSION

In the present study the most common organism found was Klebsiella pneumoniae which was also most common in Verma P et al[4], Pokhrel et al[5] and Jyothi et al.[6] In Sharma et al[7] Staphylococcus aureus was the most common, where in Investigators of DeNIS[8] Acinetobacter Spp. was most common.

Table-3a: Antibiotic sensitivity pattern of isolated organisms

	Klebsiella		CONS		E. coli		Pseudomonas	
*	S %	R %	S %	R %	S %	R %	S %	R %
Beta Lactam antibiotics								
Amoxicillin	12.4	87.6	19.1	80.9	42.9	57.1	33.33	66.66
Ampicillin	2.1	97.9	13.5	86.5	42.9	57.1	33.33	66.66
Cefoperazone	4.1	95.9	81.4	18.6	100	0	0	100
Cefotaxim	13.7	86.7	62.4	37.6	100	0	0	100
Meropenem	95	5	-	-	100	0	-	-
PIP-TAZ	73.1	26.9	16.7	83.3	100	0	-	-
Non-beta Lactam antibiotics								
Amikacin	74.8	25.2	58	42	100	0	100	0
Ciprofloxacin	24	76	46.6	53.4	42.9	57.1	100	0
Colistin	100	0	100	0	100	0	-	-
Gentamycin	46.9	53.1	59	41	100	0	100	0
Linezolid	100	0	100	0	100	0	100	0
Levofloxacin	40	60	48.9	51.1	42.9	57.1	100	0
Ofloxacin	25.6	74.4	52	48	42.9	57.1	100	0
Vancomycin	80	20	98	2	100	0	100	0

* S% = antibiotic sensitivity percentage, R% = antibiotic resistance percentage

Table-3b: Antibiotic sensitivity pattern of isolated organisms

	Enterococcus		Staphylococcus aureus		Acinetobacter spp	
*	S %	R %	S %	R %	S %	R %
Beta Lactam antibiotics						
Amoxicillin	45.2	54.8	30.8	69.2	0	100
Ampicillin	42.5	57.5	17.7	82.3	16.7	83.3
Cefoperazone	60	40	66.66	33.33	16.7	83.3
Cefotaxim	60	40	60	40	16.7	83.3
Meropenem	60	40	100	0	0	100
PIP-TAZ	0	100	-	-	-	-
Non-beta Lactam antibiotics						
Amikacin	100	0	91	9	16.7	83.3
Ciprofloxacin	45.2	54.8	73.4	26.6	16.7	83.3
Colistin	100	0	-	-	100	0
Gentamycin	100	0	95.4	16.6	16.7	83.3
Linezolid	93.6	6.4	100	0	100	0

Levofloxacin	45.2	54.8	87.5	12.5	16.7	83.3
Ofloxacin	60	40	100	0	0	100
Vancomycin	58.1	41.9	100	0	100	0

* S% = antibiotic sensitivity percentage, R% = antibiotic resistance percentage

In present study gram negative organisms were mostly found resistant to Beta lactam antibiotics, which was also found in Jyothi P et al[6] and Pokhrel et al[5]. In present study Gram negative organism were most sensitive to Colistin and most resistant to ampicillin. In Jyothi et al they were most sensitive to Amikacin and most resistant to Amoxicillin and in Pokhrel et al they were most sensitive to Colistin and most resistant to Meropenem[9] (Tables 4a and 4b).

Table-4a: Comparison of Antibiotic sensitivity pattern of isolated gram-negative organisms among other studies

Antibiotics susceptibility of gram-negative organisms						
	Present study		**Jyothi P et al[6]**		**Pokhrel et al[5]**	
	R %	S %	R %	S %	R %	S %
Beta Lactam antibiotics						
Ampicillin	93.8	6.2	97	3	66.7	33.3
Amoxicillin	85.7	14.3	93	7	100	0
Cefotaxim	81.2	18.3	-	-	80.5	19.5
Cefoperazone	89.2	10.8	-	-	-	-
PIP-TAZ	26.5	73.5	-	-	47.4	52.6
Meropenem	11.4	88.6	-	-	11.8	88.2
Non-beta Lactam antibiotics						
Amikacin	27.1	72.9	48	52	50	50
Gentamicin	51.9	48.1	67	51	60	40
Ciprofloxacin	67.2	26.8	63	37	62.5	37.5
Levofloxacin	59.6	40.4	-	-	-	-
Ofloxacin	73.8	26.2	66	34	47.4	52.6
Colistin	0	100	-	-	17.6	82.4
Linezolid	0	100	-	-	-	-
Vancomycin	16.3	83.7	-	-	66.7	33.3

Table-4b: Comparison of Antibiotic sensitivity pattern of isolated gram-positive organisms among other studies

Antibiotics susceptibility of gram-positive organisms						
	Present study		**Jyothi P et al[6]**		**Pokhrel et al[5]**	
	R%	S%	R%	S%	R%	S%
Beta Lactam antibiotics						
Ampicillin	79.1	20.9	90	10	100	0
Amoxicillin	69.8	30.2	76	24	87.5	12.5
Cefotaxim	38.1	61.9	-	-	62.5	37.5
Cefoperazone	21.7	78.3	62	38	-	-
PIP-TAZ	87.5	12.5	36	64	33.3	66.7
Meropenem	12.1	87.9	-	-	40	60
Non-beta Lactam antibiotics						
Amikacin	24.2	75.8	-	-	45.5	54.5
Gentamicin	27.8	72.8	60	40	50	50
Ciprofloxacin	50.8	49.2	48	52	61.5	38.5
Levofloxacin	47.4	52.6	-	-	-	-
Ofloxacin	73.7	26.3	-	-	64.3	35.7
Colistin	0	100	-	-	100	0
Linezolid	1.6	98.4	9	92	-	-
Vancomycin	11.3	88.7	-	-	0	100

CONCLUSIONS

The most common organism isolated was Klebsiella and it showed high resistance to 1st, 2nd and 3rd line antibiotics (Ampicillin, Aminoglycosides, Cefoperazone and Quinolones). Due to the emergence of antibiotic resistance in NICU, it is important to know antibiotics sensitivity and resistant pattern of various organisms for neonatal sepsis.

REFERENCES

1. Mortality Rate, Neonatal (per 1,000 Live Births) - India | Data [Internet]. [cited 2023 January 8]. Available from: https://data.worldbank.org/indicator/SH.DYN.NMRT?locations=IN

2. SRS statistical report 2017. [cited 2023 January 17]; Available from: https://censusindia.gov.in/vital_statistics/SRS_Reports_2017.html

3. Aggarwal R, Sarkar N, Deorari AK, Paul VK. Sepsis in the newborn. Indian J Pediatrics 2001;68(12):1143–7.

4. Verma P, Berwal PK, Nagaraj N, Swami S, Jivaji P, Narayan S. Neonatal sepsis: epidemiology, clinicalspectrum, recent antimicrobial agents and their antibiotic susceptibility pattern. Int J Contemp Pediatr 2015;2:176-80.

5. Pokhrel B, Koirala T, Shah G, Joshi S, Baral P. Bacteriological profile and antibiotic susceptibility of neonatal sepsis in neonatal intensive care unit of a tertiary hospital in Nepal. BMC Pediatr 2018;18:208.

6. Jyothi P, Basavaraj MC, Basavaraj PV. Bacteriological profile of neonatal septicemia and antibiotic susceptibility pat- tern of the isolates. J Nat Sc Biol Med 2013;4:306-9

7. Sharma CM. "Neonatal Sepsis": Bacteria & their Susceptibility Pattern towards Antibiotics in Neonatal Intensive Care Unit. J Clin Diagn Res 2013 Nov;7(11):2511-3.

8. Investigators of DeNIS. Characterisation and antimicrobial resistance of sepsis pathogens in neonates born in tertiary care centres in Delhi, India: a cohort study. Lancet Glob Health 2016 Oct;4(10):e752-60

9. Khilnani G, Khilnani AK. Antibiotic Resistance. In: Tomar AS, Mandaliya VB, editors. Red Biotechnology. New Delhi: Daya Publishing House® A Division of Astral International Pvt. Ltd;2019. p. 179-200.

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