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CULTURE AND SENSITIVITY PROFILE IN PATIENTS OF NEONATAL SEPTICEMIA IN CSF SAMPLES OF MENINGITIS CASES ADMITTED IN PEDIATRIC INTENSIVE CARE UNITS

Clinical Research

Dr. Roohi Mohamed Taj Lambe* — 2nd Year Resident, MD Pharmacology Department of Pharmacology, Dr. BVP Rural Medical College, Pravara Institute of Medical Sciences (DU), Loni, Maharashtra, India *Corresponding Author

Dr. Rudransh Ghogare — Tutor, Department of Pharmacology, Dr. BVP Rural Medical College, Pravara Institute of Medical Sciences (DU), Loni, Maharashtra, India

ABSTRACT

Introduction: Neonatal septicaemia and meningitis are among the most severe infections endured in paediatric intensive care units (PICUs), contributing significantly to high rates of mortality and morbidity in neonates. Early diagnosis and timely pharmacological intervention with efficacious antimicrobial therapy are important to achieve better outcomes. However, the increasing prevalence of multidrug-resistant organisms poses a significant challenge in clinical management. Analysis of cerebrospinal fluid (CSF) culture and sensitivity profiles provides valuable insights into the most common disease-causing organisms and their antimicrobial susceptibility patterns, guiding empirical therapy and antibiotic protection. **Material and Methods:** A retrospective study conducted over a period of four months (May to August 2025) in the Paediatric Intensive Care Unit (PICU) in collaboration with the Department of Pharmacology. All cases with clinical suspicion of Neonatal septicaemia and meningitis were included. **Results:** Among the CSF cultures analysed, the most common causative organism isolated was Coagulase negative streptococcus (CONS) (43%) followed by Acinetobacter spp. (28%) and enterococcus (11%). Sensitivity testing revealed that Tetracyclins showed highest susceptibility (35%) among other antibiotics such as Tobramycin (20%) which also showed good response. In contrast, resistance was most frequently observed against Cotrimoxazole (28%), with considerable resistance also noted to Imipenem (26%) **Conclusion:** Coagulase-negative staphylococcus emerged as the most common causative pathogen in neonatal meningitis cases, followed by Acinetobacter spp. and enterococcus. Tetracyclines and Tobramycin showed highest sensitivity whereas significant resistance was observed against Cotrimoxazole and Imipenem. The results highlight the need for continuous surveillance of antimicrobial resistance patterns and cautious use of antibiotics to ensure effective empirical therapy in neonatal septicaemia with meningitis.

KEYWORDS

Meningitis, Pravara rural hospital, paediatrics, antibiotic sensitivity

INTRODUCTION

Neonatal septicaemia and meningitis are among the most tempestuous infections encountered in paediatric intensive care units (PICUs), significantly contributing to high rates of mortality and morbidity in neonates globally. Neonatal infections result in roughly 550,000 deaths annually with sepsis and meningitis attributing for the majority of these cases. While septicaemia is a systemic response to hematogenous pathogens, the progression to neonatal meningitis demonstrates an alarming surge where pathogens surpass the blood-brain barrier (BBB). This transition mandates early diagnosis and also a targeted pharmacological approach, as the antimicrobial agents will prove to be more efficacious at the specific therapeutic concentration in Cerebrospinal fluid. [1, 2]

The pharmacological treatment of these neonatal conditions is increasingly complicated by the global surge in multidrug-resistant (MDR) organisms. Globally, the traditional empirical regimens, typically a combination of a third-generation cephalosporin and aminoglycoside are losing efficacy. The rise of Extended-Spectrum Beta-Lactamase (ESBL) producing Carbapenem-resistant and Enterobacteriaceae pathogens have made many first line treatment protocols obsolete in specific regional contexts. [3, 4] This shift is particularly prominent in neonates, whose immature immune systems and high volume of distribution make the margin for therapeutic error exceptionally narrow. [2]

Relying solely on blood cultures often proves insignificant, as clinical data suggests that nearly 30–50% of neonates with meningitis may present with negative blood culture reports. [5] Consequently, the analysis of CSF culture and sensitivity profiles remains the mainstay of definitive diagnosis. Furthermore, as susceptibility and microbial patterns profiles exhibit significant geographical variation, a common approach of empirical guidelines are often inadequate. There is an urgent need for localized surveillance to identify the specific pathogens and resistance genes prevalent in our clinical setting to ensure rational antibiotic stewardship. [4, 6]

Aim: To study the culture and sensitivity profile of cerebrospinal fluid samples in neonates with septicaemia and meningitis admitted to the paediatric intensive care unit.

Primary Objective:

- To identify the culture and sensitivity profile of pathogens isolated from cerebrospinal fluid (CSF) samples of neonates with septicaemia and meningitis admitted to the paediatric intensive care unit.

Secondary Objectives:

1. To analyse the antimicrobial resistance patterns of the isolated organisms.
2. To assess the prevalence of multidrug-resistant organisms (e.g., ESBL, MRSA) in neonatal CSF isolates.
3. To provide data that may help in guiding empirical antibiotic therapy and promoting rational antibiotic use in neonatal intensive care settings.

METHODS

Study Design and Setting

This was a retrospective observational study conducted over a period of four months at the Department of pharmacology in collaboration with Department of Paediatrics of Pravara Rural Hospital, a tertiary care teaching hospital catering predominantly to a rural population in Maharashtra, India. The hospital serves as a major referral centre for surrounding villages and primary healthcare facilities.

Study Population

The study population consisted of neonates admitted to the Paediatric Intensive Care Unit (PICU) / Neonatal Intensive Care Unit (NICU) of a tertiary care teaching hospital during the study period who were clinically suspected to have neonatal septicaemia with features suggestive of meningitis. Neonates undergoing lumbar puncture as part of diagnostic evaluation for suspected meningitis were enrolled in the study. Cerebrospinal fluid (CSF) samples obtained under aseptic precautions were subjected to microbiological culture and antibiotic sensitivity testing.

Both inborn and out born neonates, irrespective of gender, gestational age, birth weight, and mode of delivery, were included in the study. Clinical suspicion of meningitis was based on the presence of signs and symptoms such as fever or hypothermia, poor feeding, lethargy, seizures, bulging anterior fontanelle, apnoea, irritability, or hemodynamic instability, with or without laboratory evidence of sepsis. The study aimed to evaluate the bacteriological profile and antimicrobial susceptibility pattern in CSF samples of these neonates.

Inclusion Criteria

- Neonates aged 0–28 days admitted to the PICU/NICU.

- Neonates with clinical features suggestive of septicaemia and meningitis.
- Neonates in whom lumbar puncture was performed and CSF sample was sent for culture and sensitivity.
- Both preterm and term neonates, including low birth weight and normal birth weight babies.
- Neonates whose parents or guardians provided **informed consent** for participation in the study.

Exclusion Criteria

- Neonates aged **more than 28 days**.
- Neonates with **major congenital anomalies** or **neural tube defects** involving the central nervous system.
- Neonates with **traumatic lumbar puncture** rendering CSF sample unsuitable for culture interpretation.
- Neonates who had received **antibiotics for more than 48 hours prior to CSF sampling**, potentially affecting culture results.
- Neonates with **non-infectious causes of neurological symptoms**, such as metabolic encephalopathy or hypoxic-ischemic encephalopathy without evidence of infection.
- Neonates whose parents or guardians **did not consent** to participation in the study.

Data collection

Data were collected retrospectively from case records, registers, treatment charts, and discharge summaries using a pre-designed structured data collection proforma. The following variables were recorded:

- Demographic details: Age, gender
- Clinical characteristics: Fever or hypothermia, poor feeding, lethargy, seizures, bulging anterior fontanelle, apnoea, irritability, or hemodynamic instability, with or without laboratory evidence of sepsis

Outcome measures:

Culture positivity rate in cerebrospinal fluid samples of neonates with suspected meningitis.

Bacteriological profile of organisms isolated from CSF samples in neonatal septicaemia cases.

Antimicrobial sensitivity pattern of the isolated organisms, including susceptibility and resistance to commonly used antibiotics in the PICU/NICU.

RESULTS

Maximum sensitivity (35%) was seen with Tetracycline/Tobramycin whereas Maximum resistance (27%) was seen towards Cotrimoxazole/Imipenem. Gram-positive organisms were most sensitive to Tetracycline and Linezolid, while Gram-negative organisms demonstrated sensitivity towards Imipenem and Tetracycline. (Figure 1)

Most common organism isolated was CONS (43%) followed by Acinetobacter (28%) (Figure 2)

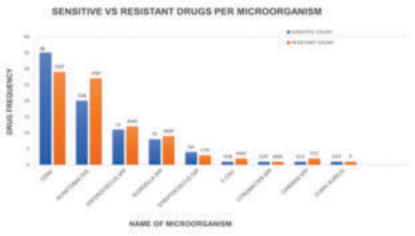

Figure 1

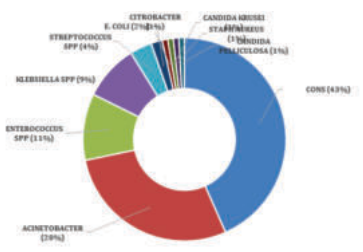

Figure 2

DISCUSSION

Neonatal septicaemia with meningitis remains a serious clinical problem, contributing significantly to neonatal morbidity and mortality, particularly in rural areas of India. Early identification of the causative organism and initiation of appropriate antimicrobial therapy are crucial determinants of outcome. This study evaluated the culture positivity rate, bacteriological profile, and antimicrobial sensitivity pattern of cerebrospinal fluid (CSF) samples in neonates admitted to the Paediatric Intensive Care Unit with suspected meningitis.

In the present study, the CSF culture positivity rate was comparable to that reported in earlier studies from similar tertiary care settings. Variability in culture positivity across studies may be attributed to prior antibiotic exposure, differences in laboratory techniques, timing of lumbar puncture, and regional microbial epidemiology. Despite these limitations, CSF culture remains the gold standard for definitive diagnosis of neonatal meningitis.

The bacteriological profile observed in this study showed a predominance of organisms such as CONS, Acinetobacter and Klebsiella species, reflecting the increasing burden of healthcare-associated infections in intensive care units. The relatively lower isolation of Gram-positive organisms such as Staphylococcus aureus and Group B Streptococcus may reflect changing epidemiological trends and improved perinatal care practices.

Antimicrobial sensitivity patterns revealed high resistance to commonly used first-line antibiotics, including ampicillin and third-generation cephalosporins, particularly among Gram-negative isolates. Better sensitivity was observed with higher antibiotics such as aminoglycosides, carbapenems, and colistin, though emerging resistance to these agents is a cause for concern. These findings underscore the growing challenge of antimicrobial resistance in neonatal intensive care settings and highlight the need for judicious antibiotic use.

Clinical outcomes in the present study indicated that culture-positive meningitis was associated with higher mortality, longer hospital stay, and increased need for intensive supportive care. Neonates infected with multidrug-resistant organisms had poorer outcomes, emphasizing the importance of early targeted therapy based on culture and sensitivity results.

Overall, the findings of this study reinforce the necessity for continuous surveillance of local microbial patterns and antibiotic susceptibility profiles. Regular updating of empirical antibiotic guidelines, strict infection control practices, and antibiotic stewardship programs are essential to improve outcomes in neonates with septicaemia and meningitis.

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