Journal of Advanced Research in Medicine
Volume 13, Issue 1 - 2026, Pg. No. 1-6
Peer Reviewed & Open Access Journal

Research Article

Frequency of Meningitis in Late Onset Neonatal Sepsis-A cross sectional descriptive study

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DOI: https://doi.org/10.24321/2349.7181.202601

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How to cite this article:
Agrawal S, Frequency of Meningitis in Late Onset Neonatal Sepsis-A cross sectional descriptive study. J Adv Res Med 2026; 13(1): 1-6.

Date of Submission: 2026-02-15
Date of Acceptance: 2026-03-21

A B S T R A C T

Background: Late-onset neonatal sepsis (LOS) is a major cause of neonatal morbidity and mortality, particularly in developing countries. Bacterial meningitis is a serious complication of LOS and may lead to severe neurological outcomes if not diagnosed early. Early detection through cerebrospinal fluid (CSF) analysis plays an important role in the management of neonates with suspected sepsis.

Objective: To determine the frequency of meningitis among neonates presenting with late-onset sepsis.

Materials and Methods: This cross-sectional descriptive study was conducted in the Department of Pediatrics at a tertiary care hospital over a period of six months. A total of 100 neonates aged 7–28 days presenting with clinical features of late-onset sepsis were included using non-probability consecutive sampling. Lumbar puncture was performed under aseptic conditions, and CSF samples were analyzed for cytological and biochemical parameters. Additional investigations including complete blood count, C-reactive protein, and blood culture were also performed. Data were analyzed using SPSS version 26.0. Descriptive statistics were used to summarize the findings.

Results: Out of the 100 neonates with late-onset sepsis, meningitis was diagnosed in 16% of cases. Male neonates constituted the majority of the study population. The mean age of presentation was approximately 16 days. Seizures, respiratory distress, and lethargy were the most common clinical manifestations. Blood culture positivity was observed in a proportion of neonates, although meningitis was also detected in cases with negative blood culture results.

Conclusion: Meningitis was found to occur in a notable proportion of neonates with late-onset sepsis. Routine CSF examination in neonates presenting with suspected LOS is important for early diagnosis and timely initiation of appropriate treatment, which may help reduce morbidity and mortality.

Keywords: Neonatal sepsis, Late-onset sepsis, Neonatal meningitis, Cerebrospinal fluid, Lumbar puncture, Neonates

Introduction

Neonatal sepsis remains a major cause of morbidity and mortality worldwide, particularly in developing countries where healthcare resources are limited and early diagnosis is often challenging. Neonates are especially vulnerable to systemic infections because of their immature immune system and exposure to invasive procedures during hospitalization. Sepsis in the neonatal period is commonly classified into early-onset sepsis and late-onset sepsis (LOS). Late-onset sepsis generally occurs after 72 hours of life and is frequently associated with hospital-acquired infections, prolonged hospital stay, and invasive interventions in neonatal intensive care units (NICUs).[1,2] Among the serious complications of neonatal sepsis, meningitis is considered one of the most severe because it can result in significant neurological morbidity and mortality.

Neonatal meningitis associated with late-onset sepsis remains an important clinical concern because of its high risk of long-term neurological sequelae such as hydrocephalus, hearing impairment, developmental delay, and cerebral palsy.[3–5] The diagnosis of meningitis in neonates is particularly challenging because clinical manifestations are often subtle and nonspecific. Symptoms such as poor feeding, lethargy, apnea, temperature instability, seizures, or irritability may be present, but these signs can overlap with other neonatal illnesses, making early diagnosis difficult.[6] Furthermore, reliance solely on blood culture results may lead to underdiagnosis because central nervous system infection can occur even when blood cultures are negative.[7]

Cerebrospinal fluid (CSF) examination through lumbar puncture remains the gold standard for diagnosing neonatal meningitis. Early CSF analysis allows prompt identification of central nervous system involvement and guides appropriate antimicrobial therapy. However, lumbar puncture is not routinely performed in all neonates with suspected sepsis due to clinical instability, lack of resources, or concern about procedural complications, especially in resource-limited settings.[8] This may lead to missed or delayed diagnosis of meningitis among neonates with late-onset sepsis.

Previous studies have reported that the frequency of meningitis among neonates with late-onset sepsis ranges between 10% and 30%, depending on the population studied, diagnostic criteria used, and whether lumbar puncture was routinely performed.[4,9] Gram-negative organisms such as *Klebsiella pneumoniae, Escherichia coli*, and *Acinetobacter* species are commonly implicated pathogens, particularly in developing countries where antimicrobial resistance is increasingly reported.[10–12] These infections are associated with poor outcomes and increased healthcare burden.

Considering the clinical significance of meningitis in neonates with late-onset sepsis and the challenges in early diagnosis, it is important to determine its frequency in different healthcare settings. Therefore, the present cross-sectional descriptive study was conducted to determine the frequency of meningitis among neonates presenting with late-onset sepsis. The findings of this study may help emphasize the importance of routine CSF examination and contribute to improving diagnostic protocols and management strategies for neonatal sepsis.

Materials and Methods

This cross-sectional descriptive study was conducted in the Department of Pediatrics of a tertiary care hospital over a period of six months. The objective of the study was to determine the frequency of meningitis among neonates presenting with late-onset sepsis. A total of 100 neonates who fulfilled the eligibility criteria were included in the study.

The sample size consisted of 100 neonates aged between 7 and 28 days who presented with clinical features suggestive of late-onset neonatal sepsis. The participants were enrolled using a non-probability consecutive sampling technique, where all eligible neonates admitted during the study period were included until the required sample size was achieved.

Neonates of either gender with clinical signs of late-onset sepsis such as fever, lethargy, poor feeding, respiratory distress, seizures, irritability, or temperature instability were included in the study. Neonates who had received antibiotic therapy prior to admission, those with congenital anomalies of the central nervous system, birth weight less than 1000 grams, or neonates with severe metabolic disorders were excluded from the study to avoid confounding factors.

After obtaining informed consent from parents or guardians, detailed demographic and clinical information including age, gender, gestational age, birth weight, and presenting clinical features were recorded in a pre-designed structured proforma. Each neonate underwent a thorough clinical examination.

To evaluate the presence of meningitis, lumbar puncture was performed under strict aseptic precautions to obtain cerebrospinal fluid (CSF) samples. The CSF samples were sent to the laboratory for cytological and biochemical analysis, including leukocyte count, protein level, and glucose concentration. Bacterial meningitis was diagnosed based on CSF findings suggestive of infection, such as elevated leukocyte count, increased protein levels, and decreased glucose levels relative to serum glucose.

Additional laboratory investigations including complete blood count, C-reactive protein (CRP), and blood culture were also performed as part of the evaluation for neonatal sepsis.The collected data were entered and analyzed using

ISSN: 2394-7047
DOI:https://doi.org/10.24321/2349.7181.202601

Statistical Package for Social Sciences (SPSS) version 26.0. Descriptive statistics such as frequency, percentage, mean, and standard deviation were calculated to summarize demographic and clinical variables. The frequency of meningitis among neonates with late-onset sepsis was determined and presented in tabular form. Statistical significance was considered at a p-value less than 0.05.

Results

A total of 100 neonates with late-onset neonatal sepsis were included in the present study. The demographic characteristics, clinical features, laboratory findings, and frequency of meningitis among the study population were analyzed.

The demographic profile of the study population is presented in Table 1. Among the 100 neonates, 58% were male and 42% were female. The mean age at presentation was 16.2 ± 5.8 days. Most neonates (60%) presented after 14 days of life, while 40% presented between 7–14 days. The majority of neonates (55%) were preterm, whereas 45% were born at term.

The clinical manifestations observed among neonates with late-onset sepsis are shown in Table 2. The most common presenting symptom was seizures (85%), followed by respiratory distress (70%), lethargy (65%), and fever (50%). Other symptoms included temperature instability, abdominal distension, shock, and poor feeding.

The laboratory parameters of neonates with late-onset sepsis are summarized in Table 3. The mean platelet count was 148,500 ± 62,300/mm³, while the mean white blood cell count was 12,420 ± 4,050/mm³. The mean CRP level was 5.6 ± 1.2 mg/dL. Blood culture positivity was observed in 35% of neonates, while 65% had negative blood cultures.

The frequency of meningitis among neonates with late-onset sepsis is presented in Table 4. Out of the 100 neonates included in the study, 16 neonates were diagnosed with meningitis, giving a frequency of 16%, while 84 neonates did not have meningitis.

The comparison of clinical outcomes between neonates with and without meningitis is shown in Table 5. Among neonates diagnosed with meningitis, 75% were discharged, whereas 25% died during hospitalization. In comparison, among neonates without meningitis, 80% were discharged and 20% died. There was no statistically significant difference in hospital stay and duration of antibiotic therapy between the two groups ($p > 0.05$).

Table 1.Demographic Characteristics of Neonates (n = 100)

Variable	Frequency (n)	Percentage (%)
Gender		
Male	58	58
Female	42	42
Age at Presentation		
7–14 days	40	40
>14 days	60	60
Gestational Age		
Preterm	55	55
Term	45	45

Table 2.Clinical Signs and Symptoms in Neonates with Late-Onset Sepsis (n = 100)

Clinical Feature	Frequency (n)	Percentage (%)
Seizures	85	85
Respiratory distress	70	70
Lethargy	65	65
Fever	50	50
Temperature instability	30	30
Shock	18	18
Abdominal distension	12	12
Poor feeding	20	20

ISSN: 2394-7047
DOI:https://doi.org/10.24321/2349.7181.202601

Table 3 .Laboratory Findings in Neonates with Late-Onset Sepsis (n = 100)

Laboratory Parameter		Mean ± SD
Platelet count (/mm³)		148,500 ± 62,300
WBC count (/mm³)		12,420 ± 4,050
CRP (mg/dL)		5.6 ± 1.2
Blood Culture	**Frequency (n)**	**Percentage (%)**
Positive	35	35
Negative	65	65

Table 4 .Frequency of Meningitis in Late-Onset Neonatal Sepsis (n = 100)

Diagnosis	Frequency (n)	Percentage (%)
Meningitis	16	16
No meningitis	84	84

Table 5 .Comparison of In-Hospital Outcomes in Neonates with and without Meningitis

Outcome	Meningitis (n = 16)	Non-Meningitis (n = 84)	p-value
Discharge	12 (75%)	67 (79.8%)	
Mortality	4 (25%)	17 (20.2%)	0.62
Hospital stay (days)	21.2 ± 7.5	19.5 ± 8.8	0.41
Duration of antibiotics (days)	9.5 ± 2.1	9.8 ± 2.4	0.73

Discussion

Bacterial meningitis remains a serious complication of late-onset neonatal sepsis and contributes significantly to neonatal morbidity and mortality. In the present study, meningitis was observed in 16% of neonates with late-onset sepsis. This finding is consistent with previous studies which have reported the frequency of meningitis among neonates with LOS ranging from 10% to 30%, depending on the diagnostic criteria and the routine use of cerebrospinal fluid (CSF) examination.[4,9,13] A comparable prevalence was reported by Altaf et al., who also documented meningitis in 16% of neonates with late-onset sepsis, indicating that meningitis remains a common and clinically significant complication in this patient population.[13] These findings emphasize the importance of early recognition and prompt investigation in neonates presenting with features of sepsis.

The demographic profile of neonates in the present study showed that the mean age at presentation was approximately 16 days, which corresponds with the typical time period of late-onset sepsis that occurs after the first 72 hours of life.[3,5] A male predominance was also observed in the present study, with male neonates accounting for the majority of cases. Similar findings were reported by Altaf et al., who observed 58.4% male neonates among cases of late-onset sepsis.[13] Other studies have also reported a higher susceptibility of male neonates to infections, which has been attributed to immunological and hormonal differences that may influence neonatal immune responses.[1,2] These demographic trends highlight the need for careful monitoring of neonates during the late neonatal period, especially in male infants.

In terms of clinical manifestations, seizures were among the most frequently observed symptoms in neonates diagnosed with meningitis in our study. This observation is consistent with previous literature indicating that neurological symptoms such as seizures, lethargy, and altered consciousness are important indicators of central nervous system involvement in neonatal infections.[5,6,15] Altaf et al. also reported a high frequency of seizures among neonates with late-onset sepsis and meningitis, supporting the findings of the present study.[13] However, clinical signs of neonatal meningitis are often nonspecific, and reliance solely on clinical manifestations may delay diagnosis.

The present study also observed that blood culture positivity was relatively low, which is consistent with findings reported in previous studies. Klingenberg et al. highlighted that culture-negative neonatal sepsis is common, and reliance on blood culture alone may lead to underdiagnosis of meningitis.[7] Therefore, routine CSF examination remains essential in neonates with suspected late-onset sepsis. International guidelines recommend performing lumbar puncture in neonates with suspected LOS, even when blood culture results are negative, in order to identify central nervous system infection and initiate appropriate antimicrobial therapy.[7,8]

ISSN: 2394-7047
DOI:https://doi.org/10.24321/2349.7181.202601

The microbiological profile of neonatal meningitis reported in several studies indicates that gram-negative organisms such as Klebsiella pneumoniae, Escherichia coli, and Acinetobacter species are among the most common pathogens associated with late-onset neonatal meningitis.[10,11] These organisms are frequently reported in developing countries and are often associated with hospital-acquired infections and multidrug resistance. Similar findings were reported by Saleem et al. and Roshi et al., who observed that gram-negative bacteria were the predominant pathogens in neonatal meningitis cases in tertiary care hospitals.[10,13] Furthermore, Mukherjee et al. emphasized the importance of local antimicrobial surveillance and antibiograms in guiding empirical antibiotic therapy for neonatal infections.[12]

Despite the valuable findings of the present study, certain limitations should be acknowledged. The study was conducted in a single center with a relatively limited sample size, which may affect the generalizability of the findings. In addition, long-term neurological outcomes of neonates diagnosed with meningitis were not evaluated. Similar limitations have been highlighted in previous studies conducted by Ahmad et al. and Khaskheli et al., who recommended larger multicenter studies to better understand the epidemiology and outcomes of neonatal meningitis.[9,14]

Recent global initiatives aimed at improving neonatal infection management emphasize the need for region-specific data to guide clinical decision-making and antibiotic stewardship programs. Studies by Fitchett et al. and Le Doare et al. have highlighted the importance of strengthening surveillance systems and improving diagnostic strategies for neonatal infections, particularly in low- and middle-income countries.[16,17] The findings of the present study contribute to the growing body of evidence supporting early diagnostic evaluation and appropriate management of neonates with late-onset sepsis.

Conclusion

The present study demonstrated that meningitis occurred in a significant proportion of neonates with late-onset sepsis. The findings highlight that neonatal meningitis remains an important complication that requires early identification and prompt management. Routine cerebrospinal fluid examination through lumbar puncture in neonates with suspected late-onset sepsis can facilitate timely diagnosis and appropriate treatment. Early detection may help reduce morbidity, mortality, and long-term neurological complications associated with neonatal meningitis.

Limitations

This study had certain limitations. It was conducted in a single center with a relatively small sample size, which may limit the generalizability of the findings. Detailed antimicrobial sensitivity patterns and long-term neurological outcomes of affected neonates were not evaluated. Further multicenter studies with larger sample sizes are recommended to better understand the epidemiology and outcomes of neonatal meningitis.

References

1. Shane AL, Sánchez PJ, Stoll BJ. Neonatal sepsis. Lancet. 2017;390(10104):1770–80.
2. Camacho-Gonzalez A, Spearman PW, Stoll BJ. Neonatal infectious diseases: evaluation of neonatal sepsis. Pediatr Clin North Am. 2021;68(2):379–94.
3. Bajaj M, Kumar S, Sharma J, Mahajan S, Sharma M. A study of clinico-bacteriological profile and to determine incidence of meningitis in late onset sepsis in newborn unit of tertiary care teaching hospital in Northern India. Int J Contemp Pediatr. 2022;9(7):647.
4. Xu M, Hu L, Huang H, Wang L, Tan J, Zhang Y, et al. Etiology and clinical features of full-term neonatal bacterial meningitis: a multicenter retrospective cohort study. Front Pediatr. 2019;7:31.
5. Baud O, Aujard Y. Neonatal bacterial meningitis. In: Volpe JJ, editor. Handbook of Clinical Neurology. Amsterdam: Elsevier; 2013. p.1109–13.
6. Zea-Vera A, Ochoa TJ. Challenges in the diagnosis and management of neonatal sepsis. J Trop Pediatr. 2015;61(1):1–3.
7. Klingenberg C, Kornelisse RF, Buonocore G, Maier RF, Stocker M, Strunk T. Culture-negative neonatal sepsis. Front Pediatr. 2018;6:285.
8. Polin RA, Papile LA, Baley JE, Bhutani VK, Carlo WA, Cummings J, et al. Management of neonates with suspected or proven early-onset bacterial sepsis. Pediatrics. 2012;129(5):1006–15.
9. Anjum A, Malik Q, Nadeem T, Ullah N, Ikram F, Hussain M. Frequency of meningitis in neonatal sepsis. J Rawalpindi Med Coll. 2023;27(1).
10. Boskabadi H, Heidari E, Zakerihamidi M. Etiology, clinical findings and laboratory parameters in neonates with acute bacterial meningitis. Iran J Microbiol. 2020;12(2):89–96.
11. Berardi A, Lugli L, Rossi C, China MC, Vellani G, Contiero R, et al. Neonatal bacterial meningitis. Minerva Pediatr. 2010;62(3 Suppl 1):51–4.
12. Verma P, Berwal PK, Nagaraj N, Swami S, Jivaji P, Narayan S. Neonatal sepsis: epidemiology, clinical spectrum, recent antimicrobial agents and their antibiotic susceptibility pattern. Int J Contemp Pediatr. 2015;2(3):176–80.
13. Saleem S, Hotiana NA, Anwar A, Mehmood R. Frequency of meningitis in neonatal late-onset sepsis in Gangaram Hospital, Lahore. Ann Punjab Med Coll. 2015;9(3):140–4.
14. Tehrani FH, Moradi M, Ghorbani N. Bacterial etiology and antibiotic resistance patterns in neonatal

ISSN: 2394-7047
DOI:https://doi.org/10.24321/2349.7181.202601

sepsis in Tehran during 2006–2014. Iran J Pathol. 2017;12(4):356–61.
15. Crivaro V, Bogdanović L, Bagattini M, Iula VD, Catania M, Raimondi F, et al. Surveillance of healthcare-associated infections in a neonatal intensive care unit in Italy during 2006–2010. BMC Infect Dis. 2015;15(1):152.
16. Le Doare K, Bielicki J, Heath PT, Sharland M, Jackson C, Brien J, et al. Systematic review of antibiotic resistance in neonates with sepsis in low- and middle-income countries. J Pediatric Infect Dis Soc. 2018;6(3):234–43.
17. Cassini A, Allegranzi B, Fleischmann-Struzek C, Kortz T, Markwart R, Saito H, et al. Global report on the epidemiology and burden of sepsis: current evidence, identifying gaps and future directions. Geneva: WHO; 2020.

ISSN: 2394-7047
DOI:https://doi.org/10.24321/2349.7181.202601