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FREQUENCY AND ANTIBIOTIC SENSITIVITY OF BACTERIAL PATHOGENS IN NEONATAL SEPSIS PATIENTS IN THE NURSERY OF BACHA KHAN MEDICAL COMPLEX, SWABI

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Abstract

Background: *Neonatal sepsis remains one of the leading causes of morbidity and mortality among newborns, with the increasing prevalence of antibiotic resistance posing significant challenges to effective treatment. This study aims to explore the microbial etiology and antibiotic resistance patterns of pathogens associated with neonatal sepsis in the nursery of Bacha Khan Medical Complex, Swabi.*

Objectives: *The primary objectives of this study were to identify the bacterial pathogens responsible for neonatal sepsis, assess the antibiotic susceptibility profiles of the isolated bacterial strains, and examine emerging trends in antibiotic resistance within this cohort.*

Methods: *A descriptive cross-sectional study was conducted, including neonates admitted with suspected neonatal sepsis. Blood cultures were obtained and analyzed to identify bacterial pathogens, followed by antibiotic susceptibility testing using standard microbiological methods. Data collection was performed in accordance with the World Health Organization (WHO) guidelines for diagnosing neonatal sepsis.*

Results: *Out of 259 blood cultures analyzed, 52 (20%) showed no bacterial growth. The most frequently isolated pathogens were Escherichia coli (26.3%), Staphylococcus aureus (26.3%), and Klebsiella spp. (25.1%). Antibiotic susceptibility testing revealed that carbapenems demonstrated the highest efficacy, with a sensitivity rate of 25%. In contrast, third-generation cephalosporins and beta-lactam inhibitors showed the lowest sensitivity, at 3.9%. Gram-negative organisms, particularly E. coli and Klebsiella spp., exhibited concerning resistance patterns, with significant resistance to common first-line antibiotics, complicating treatment options.*

Conclusion: *This study offers valuable insights into the microbial etiology and antibiotic resistance profiles of neonatal sepsis pathogens. The findings underscore the growing threat of antibiotic resistance, particularly among gram-negative bacteria. These insights are crucial for informing local treatment protocols and can contribute to evidence-based guidelines for the management of neonatal sepsis, ultimately aiming to improve healthcare outcomes in affected neonates.*

Keywords: *Antibiotic resistance, Escherichia coli, Klebsiella spp., Neonatal sepsis, Staphylococcus aureus*

INTRODUCTION

Neonatal sepsis remains a major global health concern, significantly contributing to neonatal morbidity and mortality. It is a systemic infection caused by bacterial, viral, or fungal pathogens, leading to alterations in hemodynamic stability and manifesting with a wide range of clinical symptoms, from mild infections to severe, life-threatening conditions. The incidence of neonatal sepsis typically ranges from 1 to 5 cases per 1,000 live births, with variations depending on geographical region, healthcare infrastructure, and access to neonatal care (1). Pathogens causing neonatal sepsis may be acquired intrauterinely, from maternal flora, or from hospital- or community-acquired infections. Neonatal sepsis is classified into early-onset sepsis (EOS), late-onset sepsis (LOS), and very late-onset sepsis, with EOS generally occurring within the first 72 hours of life. EOS is primarily attributed to infections acquired during delivery, whereas LOS usually results from hospital-acquired pathogens emerging after 72 hours (2).

Numerous studies across different regions have highlighted the significant burden of neonatal sepsis and its associated microbial profiles, as well as the emerging patterns of antibiotic resistance. For example, a 2003 study at Khyber Teaching Hospital in Peshawar, Pakistan, involving 112 neonates, revealed that 59.8% had positive blood cultures, with Escherichia coli (77.6%) as the most frequently isolated pathogen. High resistance was noted to penicillin and cephalosporins (3). A similar study from India in 2010 found *Klebsiella pneumoniae* (47.1%) as the predominant pathogen in 46.2% of blood culture-positive neonatal sepsis cases (4). Furthermore, various studies across different regions have reported a high sensitivity of these pathogens to carbapenems and quinolones, yet simultaneously highlighted alarming resistance patterns among both Gram-positive and Gram-negative organisms (5-10).

The primary objective of this study is to identify the prevalence of various bacterial pathogens responsible for neonatal sepsis and evaluate the antibiotic susceptibility profiles of the isolated strains. Additionally, it aims to monitor emerging patterns of antibiotic resistance in cases of neonatal sepsis. By providing valuable insights into the microbial causes and resistance trends, this research seeks to assist healthcare providers in making informed decisions regarding the most effective antibiotic treatments for affected neonates.

MATERIALS AND METHODS

STUDY DESIGN, SETTING AND DURATION

A descriptive cross-sectional study was conducted.at Bacha Khan Medical Complex, Swabi. The study was carried out over a period of six months, commencing from the date of ethical approval.

SAMPLE SIZE CALCULATION

The sample size was determined using the WHO sample size formula via the OpenEpi calculator. An estimated population of 1,000,000 was assumed due to the lack of precise data on the total population of neonatal sepsis cases. With an anticipated frequency of 78.6% for Gram-negative bacterial isolates, a 5% margin of error, and a 95% confidence level, the calculated sample size was 259. Non-probability convenience sampling was employed.

INCLUSION AND EXCLUSION CRITERIA

The study included neonates who met the following criteria:

1. Patients admitted to the Nursery of Bacha Khan Medical Complex, Swabi.
2. Patients diagnosed with neonatal sepsis according to the WHO diagnostic criteria.
3. Neonates aged less than one month.

Outpatient cases were excluded from the study.

DATA COLLECTION, BACTERIAL CULTURING, AND ANTIBIOTIC SENSITIVITY TESTING

Ethical approval was obtained from the relevant review committee, and informed consent was secured from the guardians of all enrolled neonates. Demographic and clinical data were collected from the attendants of the neonates. Blood cultures were sent to the microbiology laboratory for the identification of the causative bacterial pathogens. The bacterial isolates were subsequently subjected to antibiotic sensitivity testing using standard procedures to assess susceptibility to a range of commonly prescribed antibiotics in the hospital (11). All testing followed established guidelines and protocols. Data were gathered using a structured questionnaire and were entered into SPSS for analysis.

STATISTICAL ANALYSIS

Statistical analysis was performed using the Chi-square test to examine possible associations between the type of neonatal sepsis (early or late onset) and the bacterial pathogens identified. Additionally, the Chi-square test was applied to assess the relationship between pregnancy term (preterm vs. full-term) and the type of neonatal sepsis.

RESULTS

The study included a total of 259 neonates, of which 135 (52.1%) were male and 124 (47.9%) were female. Among the participants, 32 (12.4%) were preterm, while 227 (87.6%) were born full-term. Out of the total, 60 neonates (26.6%) were diagnosed with early-onset neonatal sepsis, and 190 neonates (73.4%) had late-onset neonatal sepsis (Table I).

Table I. Demographic data on gender, type of neonatal sepsis, and pregnancy term

Variable	Category	Frequency	Percent
Gender of Neonate	Male	135	52.1
	Female	124	47.9
	Total	259	100.0
Type of neonatal sepsis	Early onset	69	26.6
	Late-onset	190	73.4
	Total	259	100.0
Pregnancy term	Preterm	32	12.4
	Full term	227	87.6
	Total	259	100.0

The ages of the participants ranged from 2 to 31 days, with a mean age of 10.69 days (± 7.1). Birth weights varied from 1.0 to 4.0 kg, with a mean weight of 2.705 kg. Total leukocyte counts (TLC) ranged from 1,000 to 34,000/mm^3, yielding a mean TLC of 11,467. C-reactive protein (CRP) levels fluctuated between 7 and 85, with a mean of 29.39 (Table II).

Table II. Descriptive statistics for age, birth weight, TLC count, and CRP count

Variable	Number of cases	Minimum	Maximum	Mean	Standard deviation
Age (in days)	259	2	31	10.69	7.147
Birth Weight (in Kg)	259	1.0	4.0	2.705	.5975
TLC Count	259	1,000	34,000	17,114.67	13,014.968
C-Reactive Protein Count	259	7	85	29.39	17.496

Fever was the most frequently reported clinical symptom, observed in 78 cases (30.1%). A combination of fever and seizures was noted in 64 cases (24.7%), while respiratory distress was reported in 36 neonates (13.9%). Other common symptoms included poor feeding/lethargy (8.5%), vomiting (5.8%), vomiting with fever (3.1%), and vomiting with lethargy (1.5%) (Fig.1). Of the 259 blood samples sent for culture and sensitivity testing, 52 samples (20%) showed no bacterial growth.

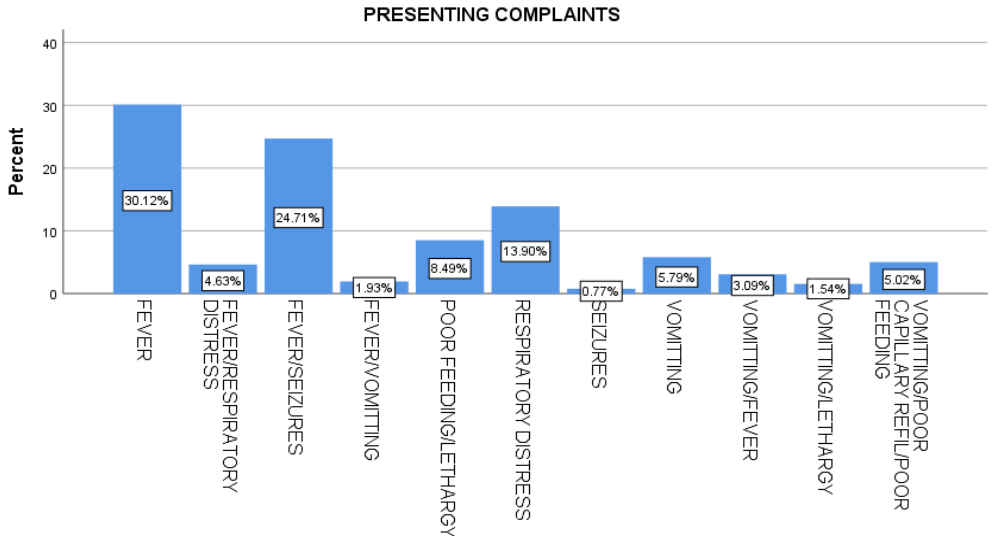

Fig. 1. Presenting complaints. This figure shows the percentage distribution of presenting complaints among neonates, with fever being the most common (30.1%), followed by fever with seizures (24.7%) and respiratory distress (13.9%). The chart highlights the key clinical symptoms associated with neonatal sepsis.

The most frequently isolated gram-negative organism was *Escherichia coli*, detected in 68 cases (26.3%), and followed by *Klebsiella spp.* in 65 cases (25.1%), with *Klebsiella pneumoniae* accounting for 6 cases

(2.3%). The predominant gram-positive pathogen was *Staphylococcus aureus*, also identified in 68 cases (26.3%) (Fig. 2).

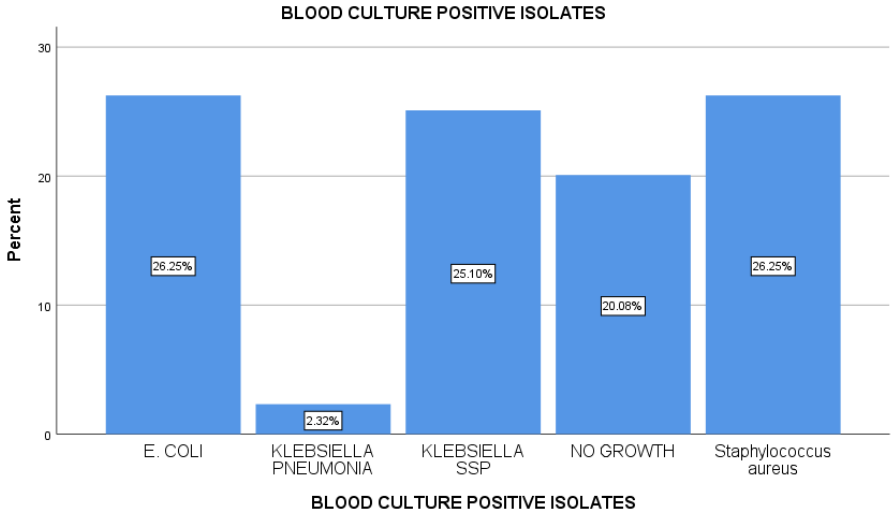

Fig. 2. Isolated bacterial strains. This figure displays the distribution of bacterial strains isolated from neonates, emphasizing the prevalence of Escherichia coli and Staphylococcus aureus. It visually represents the relative frequencies of each strain, illustrating the microbial landscape associated with neonatal sepsis in the study population.

Regarding antibiotic sensitivity, carbapenems exhibited the highest efficacy, with a sensitivity rate of 25%. This was followed by aminoglycosides at 13.1%, lipopeptides at 11.2%, tetracyclines at 11.6%, and third-generation cephalosporins and beta-lactam inhibitors, both of which had a sensitivity rate of 3.9% (Fig. 3).

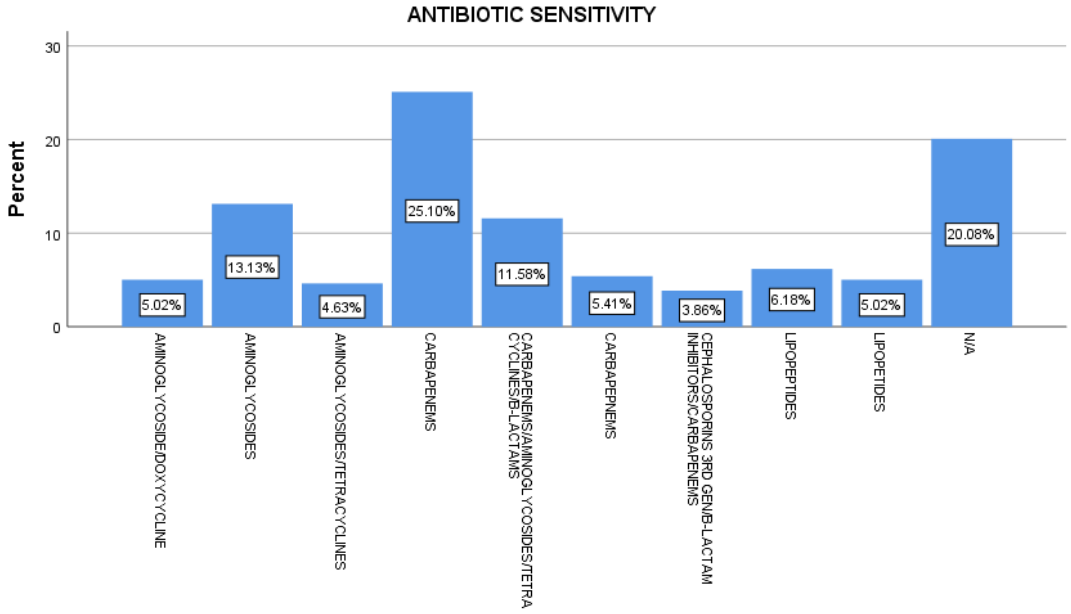

Fig. 3. Antibiotic sensitivity. The figure displays the sensitivity percentages of bacterial isolates to various antibiotics. Carbapenems showed the highest sensitivity at 25.1%, followed by Aminoglycosides at 13.1% and Aminoglycosides with Tetracyclines at 11.8%. Other antibiotics, such as Carbapenems with Beta-Lactams and Lipopeptides, also exhibited significant sensitivity. This highlights the effectiveness of these antibiotics for treating neonatal sepsis.

Statistical analysis using the Chi-square test was performed to examine possible associations between the type of neonatal sepsis (early or late onset) and the identified bacterial pathogens. The results indicated no significant association, with a p-value of 0.58. Similarly, the Chi-square test assessing the relationship between pregnancy term (preterm vs. full-term) and the type of neonatal sepsis yielded a p-value of 0.21, indicating no significant association between these variables.

DISCUSSION

Neonatal sepsis remains a leading cause of morbidity and mortality among newborns, underscoring the necessity to understand the bacterial pathogens involved and their resistance profiles for effective

management (12). This study aimed to identify prevalent bacterial strains and evaluate their antibiotic sensitivity in neonates with suspected sepsis at Bacha Khan Medical Complex. The findings provide critical insights into the local microbial landscape and emerging resistance trends, essential for informing empirical therapy in neonatal care. By enhancing our understanding of these factors, this research contributes to improving treatment outcomes and addressing the challenges posed by antibiotic resistance in this vulnerable population.

Eysus *et al.* 2017 reported bacterial growth in 117 out of 251 suspected sepsis cases, with gram-positive organisms comprising 67.5% and gram-negative organisms 18.5% (9). In contrast, our study revealed a higher bacterial growth rate, with 207 (80%) of 259 blood samples testing positive for infections. Notably, 53.6% of these isolates were gram-negative bacteria, while gram-positive organisms accounted for 26.25%. This discrepancy may indicate regional variations in pathogen distribution, differences in healthcare practices, or variations in neonatal care environments. The increased prevalence of gram-negative organisms, including *Escherichia coli* and *Klebsiella spp.*, underscores their growing significance in neonatal sepsis.

Mia *et al.*, 2017 found that Klebsiella pneumoniae was the most commonly isolated pathogen in 50 positive cultures from 120 suspected cases, accounting for 66%, followed by Staphylococcus spp. at 12% (13). In our study, E. coli and Staphylococcus aureus were identified in 26.25% of cases, with Klebsiella spp. at 25.1%. These results emphasize the variability in microbial etiology across regions and highlight the need for local surveillance to inform tailored treatment protocols in neonatal care.

Fahmey *et al.* 2013 reported that a majority of bacterial isolates were resistant to ampicillin (93%), while most were sensitive to imipenem, cefepime, and ciprofloxacin. Similarly, our study found that carbapenems were the most effective antibiotics, followed by aminoglycosides (14). However, we noted that third-generation cephalosporins exhibited the lowest sensitivity. These findings underscore the ongoing concern of antibiotic resistance, particularly in hospital-acquired infections where pathogens are often exposed to broad-spectrum antibiotics. The emerging resistance to common first-line treatments, such as cephalosporins and ampicillin, highlights the urgent need for continuous surveillance and the implementation of more targeted antibiotic therapies.

Overall, this study contributes to the growing body of evidence on neonatal sepsis, offering a snapshot of the local bacterial profile and antibiotic resistance trends. These insights are crucial for optimizing treatment strategies, reducing mortality rates, and combating the rising threat of antibiotic-resistant pathogens in neonatal care.

To mitigate antibiotic resistance, implementing local antibiotic stewardship policies is crucial to promote the judicious use of antibiotics (15, 16). These strategies should include regular monitoring of resistance patterns, guidelines for empirical therapy based on local data, and education for healthcare providers on appropriate prescribing practices. By tailoring antibiotic use to the specific microbial landscape of the community, we can enhance treatment efficacy and reduce the emergence of resistant strains.

CONCLUSION

This study highlights the critical need for continuous monitoring of bacterial pathogens and their resistance profiles to guide effective treatment strategies for neonatal sepsis. Our findings provide valuable insights into the prevalent bacterial strains and their antibiotic sensitivity patterns in neonates at Bacha Khan Medical Complex. This data is essential for optimizing empiric antibiotic therapy and improving outcomes for neonates with sepsis in this setting.

Limitations:

This study was conducted at a single medical center, limiting the generalizability of the findings to other regions or healthcare settings. The cross-sectional design provides a snapshot of bacterial pathogens at a specific time point and does not capture temporal variations. Blood cultures, while standard, may not detect all pathogens, and the study lacked advanced molecular techniques like PCR, potentially missing fastidious or novel organisms. Additionally, antibiotic sensitivity testing was based on disk diffusion, which may not

fully reflect in vivo efficacy. Future studies with broader sampling, longitudinal design, and advanced diagnostic tools are needed.

Conflict of Interest:

The authors have no conflict of interest.

Funding:

This study did not receive funding from any individual or organization.

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