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Neonatal Sepsis Diagnosis And Treatment Challenges A Prospective Study

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Abstract

Background:

Neonatal sepsis represents a fatal condition that makes significant contributions to neonatal deaths within developing nations. Limited diagnostic techniques combine with confusing clinical characteristics to make on-time diagnosis challenging. Healthcare providers face delayed treatment as well as poor medical results and increased antibiotic resistances due to this situation.

Objectives:

This study investigates the diagnostic problems and treatment results of sepsis in newborns while examining clinical and laboratory indicators to detect sepsis early and provide successful therapy.

Study design: A prospective study.

Place and duration of study: Nursery Unit Women and children teaching hospital MTI bannu from Jan 2023 to Jan 2024

Methods:

The study was carried out as a prospective study assessment in the NICU of Nursery Unit Women and children teaching hospital MTI bannu from Jan 2023 to Jan 2024. Included 100 neonates who displayed clinical signs of sepsis. Measurements of blood cultures together with CRP and procalcitonin levels were collected. The NICU started empirical antibiotic treatment by following their existing local guidelines. In the statistical analysis of this research SPSS version 24.0 was utilized with $p<0.05$ as the significance threshold.

Results:

100 neonates included 62 males together with 38 females. The medical staff collected the data from neonates who had a mean age of 5.2 days ± 2.1 days. Klebsiella pneumoniae along with E. coli were the most frequently isolated organisms from blood cultures in patients where results were positive at a rate of 32%. An elevated CRP level above 10 mg/L was detected in 76% and procalcitonin levels above 0.5 ng/mL appeared in 68% of the studied neonatal population. Testing revealed that hospitalized neonates spent an average of 11.4 days until discharge. Physicians who started treatment as soon as possible observed better patient results ($p = 0.021$) yet the fatality rate reached 12%.

Conclusion:
The diagnosis of neonatal sepsis presents clinical challenges because symptoms are ambiguous and blood culture detection ability is limited. Current research demonstrates the value of CRP and procalcitonin in early sepsis detection even though they only provide guidance rather than definitive results. The survival rate improves when sepsis diagnosis happens early and doctors provide antibiotic treatment that matches the bacterial resistance patterns in their area. The healthcare system requires both speedier diagnostic equipment and established protocols for antibiotic prescription.

Keywords: Neonatal sepsis, Diagnosis, Treatment, Biomarkers

Introduction:

Neonatal sepsis emerges as a clinical syndrome that causes throughout the body while placing bacteraemia among its cases during the initial 28 days postnatally. The condition stands as a primary source of infant illness and passing away across the world specifically inside low- and middle-income nations (LMICs) where it contributes to approximately one-third of all neonatal fatalities [1]. Advancements in neonatal healthcare have not simplified the complex management and diagnosis of neonatal sepsis because of nonspecific medical indicators together with non-existent fast diagnostic systems and expanding antimicrobial resistance patterns. The two groups of neonatal sepsis include early-onset sepsis that develops during the initial 72 hours of life through maternal genital tract transmission and late-onset sepsis that appears after 72 hours due to nosocomial or environmental infections [2]. Geographical differences along with hospital environments influence which pathogens specifically affect newborns and they include Group B Streptococcus, Escherichia coli, Klebsiella pneumoniae, and Staphylococcus aureus [3]. The main difficulty in diagnosing sepsis in newborns includes their nonspecific and subtle presentation since these signs could coincide with other non-infectious medical conditions such as respiratory distress syndrome or metabolic disorders [4]. A diagnostic confirmation through positive blood culture remains definitive yet it takes considerable time to complete and is tainted by low results due to antibiotic exposure history or insufficient blood collection [5]. The early detection of infections depends on additional laboratory markers such as C-reactive protein (CRP) and procalcitonin (PCT) even though their detection accuracy changes broadly [6]. Early antibiotic administration stands as an essential factor to benefit treatment results yet random prescription without microbiological validation may lead to antibiotic strength deterioration and the alteration of healthy intestinal microorganisms [7]. Wide disparities exist among the antibiotics used as empirical regimens between healthcare institutions mainly due to local antibiogram data and clinical expertise. The management of multidrug-resistant infections requires immediate administration of proper antimicrobial drugs because delays produce elevated mortality rates along with complicated medical situations [8]. The combination of fast pathogen identification technologies through PCR and multiplex assays represents potential advances in molecular diagnostics although these systems remain costly for use in LMICs during recent years. The use of central lines along with prolonged hospital stays and invasive procedures elevates the risk of LOS requiring better infection control methods together with specific treatment approaches [9]. Ease the understanding of sepsis management optimisation in newborns by comprehending existing diagnostic constraints along with therapeutic practices. This research evaluates both diagnostic and therapeutic challenges related to neonatal sepsis in a tertiary healthcare environment through clinical parameter and laboratory parameter evaluation and early intervention outcome assessment.

Methods:

The study took place throughout Nursery Unit Women and children teaching hospital MTI bannu. from Jan 2023 to Jan 2024 One hundred clinically suspected sepsis neonates participated in this research through consecutive sampling. Medical staff diagnosed neonatal sepsis using clinical indicators in combination with

laboratory exams such as CRP, PCT and complete blood count test results either with or without microbial identification tests. Medical staff obtained blood, cerebrospinal fluid samples and urine samples before administering empirical antibiotic treatment. Commercial immunoassays provided the measurements of CRP combined with PCT levels. The therapy's response evaluation involved both clinical signs disappearing and biomarker normalization. Healthcare providers began empirical antibiotic treatments per hospital guidelines which would be modified in accordance with culture test results. All patients received treatment while the medical staff recorded hospital stay periods along with complications and final treatment results.

Inclusion Criteria:

Neonates born anywhere from 0 to 28 days of age develop sepsis when they display any of the symptoms including fever along with lethargy, poor feeding ability, respiratory distress or irritability. The evidence may or may not require laboratory or culture confirmation for diagnosis.

Exclusion Criteria:

The trial excluded infants with congenital anomalies or metabolic disorders and infants already taking antibiotics for other infections because such conditions could affect clinical or laboratory diagnosis.

Data Collection:

The clinical data collection process occurred through the use of a structured questionnaire. The study included laboratory assessments of CRP and procalcitonin together with CBC and cultures. The study recorded patient demographics together with clinical aspects and therapeutic approaches and resulting outcomes. Healthcare professionals checked the data records every day until the patient left the hospital or passed away. Appropriate ethical approval granted the protection of all anonymized information which received secure storage.

Statistical Analysis:

Study data analysis used SPSS version 24.0 for information entry and processing. The researchers presented categorical data as frequencies alongside percentages and continuous data as means together with standard deviation. The researchers used both chi-square test and t-test to evaluate associations between variables. The study established a p-value lower than 0.05 to denote statistical significance.

Results:

100 neonates with a male population comprising 62 percent while female patients made up 38 percent of the participants. The study participants had an average of 5.2 ± 2.1 days in age. Sepsis presented early to the neonatal patients in 58% of cases but it appeared late in the remaining 42% of subjects. Blood tests revealed positive cultures in 32% of cases and among them Klebsiella pneumoniae (13%) was followed by E. coli (11%) and Staphylococcus aureus (8%) as the primary bacterial agents. Blood tests revealed elevated CRP levels above 10 mg/L in 76% of neonates while procalcitonin levels above 0.5 ng/mL occurred in 68% of them. The patients spent 11.4 ± 3.7 days on average in the hospital. Of all the patients studied during empirical antibiotic treatment 35% required therapy adjustments after running sensitivity tests. Survival outcomes demonstrated a statistically important connection to how early infants received their antibiotics ($p = 0.021$). The total mortality rate was 12% yet more fatalities occurred in patients with culture-positive sepsis combined with delayed antibiotic therapy. The analysis demonstrated a weak link between biomarkers CRP and procalcitonin and positive cultures ($p < 0.05$) which suggests these markers can help identify sepsis before blood culture results return.

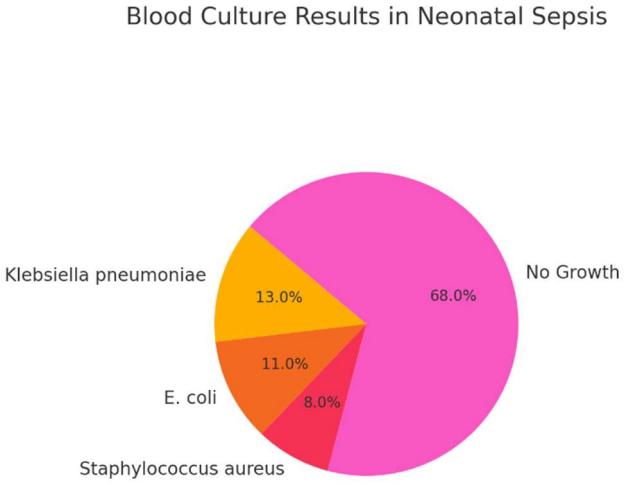

Table 1: Demographic and Clinical Characteristics

Variable	Value
Total Patients	100
Male	62
Female	38
Mean Age (days)	5.2 ± 2.1
Early-Onset Sepsis	58
Late-Onset Sepsis	42

Table 2: Blood Culture Results

Organism Isolated	Number of Cases	Percentage (%)
Klebsiella pneumoniae	13	13
E. coli	11	11
Staphylococcus aureus	8	8
No Growth	68	68

Table 3: Biomarkers and Outcomes

Parameter	Value
CRP >10 mg/L	76%
Procalcitonin >0.5 ng/mL	68%
Modified Antibiotic Regimen	35%
Mean Hospital Stay (days)	11.4 ± 3.7
Mortality Rate	12%

Discussion

Neonatal sepsis remains an extensive clinical diagnosis and treatment challenge throughout the globe with special importance in low- and middle-income nations. Culture test results indicated a positive pathogen detection in 32% of all selected samples a rate that matches Vergano et al.'s study which discovered sepsis pathogens in 30% of suspected newborns [10]. Literature reviews from South Asia display similar findings by indicating Klebsiella pneumoniae and E. coli as the main causes of hospital-based early and late-onset neonatal sepsis [11,12]. Our study results confirm that CRP and procalcitonin (PCT) levels show promising value as early sepsis biomarkers because they were elevated in 76% and 68% of our patient cohort in line with Chiesa et al.'s research on neonatal populations [13]. These biomarkers remain insufficient for definitive diagnosis because nonspecific results can occur from non-infectious situations including birth asphyxia and meconium aspiration [14]. Our study showed a mean patient age of 5.2 days due to a high proportion of cases from early-onset sepsis (EOS) which represented 58% of patients. These findings matched the EOS percentage reported by Simonsen et al. that reflected 60% of neonatal sepsis cases [15]. Maternal screening alongside intrapartum antibiotic prophylaxis strategies for Group B Streptococcus prevention need enhanced implementation in order to improve perinatal infection control despite the fact that this bacterium has limited infection rates in our region [16]. The 32% culture positivity rate presents diagnostic challenges for blood cultures in neonatal sepsis because mature born babies usually receive antibiotics before testing or sample collection as mentioned by Dong and Speer [17]. The clinical staff depends on their expert decision making and substitute indicators because of this leading to unnecessary antibiotic prescriptions. The use of empirical drugs in treatment leads to antibiotic resistance and this phenomenon has become common in neonatal units across the world [18]. Research data showed 12% mortality which represents an important number of deaths compared to previously documented rates between 15–30% [19]. Studies show that early antibiotic medication commencement leads to better neonatal survival rates ($p = 0.021$) resulting in the need for urgent marker identification and treatment. Hornik et al. observed that delayed empirical antibiotic administration leads to higher mortality rates especially regarding Gram-negative infections [20]. The success of neonatal sepsis patient outcomes depends on better diagnostic tools including real-time molecular diagnostics and multiplex PCR assays which detect pathogens quickly although they remain unavailable for many resource-poor regions. Hospital antibiotic stewardship initiatives and antibiogram reviews enable healthcare providers to choose appropriate initial treatment drugs and stop resistance development.

Conclusion:

The medical challenge of neonatal sepsis persists because clinical signs are nonspecific and laboratory results take too long and antibiotic resistance continues to increase. Patients who receive specific therapeutic

approaches soon after diagnosis with supportive biomarkers experience better survival chances. The diagnosis infrastructure and antimicrobial stewardship practices need enhancement because they lead to better outcomes and decreased mortality rates in newborns within resource-poor regions.

Limitations:

The study faced limitations from its single location design and small participant number because these factors restrict broad applicability. Traditional culture assessments might provide an underestimation of the actual infection numbers. Time-dependent neurodevelopmental outcomes along with molecular diagnostic performance assessment did not occur due to funding limitations.

Future Directions:

Future study needs to analyze how rapidly available molecular tests along with point-of-care biomarkers diagnose sepsis in newborns. More extensive research in various medical centers must validate predictive algorithms while assessing the outcomes related to these prediction systems. Skilled implementation of machine learning algorithms together with real-time surveillance systems would help doctors detect sepsis earlier and provide better treatment solutions for neonates.

Abbreviations

1. **NICU** Neonatal Intensive Care Unit
2. **CRP** C-Reactive Protein
3. **PCT** Procalcitonin
4. **CBC** Complete Blood Count
5. **LMICs** Low- and Middle-Income Countries
6. **EOS** Early-Onset Sepsis
7. **LOS** Late-Onset Sepsis
8. **PCR** Polymerase Chain Reaction
9. **SPSS** Statistical Package for the Social Sciences

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Authors Contribution

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Final Approval of version:**All Authors Approved the Final Version.**

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