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ASSESSMENT OF STAPHYLOCOCCUS AUREUS PREVALENCE AND ANTIBIOTIC SENSITIVITY IN LATE-ONSET SEPSIS

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Abstract

Objective: *To assess the prevalence of Staphylococcus aureus infection in neonates with late-onset sepsis (LOS) and evaluate the antibiotic susceptibility patterns of the isolates.*

Methods: *This cross-sectional study included 161 neonates aged 4–28 days admitted with LOS to the NICU of Nishtar Hospital, Multan, between November 2023 and November 2024. Venous blood samples were collected and analyzed in the hospital laboratory to detect Staphylococcus aureus and determine its antibiotic susceptibility.*

Results: *The mean age of the neonates was 14.93 ± 7.41 days, with an average gestational age of 37.3 ± 1.8 weeks. Of the participants, 100 (62.1%) were male and 61 (37.9%) were female. Staphylococcus aureus was isolated in 18 (11.2%) cases. Antibiotic susceptibility testing revealed the highest sensitivity to vancomycin (94.4%), followed by amikacin (83.3%) and clindamycin (72.2%). Co-amoxiclav showed moderate sensitivity* ***at 50%.***

Conclusion: *Staphylococcus aureus is a notable pathogen in neonatal late-onset sepsis. Vancomycin, amikacin, clindamycin, and co-amoxiclav demonstrated good efficacy against these isolates, supporting their use in empirical or targeted therapy.*

INTRODUCTION

Neonatal sepsis is a serious condition characterized by a widespread inflammatory response caused by infection in newborns. It remains a leading cause of death among infants worldwide, especially in developing countries, accounting for approximately 30% to 50% of infant mortality in these regions.[1, 2] The classification of neonatal sepsis is based on the timing of disease onset after birth. Typically, healthcare providers define early-onset sepsis (EOS) as occurring within the first 72 hours of life, while late-onset sepsis (LOS) is diagnosed if symptoms appear after this period.[3, 4]

Approximately 70% of LOS infections are caused by Gram-positive bacteria, with coagulase-negative staphylococci accounting for about two-thirds of these cases. Staphylococcus aureus (SA) is the second most common pathogen involved. In infants within their first month, SA sepsis is characterized by positive blood cultures combined with clinical signs of illness.[5] This infection can lead to severe complications such as pneumonia, osteomyelitis, septic arthritis, and endocarditis.[6] Additionally, any neonatal sepsis significantly raises the risk of long-term neurodevelopmental issues.[7]

There is no universally accepted standard for the most effective empirical antibiotic treatment for neonatal sepsis. Selection of appropriate antibiotics should be guided by local bacterial prevalence and resistance patterns. According to regional guidelines, initial therapy often involves Vancomycin and Gentamicin for late-onset sepsis, while Penicillin combined with Gentamicin is typically used for early-onset cases, pending results from blood cultures and susceptibility testing.[8]

The patterns of antibiotic sensitivity and resistance are constantly evolving, making ongoing and rigorous monitoring crucial. Such surveillance not only helps document the scope of the problem but also ensures that vulnerable neonates receive appropriate treatment. It is especially important to monitor for Staphylococcus aureus, particularly strains that are resistant to methicillin and vancomycin, as these cases must be reported to infectious disease authorities. This study has two primary objectives: first, to determine the prevalence of Staphylococcus aureus infections in neonates with late-onset sepsis; and second, to assess the effectiveness of various antibiotics against Staphylococcus aureus in this vulnerable population.

METHODS:

In this cross-sectional study, we included 161 neonates of age 4 to 28 days admitted with LOS. These neonates were selected from the NICU of Nishtar Hospital, Multan from November-2023 to November-2024. Neonates who were taking antibiotics at the time of admission or those who had congenital anomalies were excluded.

In this study, baseline characteristics such as age (measured in days), gestational age at birth (in weeks), gender (male or female), birth weight (in grams), mode of delivery (vaginal or cesarean section), history of previous hospitalizations, and prior episodes of premature rupture of membranes (PROM) were recorded. For blood culture collection, two venous blood samples of 5cc each were obtained using aseptic techniques and immediately placed into culture bottles. These samples were then transported to the laboratory for analysis. The culture bottles were loaded into an automated blood culture system that continuously monitored for microbial growth without the need for manual intervention. When a culture was flagged as positive, a laboratory technologist performed gram staining and sub-cultured the broth onto blood agar plates for further analysis. The growth of Staphylococcus aureus was confirmed using the coagulase test. Additionally, antibiotic susceptibility testing was carried out on the isolates against a panel of antibiotics including amikacin, co-amoxiclav, ceftriaxone, cefotaxime, ceftazidime, ciprofloxacin, clindamycin, gentamicin, methicillin, ofloxacin, oxacillin, and vancomycin. This testing was performed using the disk diffusion method and was documented accordingly.

RESULTS:

The average age of babies was 14.93 (±7.41) days, with an average gestational age of 37.3 (±1.8) weeks. In terms of gender, there were 100 (62.1%) male babies and 61 (37.9%) female babies. The average weight of the subjects was 2.4 (±0.7) kg. As for delivery method, 112 (69.6%) participants were born vaginally, and 49 (30.4%) had a cesarean section. Additionally, 38 (23.6%) participants reported a history of premature rupture of membranes (PROM), while 123 (76.4%) reported no such history. Lastly, Staphylococcus Aureus growth was found in 18 (11.2%) participants, and 143 (88.8%) participants showed no such growth (Table 1).

The antibiotic sensitivity pattern of Staphylococcus aureus shows varying effectiveness among different antibiotics. Vancomycin had the highest sensitivity, with 94.4% of strains responding to it. Amikacin followed with an 83.3% sensitivity rate, while Clindamycin showed a 72.2% sensitivity. Co-amoxiclav had a moderate response, with 50% of strains being sensitive. In contrast, Ofloxacin and Oxacillin exhibited lower sensitivity rates of 33.3% each. Further down the list, Ceftriaxone and Cefotaxime showed sensitivities of 27.7% and 16.7%, respectively. Ciprofloxacin, Methicillin, and Ceftazidime all had similar low sensitivity levels of 16.7%, while gentamicin was the least effective, with only 5.5% of strains being sensitive (Table 2).

Table 1. Baseline Characteristics.

Age (days)	14.93±7.41
Gestational Age (Weeks)	37.3±1.8
Gender (Male/Female)	100 (62.1%) / 61 (37.9%)
Weight (Kg)	2.4±0.7
Mode of Delivery (%)	
Vaginal	112 (69.6%)
Cesarean Section	49 (30.4%)
History of PROM (%)	
Yes	38 (23.6%)
No	123 (76.4%)
Staphylococcus Aureus Growth (%)	
Yes	18 (11.2%)
No	143 (88.8%)

Table 2. Antibiotic sensitivity pattern of Staphylococcus Aureus.

Antibiotic	Sensitive (%)
Vancomycin	17 (94.4%)
Amikacin	15 (83.3%)
Clindamycin	13 (72.2%)
Co-amoxiclav	9 (50%)
Ofloxacin	6 (33.3%)
Oxacillin	6 (33.3%)
Ceftriaxone	5 (27.7%)
Cefotaxime	3 (16.7%)
Ciprofloxacin	3 (16.7%)
Methicillin	3 (16.7%)
Ceftazidime	2 (11.1%)
Gentamicin	1 (5.5%)

DISCUSSION:

Infants are generally more vulnerable to infections compared to adults, primarily due to their immature immune systems. This vulnerability makes conditions like sepsis particularly dangerous for newborns, especially in settings with inadequate hygiene. Before the advent of antibiotics, mortality rates from neonatal sepsis were extremely high, often exceeding 90%. However, with the widespread use of antibiotics, these rates have significantly declined to a range between 10% and 50%, as documented in studies by Rubin and Yalaz. The most reliable method for diagnosing sepsis is blood culture, which remains the gold standard. In advanced medical centers, blood cultures yield positive results in approximately 80% of true cases.[9-11]

The primary approach for diagnosing sepsis involves the identification of pathogens through blood cultures. Since infants do not exhibit specific signs or symptoms that distinctly point to sepsis, thorough laboratory investigations are crucial, requiring facilities equipped for such analyses. A study conducted in Nepal indicated that certain clinical indicators—such as difficulty feeding, lethargy, convulsions, elevated respiratory rates, and cyanosis—are strongly linked to culture-confirmed early-onset sepsis. In contrast, signs like hypothermia, chest retraction, redness around the umbilical area, and jaundice are associated with the late-onset variety of sepsis. For the treatment of sepsis in neonates, empirical therapy is administered based on the guidelines set forth by the World Health Organization (WHO) Integrated Management of

Neonatal and Childhood Illness (IMNCI) protocol, which focuses on the early detection of serious conditions, including severe bacterial infections.[12, 13]

In present study, the frequency of SA infection was 11.2%. A study assessed 658 children (47.1% male, 52.9% female) amongst which 72% children had positive bacterial growth and reported that the frequency of Staphylococcus aureus being the culprit organism is neonatal sepsis was 20.4%.[14] In another study, it was found that amongst 140 neonatal sepsis cases (85 male and 55 female), 54 neonates had late onset sepsis and amongst these frequency of Staphylococcus aureus was 10.71%.[15] In another study which included 2514 neonates, 528 (21%) [364 male and 164 female] had neonatal sepsis. Amongst these, 171 (32.4%) had late onset sepsis, in which the frequency of Staphylococcus aureus was much less as compared to the aforementioned frequencies and was reported at 16/171 (9.35%).[16]

In our study, the following antibiotics had the highest sensitivity against SA, Vancomycin was sensitive against 94.4% cases, amikacin was sensitive against 83.3% cases, clindamycin was sensitive against 72.2% cases, and co-amoxiclav was sensitive against 50.0% cases.

In another study, sensitivity of Staphylococcus aureus to various antibiotics was given as follows: amikacin (85%), co-amoxiclav (47.1%), ceftriaxone (26.4%), cefotaxime (16.9%), ceftazidime (11.3%), ciprofloxacin (16.9%), clindamycin (66%), gentamicin (5.6%), methicillin (15%), ofloxacin (32%), oxacillin (30.1%) and vancomycin (88.67%) [7]. Most important and worrying finding was such high frequency of methicillin resistant Staphylococcus aureus (MRSA).[17]

CONCLUSION:

Staphylococcus aureus (SA) is a frequent cause of neonatal sepsis. The antibiotics vancomycin, amikacin, clindamycin, and co-amoxiclav have shown good effectiveness against SA.

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