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Dr. Shridhar
Associate Professor,
Department of Paediatrics, Sri
Lakshmi Narayana Institute
of Medical Sciences,
Puducherry India

Dr. Hyma Reddi
Assistant Professor,
Department of Pharmacology,
I-Care Institute of Medical
Sciences and Research, Haldia,
West Bengal, India

Pattern of antibiotic use in a tertiary care hospital's neonatal intensive care unit (NICU)

Shridhar and Hyma Reddi

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Abstract
Background and objectives: In neonatal intensive care units (NICUs), antimicrobials are the most frequently prescribed drugs, often initiated for managing suspected sepsis. However, empirical antibiotic use remains prevalent, even in neonates not exhibiting overt signs of infection. While developed countries have largely transitioned to evidence-based prescribing, many developing regions still rely on empirical treatment, often influenced by financial limitations. The study aims to examine antimicrobial usage patterns in neonates admitted to the NICU.
Methods: A retrospective, observational study was conducted in a tertiary care hospital. Data were collected for neonates who received antibiotics during hospitalization.
Results: Out of 110 neonates admitted, 82 (74.5%) were treated with antimicrobials. Of these, 52.4% were term and 47.6% were preterm. The most frequently used antibiotics were Amikacin (92.7%), Cefotaxime (67.1%), and Ampicillin (31.7%). A change in antimicrobial regimen was necessary for 53.7% of neonates, predominantly due to culture sensitivity reports.
Conclusion: A large proportion of NICU admissions involved antibiotic administration, especially among preterm neonates. Resistance to first-line antibiotics necessitated exposure to multiple drug regimens.

Keywords: Antimicrobial usage, NICU, antibiotic resistance, neonates

1. Introduction

Antibiotics are extensively used in NICU settings, predominantly to treat or prevent sepsis. However, it is common for these drugs to be initiated empirically, even when a diagnosis of infection is not established. In high-income countries, treatment strategies have gradually evolved from empirical methods to evidence-based protocols. In contrast, low- and middle-income countries often follow empirical regimens due to constraints such as affordability and limited diagnostic resources [1, 2].

This practice carries risks, including increased susceptibility to invasive fungal infections, necrotizing enterocolitis, and late-onset sepsis, particularly with prolonged broad-spectrum antibiotic use. Additionally, neonatal pharmacotherapy is hindered by limited safety and efficacy data, especially in preterm infants, due to challenges in clinical trial recruitment. Off-label use is therefore frequent [3-5].

Unregulated and prolonged antibiotic use in neonates can result in resistance, nosocomial infections, extended hospitalization, and increased mortality. Meanwhile, delaying appropriate treatment in true sepsis cases also elevates mortality risk. India lacks standardized national guidelines for NICU antibiotic use, and local prescribing practices vary. Given the scarcity of regional data, this study was undertaken to assess patterns of antimicrobial use in a NICU setting [6-8].

Methodology

This retrospective observational study was carried out at Department of Pharmacology, I-Care Institute of Medical Sciences and Research, Haldia from January 2019 to December 2019. Data were gathered from medical records, focusing on neonates who received antibiotic therapy. Patients not administered antimicrobials were excluded.

A total of 110 neonates were admitted to the Neonatal Intensive Care Unit (NICU) during the study period. Of these, 82 neonates (74.5%) received at least one course of antibiotic therapy, while the remaining 28 neonates (25.5%) were managed without the use of antimicrobials.

Corresponding Author:
Dr. Hyma Reddi
Assistant Professor,
Department of Pharmacology,
I-Care Institute of Medical
Sciences and Research, Haldia,
West Bengal, India

Results

Table 1: Proportion of Neonates Receiving Antibiotics

Parameter	Total Number	Percentage (%)
Total NICU Admissions	110	100%
Neonates Receiving Antibiotics	82	74.5%
Neonates Not Receiving Antibiotics	28	25.5%

Table 2: Gestational Age Distribution among Antibiotic-Treated Neonates

Gestational Category	Number of Neonates	Percentage
Term	43	52.4%
Late Preterm	24	29.3%
Early Preterm	15	18.3%
Total	82	100

Among the neonates who received antibiotics, 43 (52.4%) were born at term, while 39 (47.6%) were preterm- including both early and late preterm categories.

Table 3: Gender Distribution among Antibiotic-Treated Neonates

Gender	Number	Percentage
Male	43	52.4%
Female	39	47.6%

The gender distribution was nearly equal, with a slight predominance of male neonates.

Table 4: Antimicrobial Profile among 82 Neonates

Antibiotic	Dose	No. of Cases (%)
Amikacin	7.5 mg/kg IV BID	76 (92.7%)
Cefotaxime	50 mg/kg IV BID	55 (67.1%)
Ampicillin	50 mg/kg IV BID	26 (31.7%)
Amoxicillin + Clavulanic Acid	50 mg/kg IV BID	30 (36.6%)
Piperacillin + Tazobactam	100 mg IV BID	21 (25.6%)
Ceftriaxone	50 mg/kg IV BID	10 (12.2%)
Meropenem	20 mg/kg IV BID	8 (9.8%)
Metronidazole	7.5 mg/kg IV TID	7 (8.5%)
Vancomycin	40 mg/kg IV QID	6 (7.3%)
Colistin	50,000 IU/kg IV TID	5 (6.1%)

Empirical antibiotic therapy was initiated for all 82 neonates. Amikacin was the most frequently used antibiotic, administered to 76 neonates (92.7%), and followed by Cefotaxime (67.1%) and Ampicillin (31.7%). Combination therapies were also used based on clinical judgment and response.

Table 5: Frequency of Antimicrobial Regimen Changes

Change in Treatment	Number	Percentage
Yes	44	53.7%
No	38	46.3%
Total	82	100

A change in the initial antibiotic regimen was required in 44 neonates (53.7%), while the remaining 38 (46.3%) continued on first-line therapy without modification.

Table 6: Reasons for Change in Antimicrobial Regimen

Reason for Change	Number	Percentage
Culture Sensitivity Report	19	43.2%
Specific Clinical Indication (e.g., NEC, Meningitis)	13	29.5%
Lack of Clinical Response	12	27.3%
Total	44	100

Among those who required a change in therapy, the primary reason was the availability of culture and sensitivity reports (43.2%), followed by specific clinical indications such as necrotizing enterocolitis (NEC), meningitis, and septic arthritis (29.5%). In 12 cases (27.3%), the antibiotics were changed due to inadequate clinical response.

Discussion

In this study, out of 110 neonates admitted to the NICU, 82 (74.5%) received antibiotic therapy. This finding is consistent with earlier studies such as that of Suryavanshi *et al.*, who reported antibiotic usage in approximately 70% of neonates in a tertiary care center in Pune, India. Similarly, Hauge *et al.*, in a study conducted in Ujjain, documented antibiotic use ranging from 71% to 89%, while Megha Sharma *et al.* observed rates between 79% and 82%, reinforcing the widespread use of antimicrobials in neonatal units across Indian healthcare settings [9, 10].

Of the 82 neonates who received antibiotics in the current study, 43 (52.4%) were full-term, and 39 (47.6%) were born preterm. These findings mirror those reported by Suryavanshi *et al.*, where 46.6% were term and 53.4% were preterm neonates, indicating a fairly balanced gestational distribution [11, 12].

Regarding empirical antibiotic therapy, Amikacin was the

most frequently administered drug, used in 76 neonates (92.7%), followed by Cefotaxime (55 neonates, 67.1%), and Ampicillin (26 neonates, 31.7%). These preferences are similar to those reported by Suryavanshi *et al.*, where Amikacin, Cefotaxime, and Levofloxacin were commonly prescribed. Furthermore, Sharma *et al.* identified aminoglycosides, cephalosporins, and fluoroquinolones as the most utilized antibiotic classes in neonatal units [13, 14].

In the current analysis, 38 neonates (46.3%) responded well to the initial antibiotic regimen. However, 44 neonates (53.7%) required a modification in treatment. Among these, the most common reason was the result of culture and sensitivity testing (19 cases, 43.2%), followed by specific clinical indications such as necrotizing enterocolitis, arthritis, or meningitis (13 cases, 29.5%). In 12 neonates (27.3%), a change in therapy was prompted by lack of clinical improvement [14].

Interestingly, this trend contrasts with findings from studies conducted in developed nations. For example, Muller-Pebody *et al.* in the UK and Chryssoula Tzialla *et al.* in Italy observed that over 90% of organisms isolated in NICU settings were sensitive to first-line antimicrobials. In contrast, our study noted that only 46.3% of neonates responded to initial therapy, similar to Indian studies like that of Suryavanshi *et al.*, suggesting a concerning rise in antimicrobial resistance within the Indian NICU context [15].

Conclusion

A significant proportion of neonates (74.5%) admitted to the NICU received antibiotic therapy during their hospitalization. Among those treated, preterm infants accounted for a slightly higher percentage compared to term neonates. The study also revealed a decline in the effectiveness of first-line antibiotics, resulting in the need for multiple antibiotic regimens in over half of the cases. These findings highlight the emerging challenge of antimicrobial resistance in NICU settings and emphasize the importance of implementing antibiotic stewardship programs tailored to local microbial patterns.

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