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Original Research Article

Bloodstream Bacterial Isolates Spectrum and Pattern of Antibiotic Susceptibility in Newborns with Sepsis in a Tertiary Care Centre

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Abstract

Background: Newborn sepsis is a serious medical conditions with a high death rate. Neonatal sepsis is a major problem in India and other developing countries. Determining the antibiotic action pattern and bacterial spectrum in neonatal sepsis is the aim of this study.

Methods: This cross-sectional study was performed at the Pediatrics Department of Sri Krishna Medical College and Hospital, Muzaffarpur, Bihar from March 2025 to August 2025. A total of 120 neonates admitted with the clinical suspicion of sepsis in this study period. Nonprobability convenience sampling technique was used. Data regarding clinical characteristics of neonates, type of bacteria isolated and antibiotic susceptibility results were recorded. SPSS version 20 was used for statistical analysis. The results were written as frequencies /percentages.

Results: Neonatal sepsis was suspected in 120 newborns but blood culture proven infection was present in 32 (13.3%) neonates with 23(71.8%) having early onset sepsis.

The mean age on admission was 7.61±3.61 days. Acinetobacter was the commonest bacteria implicated in sepsis followed by Klebsiella, Burkholderia and Serratia. The mortality rate in study population was 8.3%. Mortality was highest in Klebsiella sepsis. None of the bacterial species were sensitive to ampicillin while Acinetobacter and Burkholderia species responded to colistin, polymyxin and meropenem but showed resistance to imipenem.

Conclusion: Early-onset neonatal sepsis has a high prevalence especially with gram-negative bacteria. Antimicrobial resistance to first line empiric therapy is common.

Keywords: Antimicrobial Susceptibility, Sepsis, Nosocomial Infection, Gram Negative Bacteria, Gram Positive Bacteria, Neonates.

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Introduction

A medical condition known as neonatal sepsis usually manifests early in life. It is acknowledged as one of the leading causes of sickness and mortality in neonates globally and exhibits particular clinical symptoms [1].

Sepsis in the first month of life is grouped as early onset sepsis (EOS) if occurring before 72 hours of life and late onset sepsis (LOS) if after. EOS is caused mainly by bacterial organisms acquired intrauterine and at birth from the maternal reproductive tract whereas late onset sepsis results from infection acquired after birth from the home or hospital environment. It is challenging to confirm sepsis in newborns on the basis of mere clinical presentation as clinical signs can be generalized and non-specific. It is defined clinically or bacteriologically, either by positive blood or body fluid culture.

Despite the advancement in medical management of infections in newborn, blood culture is still the mainstay of investigation [2]. World Health Organization (WHO) has reported that throughout

the world, the annual death rate in newborns is 1.6 million and 40% of these happen in growing countries [3]. In India, neonatal sepsis is a leading cause of mortality, with an estimated incidence of 30–38 per 1,000 live births in clinical settings, contributing to approximately 19%–36% of all neonatal deaths. The case fatality rate for sepsis in Indian neonates varies widely, often reported between 25% and 65%, with high mortality in preterm infants. The type of pathogens causing neonatal sepsis exhibits dissimilarity in not only different countries but even within medical facilities as particular bacteria transition and exhibit variability in occurrence.

Developing countries have sepsis caused predominantly by gram-negative organisms such as Klebsiella pneumonia and Escherichia coli, whereas in high income countries

Group B streptococci and other gram-positive bacteria predominantly cause neonatal infection [4].Therefore, the bacteriological profile varies significantly based on the geographical location. The bacterial isolates causing infection in newborns shows variation from time to time in the same setting. A majority of neonatal deaths can be prevented by early institution of suitable antibiotics according to the local sensitivity pattern [5]. In this era of widespread antibiotic use, multi-drug resistant (MDR) organisms are a constant challenge to treat especially in low and middle income set up. Bacteria implicated in late onset sepsis have been observed to be resistant to antibiotics to a greater extent as compared to those producing early-onset sepsis [6]. Nosocomial infection is acquired during hospitalization and is contracted by a patient at least 48 hours after being admitted. In developing countries Burkholderiacepacian, Acinetobacter baumannii, Klebsiella pneumoniae, Pseudomonas aeruginosa and Serratia marcescens have been found to be implicated in a majority of these infections. Insensitivity to antibiotics is defined as development of unresponsiveness to at least one or more antimicrobial medications as per recommendations [7].

Material and Methods

This cross-sectional retrospective took place at Pediatrics Department of Sri Krishna Medical College and Hospital, Muzaffarpur, Bihar from March 2025 to August 2025. All neonates admitted with suspected sepsis, and also those with a positive blood culture result were included.

Newborns with congenital malformations, laboratory evidence of inborn error of metabolism and those with a history of perinatal hypoxic insult were excluded to control effect modifiers and bias in results.

Blood samples from 120 clinically suspected neonatal sepsis were collected and processed in the microbiological protocol and their antimicrobial sensitivity pattern was determined. Babies born in the hospital and admission from outside were included. For purpose of all this study, neonatal sepsis was defined a neonates presenting with one or more features like reluctant to feed, lethargy, presence of fever ($\geq 38^0$C), or hypothermia ($\leq 36^0$C), abdominal distension, vomiting, diarrhea, jaundice, convulsion, bulging fontanels, respiratory distress, hypoglycemia, umbilical discharge were considered as the main clinical features of neonatal sepsis. Mother of those neonates who delivered by either cesarean section or vaginal delivery with history of high risk delivery like premature rupture of membrane >12 hours, prolonged labour, foul smelling liquor, meconium stained amniotic fluid were also included in this study. Suspected neonates who died upon arrival before blood culture report could be obtained or neonates had clinical picture of sepsis without positive blood culture were excluded. Neonates with congenital anomalies, extreme low birth weight babies were also excluded. A thorough physical examination was carried out after taking detailed and careful history of each case. Patient's care givers were interviewed and only those babies were enrolled where the guardians gave permission for collection of samples. Total 120 neonates were selected who were admitted in the Neonatal intensive care unit (NICU) and neonatal ward during the time of study. Data on the pathogens isolate and their antibiotic susceptibility pattern were collected after laboratory test was done.]Data was collected for the subsequent variables: demographic profile, blood culture result and antibiotic sensitivity pattern. As a sample 1- 2 ml of blood was asceptically obtained from the peripheral vein of every neonates and dispensed into a sterilized universal bottle containing 20 ml of Tryptone Soy Broth (TSB) and Brain Heart infusion Broth to form a 1:10 dilution. The location was cleaned with povidine and chlorhexidane before blood was collected. Blood culture samples were then transported to the laboratory and incubated at 37^0C for 24 hours using thermo scientific detection system. After detection of presence of organism, subculture were done on Solid media (blood agar, McConkey agar and chocolate agar media) on appearance of turbidity. On day 1, 2, 3 and 7. Organisms were identified according to the standared microbial procdures including gram stain, colony morphology, motility, and biochemical reactions. All the records of this study were carefully revised and data including sex, birth weight, preterm or term and Clinical features consistant with sepsis results of culture antibiotic sensitivity were recorded into a data collection sheet. Cerebro spinal fluid was collected by lumber

puncture only when meningitis was a suspicion. Antibiotic susceptibility testing was performed for all blood culture isolates, according to the criteria of the National Laboratory Standared by disk diffusion method.

Analyses of data was done through SPSS version 20.0. Mean and standard deviation were used to denote continuous variables. Measurement data that was qualitative was expressed as frequencies and percentages. Effect modifiers were controlled through stratification of data to see the effects of these outcome variables using chi square and p-value was considered significant if <0.05.

Results

In 120 neonates there was a clinical suspicion of sepsis but only 32 neonates had a positive blood culture result i.e. the prevalence of neonatal sepsis was 13.3 %.

Table 1, shows the clinical characteristics of the study population.

The male to female ratio was 1.5:1 as 72 were males and 48 females. The mean age of the study population on admission was 7.61±3.61 days. The mean birth weight was 2.78 ± 3.07 kg. Majority of neonates i.e. 23 (71.8%) had early onset sepsis. The frequency of gram negative bacteria was 27 (84.3%) was much higher than gram-positive organisms which was 5 (15.6%).

Table 1: Characteristics of study population

Variable	N (%)
Gender	
Male	72(60%)
Female	48(40%)
Age (Days)	7.50±8.4
Weight (Kg)	2.78±3.07
Occipitofrontal Circumference (CM)	33.88±4.9
Gestational Age (Weeks)	
Pre-Term	53(44.2%)
Term	67(55.8%)
Mode of Delivery	
SVD	39(32.5%)
C-Section	81(67.5%)
Maternal Antenatal Visits	
Regular	110(91.7%)
Irregular	10(8.3%)
Onset Of Sepsis	
Early Onset	88(73.3%)
Late Onset	32(26.7%)

Among gram-negative isolates, Acinetobacter baumannii was the predominant organism being isolated in 12 (37.5%), followed by Pseudomonas aeruginosa in 6(18.75%), Burkholderia cepacia in 3(9.4%) and Serratia Marcescens in 3 (9.4%).Table 2 shows the distribution of bacterial isolates in blood culture of the study population. It was noted that among the gram-positive isolates, streptococcus pneumoniae (12.5%) and staphylococcus aureus 1 (3.1%) were the commonest organisms isolated. Table 2 shows the bacterial spectrum of blood culture isolates.

Table 2: Bacteriological profile in blood culture – positive neonates

Gram Negative	Total n=32	Early-onset sepsis	Late-onset sepsis
		N (%)	N (%)
Escherichia coli	1		1(100%)
Burkholderia cepacia	3	2(66.7%)	1(33.3%)
Serratia marcescens	3	2(66.7%)	1(33.3%)
Klebsiella pneumoniae	2	2(100%)	
Pseudomonas aeruginosa	6	5(83.3%)	1(16.7%)
Acinetobacter baumannii	12	9(75%)	3(25%)
Gram positive			
Staphylococcus aureus	1		1(100%)
Streptococcus pneumoniae	4	3(75%)	1(25%)

The overall mortality rate was 8.3% in the study population as 10 neonates expired. All the neonates who expired had gram-negative sepsis while no mortality was observed in sepsis with gram-positive organisms (p –

value 0.04). Klebsiella pneumoniae sepsis had the highest mortality as out of the 10 expiries 7(70%) were infected with this organism whereas it was 3 (30%) had Acinetobacter baumannii infection. It was noted that 12 (44.4%) neonates with sepsis from gram-negative bacteria required invasive ventilation while those with gram-positive sepsis did not require ventilator support (p-value 0.0001).

Table 3: Association (cross tabulation) between gram staining and different factors

Variable		Gramstaining				Chi- square value	p-value
		Negative (24)		Positive (3)			
		%	No.	%	No.		
Sepsis onset	Early	74.1	20	60	3	0.792	0.373
	Late	25.9	7	40	2		
Neonatal outcome	Discharged	63	17	100	5	11.23	0.004
	Expired	37	10	0	0		
Ventilation support provided	Yes	44.4	12	0	0	36.175	0.0001

The bacterial isolates from blood culture of the study population showed a variable pattern of antibiotics sensitivity. All species of gram-negative microorganisms causing neonatal sepsis in our study were sensitive to Meropenem. However, colistin was effective against all gram -negative bacteria except Burkholderia cepacia and Escherichia coli. The results of antibiotic sensitivity pattern for both Gram-negative and Gram-positive bacteria are shown in Table 4.

Table 4: Antibiotic sensitivity pattern of the isolate

Antibiotics	Gram negative organism						Gram positive organism	
	Escherichiacoli (1/100%)	Burkholderia Cepacia (3/100%)	Serratia marcescens (3/100%)	Klebsiella pneumoniae (2/100%)	Pseudomonas aeruginosa (6/100%)	Acinetobacter baumannii (12/100%)	Staphylococcus Aureus (1/100%)	Streptococcus Pneumoniae (4/100%)
Ampicillin								
Co-trimoxazole		3(100%)				12(100%)		4(100%)
Ciprofloxacin				2(100%)	6(100%)		1(100%)	
Colistin			3(100%)	2(100%)	6(100%)	12(100%)		4(100%)
Ceftriaxone						12(100%)		4(100%)
Ceftazidime		3(100%)	3(100%)		6(100%)			
Gentamicin	1(100%)	3(100%)					1(100%)	
Imipenem/ meropenem	1(100%)	3(100%)	3(100%)	1(50%)	6(100%)	3(25%)		
Levofloxacin		3(100%)						4(100%)
Vancomycin						12(100%)	1(100%)	4(100%)
Clindamycin		3(100%)	3(100%)	2(100%)	6(100%)		1(100%)	4(100%)
Piperacillin tazobactam	1(100%)							
Teicoplanin							1(100%)	
Polymyxin			3(100%)	2(100%)	6(100%)	12(100%)		4(100%)

Discussion

A study on neonatal sepsis from Roy et al culture-positivity rate of 26% was reported [8].

Other studies report considerable disparity in prevalence of culture proven sepsis in newborns as evidenced by a prevalence rate of 49.5% observed by Shehab-El Din et al from Egypt, 24% was reported in a study from Tanzania and 12.1% from Nepal [9-11]. These differences in the prevalence of neonatal sepsis across different geographical regions could be as a result of various elements involved, such as different socioeconomic conditions and dissimilarity in sampling methods.

In advanced countries, neonatal sepsis in a large majority of cases is caused by gram-positive bacteria (58-70.2%) [12].In the present study, gram-negative bacteria were the most prevalent organisms implicated in both early onset and late onset sepsis. This finding is in concordance with findings of research studies conducted earlier in other growing countries. Macharashviliet al in a study from Georgia, stated that gram-negative bacteria were responsible for 78% of neonatal sepsis cases, with Klebsiella pneumoniae accounting for 37% and Escherichia coli 11% of the cases [13]. Acinetobacter baumannii is a causative organism for a majority of nosocomial

infections globally. An Indian study by Kamath et al observed Klebsiella pneumoniae species to be most commonly responsible for neonatal sepsis, being present in16.4%, and Acinetobacter baumannii in 10% of their study population [14]. Similarly, we also found an alarmingly high rate of sepsis with Acinetobacter baumannii in our study, indicating the need to implement strict infection control measures to decrease nosocomial infection. Similar to our findings, Yusefet al, found Acinetobacter baumannii (27%) to be the commonest bacteria isolated followed by Klebsiella pneumoniae (22%) [15].

In our study both colistinand polymyxin were found to be effective against all cases of neonatal sepsis with Acinetobacter baumannii and Klebsiella pneumoniae whereas in 75% of Acinetobacter baumannii and 50% of Klebsiella pneumoniae isolates, carbapenem resistance was observed. In concert with our findings, a study reported that 93.68 % of

Acinetobacter baumannii isolates showed carbapenem resistance and a very high mortality of 59% was observed with Acinetobacter baumannii infection [16].The use of cotrimoxazole is not very common these days but we found it to be quite effective against Burkholderia cepacia. Being a cheaper drug, it would offer the advantage of cost-effectiveness in nosocomial infections caused by unusual organisms such as Acinetobacter baumannii and Burkholderia cepacia [14]. We report an overall mortality rate of 8.3% for neonatal sepsis and it was significantly related to sepsis with gram -negative organisms. In our study, Acinetobacter baumannii infection was implicated in 30% of the expiries whereas 70% mortality was due to Klebsiella pneumoniae sepsis. Yusefet al have reported similar findings [15]. In the present study, Pseudomonas was isolated in 6 blood culture samples out of a total of 32 culture positive samples (18.8%), this suggests the need to control hospital-acquired infection. In concert with the findings of Vinod kumar et al, we observed Pseudomonas Aeruginosa isolates to be mostly resistant to aminoglycosides which is a cost effective antibiotic [17].However, they were sensitive to expensive therapy such as colistin and ceftazidime. In the present study we observed that ampicillin was not effective against any type of bacteria though it should be empiric first line therapy in neonatal sepsis along with aminoglycosides. This antimicrobial resistance and increase in the prevalence of nosocomial infection in under developed countries is worrisome and can be explained by the irrational use of antibiotics, lack of antibiotic stewardship programs, self-medication and malpractice by physicians [18].

Conclusion

Early-onset newborn sepsis caused by gram-negative bacteria is very common. The two most frequently isolated bacteria, Acinetobacter and Pseudomonas, have a high death rate and suggest that nosocomial infections need to be controlled. The concerning issue of bacterial insensitivity to ampicillin as an empirical treatment necessitates the rigorous adoption of antibiotic stewardship initiatives in order to legitimize the use of antibiotics.

References

1. Nyenga A, Mukuku O, Wembonyama S. Neonatal sepsis: A review of the literature. Theory and Clinical Practice in Pediatrics. 2021 Nov; 3(1): 94-101.
2. Hammad E and Zainab M. Meta-analysis on factors influencing early onset neonatal sepsis. Journal of Applied Sciences and Research. 2018 Nov; 1(8): 20-2.
3. Reinhart K, Daniels R, Kissoon N, Machado FR, Schachter RD, Finfer S. Recognizing sepsis as a global health priority-a WHO resolution. New England Journal of Medicine. 2017 Aug; 377(5): 414-7.
4. Liu L, Oza S, Hogan D, Chu Y, Perin J, Zhu J, et al. Global, regional, and national causes of under-5 mortality in 2000-15: an updated systematic analysis with implications for the Sustainable Development Goals. Lancet. 2016 Dec; 388(10063): 3027-35.
5. Masaba BB and Mmusi-Phetoe RM. Neonatal Survival in Sub-Sahara: A Review of Kenya and South Africa. Journal of Multidisciplinary Healthcare.2020 Jul; 13:709-16.
6. Laxminarayan R, Matsoso P, Pant S, Brower C, Røttingen J-A, Klugman K, et al. Access to effective antimicrobials: a worldwide challenge. Lancet. 2016 Jan; 387(10014): 168-175.
7. Kumar DVP, Mohan J, Rakesh P, Prasad J, Joseph L. Bacteriological profile of neonatal sepsis in a secondary care hospital in rural Tamil Nadu, Southern India. Journal of Family Medicine and Primary Care. 2017 Oct-Dec; 6(4): 735-8.
8. Roy P, Kumar A, Faridi M, Kaur R, Kashyap B. Clinicobacteriological Profile of Neonates Born with Risk Factors of Septicemia. Indian Journal of Neonatal Medicine and Research. 2014 Jul; 2(1): 1-6.
9. Shehab El-Din EMR, El-Sokkary MMA, Bassiouny MR, Hassan R. Epidemiology of neonatal sepsis and implicated pathogens: a study from Egypt. Biomed Research International. 2015 Jun; 2015.
10. Mhada TV, Fredrick F, Matee MI, Massawe A. Neonatal sepsis at Muhimbili National Hospital, Dar es Salaam, Tanzania; aetiology, antimicrobial sensitivity pattern and clinical

outcome. BMC public health. 2012 Dec; 12(1): 1-6.
11. Ansari S, Nepal HP, Gautam R, Shrestha S, Neopane P, Chapagain ML. Neonatal septicemia in Nepal: earlyonset versus late onset. International Journal of Pediatrics. 2015 Nov.
12. Williams PCM, Isaacs D, Berkley JA. Antimicrobial resistance among children in sub-Saharan Africa. Lancet Infectious Diseases. 2018 Feb; 18(2): e33-44.
13. Macharashvili N, Kourbatova E, Butsashvili M, Tsertsvadze T, McNutt LA, Leonard MK. Etiology of neonatal blood stream infections in Tbilisi, Republic of Georgia. International Journal of Infectious Diseases 2009 Jul: 13; 499-505.
14. Kamath S, Mallaya S, Shenoy S. Nosocomial infections in neonatal intensive care units: profile, risk factor assessment and antibiogram. Indian Journal of Pediatrics.2010 Jan; 77: 37-9.
15. Yusef D, Shalakhti T, Awad S, Algharaibeh H, Khasawneh W. Clinical characteristics and epidemiology of sepsis in the neonatal intensive care unit in the era of multi-drug-resistant organisms: A retrospective review. Pediatrics and Neonatology. 2018 Feb; 59(1): 35-41.
16. Jajoo M, Manchanda V, Chaurasia S, Sankar MJ, Gautam H, Agarwal R et al. Investigators of the Delhi Neonatal Infection Study (DeNIS) collaboration, New Delhi, India. Alarming rates of antimicrobial resistance and fungal sepsis in outborn neonates in North India. Public Library of Science One. 2018 Jun; 13(6): e0180705.
17. Vinod Kumar CS, Kalappaanavar NK, Patil U Basavrajappa KG. Change in spectrum of microbial etiology in relation to gestational age and birth weight and emergence of ESBL in tertiary neonatal intensive care units. International Journal of Biological and Medical Research. 2011 May; 2(3): 727-34
18. Punpanich W, Nithitamsakun N, Treeratweeraphong V, Suntarattiwong P. Risk factors for carbapenem non-susceptibility and mortality in Acinetobacter baumannii bacteremia in children. International Journal of Infectious Diseases. 2012 Nov; 16(11): e811-5.