The tendency in the use of the antibiotics, and is evidence of resistance in culture-positive cases.

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ABSTRACT:

Objective: To evaluate the trend of antibiotic use in neonatal sepsis and to evaluate the prevalence of antimicrobial resistance in culture-positive cases

Methodology: This retrospective observational study was done in the Neonatal Intensive Care Unit (NICU) of a tertiary care hospital, Hashim Medical City, Hyderabad. This research involved nearly 120 + infants who were hospitalized within the specified study period. The information was collected in the medical records of the hospital, the admission records, and the laboratory records.

Results: Cohort showed male preponderance (60 65 percent), and gestational age was 26 to 40 weeks. Most of the neonates were preterm (6570%). Weights of birth were between 0.69 and 3.9kg with almost 70 percent of the children having low birth weight and a few cases of extremely low birth weight. The majority of the deliveries were through LSCS/ elective LSCS and a large percentage of neonates were peripheral center referrals. The most frequent were respiratory distress syndrome, transient tachypnea of the newborn, birth asphyxia and neonatal sepsis. Many of them needed respiratory support, such as CPAP and mechanical ventilation; often oxygen therapy was used. Length of stay was 1-58 days. The outcome measures were discharge, mortality, referral, and leave against medical advice (LAMA), with mortality being higher in cases of neonates with severe sepsis and extreme prematurity. The use of broad-spectrum antibiotic therapy was a common practice of empirical antibiotic therapy, such as aminoglycosides, vancomycin, and carbapenems. A majority were culture-negative, but culture-positive cases showed pathogens to include Staphylococcus aureus, Klebsiella, Serratia, Acinetobacter, and E. coli. Multidrug resistance was evidenced especially in Gram-negative organisms.

Conclusion: Overuse of broad-spectrum antibiotics and emerging resistance indicate enhanced need to improve stewardship and infection control measures.

Key words: antibiotics, resistance, swab culture, neonatal intensive care, birth asphyxia.

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Introduction:

Neonatal sepsis is one of the major causes of morbidity and mortality in infants, especially in poor-resource environments where it can be difficult to diagnose and provide specific treatment. The treatment is usually started empirically in the suspected cases as the infection is rapidly progressing and it will take time to confirm the culture.1 Nonetheless, extensive and even inappropriate treatment with broad-spectrum antibiotics has led to the development of antimicrobial resistance among the neonatal pathogens. Culture-positive sepsis is a valuable possibility to check the organisms, as well as their sensitivity profiles, and use antibiotics more reasonably.2 It is imperative to know the local trends in the prescription and resistance of antibiotics to inform effective treatment measures and enhance the outcomes of neonatal patients.

Empirical antibiotic therapy is the mainstay of neonatal sepsis. The general guideline is to prescribe broad-spectrum antibiotics on the basis of probable pathogens and local epidemiology. Typical first line treatment have ampicillin with gentamicin, and second line treatment is usually third-generation cephalosporin, vancomycin or a carbapenem like meropenem.3 In most developing environments, due to a high resistance rate and slow reporting to the laboratory, broad-spectrum antibiotics are started early. But patterns of antibiotic prescribing are diverse among NICUs.4 Empirical therapy may be maintained in culture-negative cases even in resource-limited settings because of the fear of missing a life-threatening infection. This results in the increased exposure to antibiotics, which raises the chances of developing resistance, disturbing the microbiota of newborns, necrotizing enterocolitis, and invasive infections with fungi.5 Therefore, it is necessary to assess the trends of antibiotic use that will enhance the treatment practice. Culture-positive sepsis gives valuable data on causative organisms and their susceptibility trends. Research indicates that gram-negative bacteria are the most common in the NICUs in developing nations. Popular organisms are Klebsiella pneumoniae,6 Staphylococcus aureus and coagulase-negative staphylococci are commonly isolated among gram-positive organisms. Domination of gram-negative pathogens is worrisome because they are highly resistant. Neonatal pathogens are of global

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concern due to antimicrobial resistance.7 Rising resistance to first-line antibiotics like ampicillin and gentamicin has been extensively reported. The increasing resistance to the third generation cephalosporins is also a result of production of extended spectrum beta-lactamase (ESBL), especially in E. coli and Klebsiella.8 As a result, the utilization of carbapenems as the last-resort medications is on the rise. Since there are new carbapenem-resistant organisms like Acinetobacter and Klebsiella, which further restrict treatment options. One of the leading causes of resistance is inappropriate and excessive use of antibiotics.9 Factors that lead to this in NICUs include the absence of standardized procedures, poor infection control, and inaccessibility to up-to-date microbiological findings.10 Multidrug-resistant infections are linked with poorer neonatal outcomes, such as a longer stay in the hospital, a greater use of ventilatory support, and higher mortality. Extensively drug-resistant and pan-drug-resistant organisms are extremely challenging to treat, with few or no treatment options remaining.11 These infections also make healthcare expensive and a burden on the hospital facilities. To overcome these issues, antibiotic stewardship programs (ASPs) are necessary. ASPs foster the right choice of antibiotics, dosage, and time.12 The main actions involve prompt empirical treatment according to the guidelines, cultures prior to the introduction of antibiotics, periodic reassessment of treatment and a de-escalation of treatment according to the sensitivity outcomes.13 It has been demonstrated that stewardship programs decrease the use of antibiotics, antibiotic resistance, and enhance clinical outcomes. The prevention and control of infection (IPC) are also important in the NICUs. The high susceptibility of the neonates and the high invasive nature of the procedures conducted on them means that hand hygiene, aseptic practice, and cleaning of the environment must be adhered to strictly.14 The monitoring of infection rates and resistance patterns enhances improved clinical decisions and development of policy.15 Local antibiograms are important to guide empirical therapy. They give latest information on organism susceptibility patterns in a hospital or area. Regular updates assist clinicians in choosing the right antibiotics and changing protocols to the latest resistance trends.16 Timely and correct diagnosis of neonatal sepsis will help decrease the use of inappropriate antibiotics. C-reactive protein and procalcitonin biomarkers as well as the use of molecular diagnostic tools have demonstrated promise.17 Their use is however limited in low-resource settings due to limited availability and cost. Clinical judgment along with the provided laboratory data will be crucial until the extensive availability of advanced diagnostics, which is why, until then, it is necessary to rely on clinical judgment to guide therapy.18

Objective:

The objective of the study is to evaluate the trend of antibiotic use in neonatal sepsis and to evaluate the prevalence of antimicrobial resistance in culture-positive cases, thus, helping in the provision of evidence-based clinical judgment and antimicrobial stewardship in the context of neonatal intensive care units.

Methodology:

The study was carried out in the Neonatal Intensive Care Unit (NICU) of a tertiary care hospital called Hashim Medical City in Hyderabad. This was a retrospective observational study, where all the neonates admitted in the study period were included. Hospital records, admission registers, and laboratory reports were used to obtain data. Neonates who were suspected or confirmed to have sepsis and were treated with antibiotic therapy were included. Data was documented on the following: demographic data (age, gender, gestational age, and birth weight), clinical diagnosis, antibiotic use, culture, antimicrobial sensitivity pattern and results. Causative organisms and resistance profiles were specifically determined by culture-positive cases. The trend in the use of antibiotics, both empirical and culture-guided treatment, was assessed. The results were summarized using descriptive statistics and the prevalence of antimicrobial resistance was determined. Neonatal sepsis continues to be a significant cause of morbidity and mortality in the world, especially in low- and middle-income nations. A major percentage of neonatal deaths is linked to infection in the first 28 days of life. The problem with management is that there is no specific clinical manifestation, the disease progression is fast, and there is little access to fast diagnostic methods. This has led to pre-culture antibiotic therapy which is often empirical. Although this practice is lifesaving, it leads to increased problem of antimicrobial resistance (AMR), particularly in NICU.

Results:

The sample size was about 120 or more neonates, and it was found that males formed a majority (60-65 percent) of the sample, which was also comparable to the earlier research which revealed gender difference in neonatal admissions. The gestational age was 26 to 40 weeks, with most of them being preterm (6570%), thus prematurity was identified as one of the main causes of neonatal morbidity in this group. The analysis of the birth weights showed a wide range (0.69-3.9 kg), high prevalence of low birth weight (<2.5 kg) in almost 70% of cases and in some cases extremely low birth weight (<1kg), which means that the population of the neonatal patients is high-risk. The delivery method was mostly LSCS/elective LSCS which implied more obstetric interventions or high-risk pregnancies. Furthermore, a high percentage of neonates were preterm which implies burden on referrals and potential delays in accessing early neonatal care.

Table No1: Demographic and Birth Characteristics – Observations.

Table 2 shows clinical profile and outcomes observations.

Variable	Observation
Total Neonates	~120+ cases
Gender Distribution	Male predominance (~60–65%)
Gestational Age	Range: 26–40 weeks
Preterm (<37 weeks)	Majority (~65–70%)
Birth Weight Range	0.69 kg – 3.9 kg
Low Birth Weight (<2.5 kg)	Very common (~70%)
Extremely Low Birth Weight (<1 kg)	Present in several cases
Mode of Delivery	Mostly LSCS / eLSCS
Place of Birth	Both inborn and referred (out born significant)

The most frequent clinical diagnoses were respiratory distress syndrome (RDS), transient tachypnea of the newborn (TTN), birth asphyxia, and neonatal sepsis, indicating a bias towards respiratory and infectious morbidities. A significant number of neonates needed respiratory care, such as CPAP, bubble CPAP, high-flow oxygen therapy, and mechanical ventilation, which meant moderate to severe

severity of the illness. Oxygen treatment was also commonly enforced, which once again put a strong focus on respiratory impairment as a key problem. Hospital stay was heterogeneous (1-58 days) indicating that there was variation in the severity of the disease and recovery patterns.

Table No 2: Clinical Profile and Outcome

Variable	Observation
Common Diagnoses	RDS, TTN, Birth Asphyxia, Neonatal Sepsis
Respiratory Support	CPAP, Bubble CPAP, High Flow, Ventilator
Oxygen Therapy	Frequently used
Hospital Stay	1 – 58 days
Outcomes	Discharged, Expired, LAMA, Referred
Mortality	Notable in severe sepsis, extreme prematurity
LAMA Cases	Present (resource or social factors)

The outcomes were discharge, mortality, LAMA (leave against medical advice), and referral, with a significant elevation of mortality in severe sepsis and extreme prematurity. The occurrence of LAMA cases leads to the indications of socioeconomic, caregiver, or healthcare accessibility.

Table No 3: Antibiotic Use and Culture Findings.

Category	Findings
Empirical Antibiotics	Gentamicin, Vancomycin, Meropenem, Amikacin, Carbapenems
Culture-Negative Cases	Majority
Culture-Positive Cases	Limited but clinically significant
Isolated Organisms	Staphylococcus aureus, Klebsiella, Serratia, Acinetobacter, E. coli
Broad-Spectrum Use	Common in severe/late sepsis
Escalation Therapy	Meropenem, Vancomycin frequently used
Evidence of Resistance	Present (e.g., Serratia resistant to multiple drugs, Acinetobacter, Klebsiella)

Common empirical antibiotic therapy consisted of aminoglycosides (gentamicin, amikacin), glycopeptides (vancomycin), and broad-spectrum agents (meropenem and other carbapenems), suggesting a shift to early broad-spectrum coverage, especially in possible sepsis. Most of them were culture-negative, and this could be due to previous exposure to antibiotics, constraints in microbiological methods or non-infectious etiologies. Nevertheless, culture-positive cases, however few, were clinically relevant, and pathogens like Staphylococcus aureus, Klebsiella, Serratia, Acinetobacter, and E. coli, which are typically linked to the development of neonatal sepsis, were isolated. The common occurrence of escalation therapy (meropenem, vancomycin) indicates clinical deterioration or possible antimicrobial resistance. Interestingly, multidrug resistance is present, especially with Gram-negative pathogens (e.g., Serratia, Acinetobacter, Klebsiella), and this raises questions about antibiotic stewardship and infection control measures.

Table No 4: Representative Sample (Detailed Extract) (First 10 entries shown for clarity; full dataset can be expanded similarly)

DOA	MR#	City	Age	GA (weeks)	Sex	Birth Weight	Diagnosis	Culture	Support	Stay	Outcome
1-Jan-26	42	Hyderabad	3 days	37	M	1.9 kg	LBW, Sepsis	–	Oxygen	18 d	Discharged
3-Jan-26	197	Hyderabad	Day 1	33	M	3.6 kg	IDM, TTN	–	Oxygen	6 d	Discharged
4-Jan-26	336	Umerkot	Day 1	28	F	1.0 kg	RDS	–	CPAP	24 d	LAMA
5-Jan-26	493	Shahdadpur	Day 1	37	M	3.3 kg	TTN, RDS	–	BCPAP	5 d	Discharged
5-Jan-26	427	Umerkot	Day 1	35	M	2.6 kg	TTN	–	Oxygen	2 d	LAMA
6-Jan-26	624	Hyderabad	Day 1	37	F	3.35 kg	TTN	–	Oxygen	3 d	Discharged
7-Jan-26	794	TM Khan	Day 1	32	M	1.6 kg	RDS	No growth	CPAP	31 d	Discharged
9-Jan-26	999	Sanghar	Day 1	36	F	2.3 kg	Asphyxia	–	BCPAP	5 d	Discharged
10-Jan-26	1028	Hyderabad	2 days	36	M	1.9 kg	RDS, Sepsis	–	Ventilator	1 d	Expired
10-Jan-26	1094	Hyderabad	Day 1	28	F	1.1 kg	RDS	No growth	CPAP/Vent	9 d	Referred

The sample entries demonstrate early neonatal presentation with the majority of the admissions being carried out during the initial 1-3 days of life underlining the importance of the first postnatal years as shown in table 4. It has a preponderance of preterm and low birth weight infants with a significant percentage needing respiratory assistance in the form of CPAP or mechanical ventilators. In the sample, clinical diagnoses are consistent with general trends especially RDS, TTN, and neonatal sepsis. The outcomes of culture were often counterproductive, which is consistent with the overall dataset results. The results were varying such as successful discharge, mortality, LAMA and referral as the severity of the disease and choice of healthcare vary. It is worth noting that severe cases (e.g., combined RDS and sepsis on ventilator) were correlated with mortality, whereas cases of LAMA were observed even in moderately ill newborns, which supports the clinical importance of non-clinical factors in the discontinuation of treatment. The patients area wise were referred to the facility by various regions around it (e.g., Hyderabad, Umerkot, Sanghar) meaning that the facility was used as a regional referral center.

Discussion:

The neonates that were analyzed included the total number of neonates that were admitted in the NICU of Hashim medical city within the study period. One of the most common diagnoses was neonatal sepsis, as a primary or comorbid diagnosis. Most suspected cases of sepsis began empirical antibiotic therapy, which most often involved some combination of gentamicin, vancomycin, mero-

penem, amikacin, and trimethoprim. Various organisms were isolated among culture-positive cases.

Most commonly observed pathogens were Staphylococcus aureus, Klebsiella pneumoniae, Acinetobacter, Serratia species, and Escherichia coli. Gram-negative organisms were predominant as compared to gram-positive organisms. Some of the cases did not have any bacterial growth despite the presence of clinical features of sepsis. Notably, antimicrobial resistance was observed. A few isolates, especially Serratia and Klebsiella, were found to be resistant to frequently used antibiotics, and one case was reported as resistant to all(indicating multidrug resistance). These resistant cases were often treated with broad-spectrum antibiotics like meropenem and combination therapies. Culture-positive and resistant infections of neonates were associated with longer hospitalization, escalated demand of advanced respiratory support, and worse outcomes, such as an increase in mortality or against-medical-advises discharge.

The present research indicates a high dependency on empirical broad-spectrum antibiotic treatment of neonatal sepsis, which is related to the urgency of treatment among critically ill neonates. Nonetheless, the results also indicate a worrying trend of antimicrobial resistance in culture-positive cases. The gram-negative dominance, especially of Klebsiella, Acinetobacter, and Serratia, is consistent with the data in most NICUs in developing countries. The development of multidrug-resistant organisms with some cases resistant to a variety of or all the tested antibiotics indicates that broad-spectrum antibiotics may be over-utilized or abused.

This highlights the necessity of stringent antibiotic stewardship measures, prompt culture sampling, and prompt de-escalation of treatment with reports of sensitivities. Moreover, there was a correlation between resistant infections and the length of hospital stay, as well as poor clinical outcomes, which poses a greater burden on healthcare facilities. To fight the increasing resistance, it is important to enhance infection control measures and adopt evidence-based antibiotic prescriptions. This paper highlights the urgent necessity of ongoing monitoring of antibiotic use and resistance trends to enhance the care of neonatal units and decrease morbidity and mortality in the NICUs.

Conclusion:

This paper brings to light some of the most crucial issues in the practice of neonatal intensive care. Empirical antibiotic therapy is heavily relied on, which is followed by escalation in most cases without microbiological validation. The majority of suspected sepsis cases are culture-negative, but patients receive aggressive antimicrobial therapy, as there is diagnostic uncertainty and clinical suspicion. The fact that multidrug-resistant organisms are present in the NICU is especially concerning and highlights the possible outcome of being exposed to broad-spectrum antibiotics over an extended period of time. All these findings highlight the importance of the urgent need to enhance antibiotic stewardship initiatives in order to maximize prescribing behavior and minimize the use of antimicrobials that are not necessary. Besides, culture guided therapy should be more emphasized in order to achieve a specific and effective treatment. Infection control measures such as hand hygiene, environmental cleaning and surveillance should be strengthened to curb the transmission of resistant pathogens.

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