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Original Research Article

Clinical Profile and Outcome of Acute Meningitis Patients Admitted to the Intensive Care Unit

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Abstract:

Background: Acute meningitis is a life-threatening neurological emergency associated with high morbidity and mortality, particularly among patients requiring intensive care unit (ICU) admission. Early diagnosis and prompt management are essential to improve survival and reduce neurological complications.

Objectives: To evaluate the clinical profile, etiological pattern, management, and outcomes of patients with acute meningitis admitted to the intensive care unit and to identify factors associated with mortality.

Materials and Methods: This prospective observational study included 120 consecutive patients with acute meningitis admitted to the ICU of a tertiary care hospital over an 18-month period. Demographic characteristics, clinical presentation, laboratory and cerebrospinal fluid findings, neuroimaging, treatment modalities, complications, and clinical outcomes were recorded. Patients were categorized into survivors and non-survivors for comparative analysis. Statistical analysis was performed using SPSS version 26.0, and a p-value <0.05 was considered statistically significant.

Results: The mean age of the patients was 42.8 ± 16.4 years, with males comprising 66.7% of the study population. Acute bacterial meningitis was the commonest etiology (60.0%), followed by tuberculous (23.3%), viral (13.3%), and fungal meningitis (3.4%). Fever (93.3%), headache (86.7%), neck stiffness (75.0%), and altered sensorium (68.3%) were the predominant presenting features. Mechanical ventilation was required in 28.3% of patients, while raised intracranial pressure (23.3%) and septic shock (16.7%) were the most common complications. The overall in-hospital mortality was 24.2%. Older age, Glasgow Coma Scale score ≤8, septic shock, raised intracranial pressure, requirement for mechanical ventilation, and prolonged ICU stay were significantly associated with mortality ($p<0.05$).

Conclusion: Acute bacterial meningitis remains the predominant cause of ICU admission among patients with acute meningitis and is associated with considerable mortality. Poor neurological status at admission and severe systemic complications significantly influence clinical outcomes. Early recognition, prompt antimicrobial therapy, and comprehensive intensive care management are crucial for improving survival and reducing neurological sequelae.

Keywords: Acute Meningitis, Bacterial Meningitis, Intensive Care Unit, Cerebrospinal Fluid, Glasgow Coma Scale, Mortality, Mechanical Ventilation.

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Introduction

Acute meningitis is a serious neurological emergency characterized by inflammation of the meninges and may result from bacterial, viral, fungal, or tubercular infections. Among these, acute bacterial meningitis is associated with substantial mortality and long-term neurological disability despite advances in antimicrobial therapy and critical care. Early recognition, prompt initiation of appropriate antibiotics, and supportive intensive care are essential for improving patient outcomes. [1] The clinical presentation of meningitis is variable and commonly includes fever, headache, altered sensorium, neck stiffness, vomiting, seizures, and focal neurological deficits. However, the classical triad of fever, neck stiffness, and altered mental status is not present in all patients, which may lead to delayed diagnosis and treatment. [2] Cerebrospinal fluid analysis remains central to diagnosis, while blood culture, neuroimaging, and microbiological testing help identify the underlying etiology and guide treatment. [3] The outcome of acute meningitis is

influenced by several factors, including advanced age, low Glasgow Coma Scale score, and delayed initiation of antibiotics, seizures, shock, respiratory failure, cranial nerve involvement, and the need for mechanical ventilation. Diagnostic challenges may arise in critically ill patients, particularly when prior antibiotic use alters cerebrospinal fluid findings or when neuroimaging is required before lumbar puncture. [4]

Current guidelines recommend immediate empirical antimicrobial therapy with adjunctive corticosteroids in suspected bacterial meningitis, without waiting for completion of diagnostic procedures when delay is anticipated. [5] Despite adherence to recommended treatment protocols, critically ill patients may develop complications such as raised intracranial pressure, septic shock, acute respiratory failure, hydrocephalus, cerebral infarction, and multiorgan dysfunction. [6]

Recent cohort studies have shown that bacterial meningitis continues to carry a considerable risk of death and neurological sequelae, particularly among patients requiring intensive care admission. [7] Evaluation of the clinical profile, etiological pattern, complications, and predictors of outcome among ICU patients may help in early risk stratification and optimization of management.

Therefore, the present study was undertaken to assess the clinical profile and outcome of patients with acute meningitis admitted to the intensive care unit and to identify factors associated with adverse outcomes.

Materials and Methodology

Study Design and Setting: This prospective observational study was conducted in the intensive care unit of a tertiary care teaching hospital over a period of 18 months.

Study Population: A total of 120 consecutive patients diagnosed with acute meningitis and admitted to the intensive care unit were included in the study.

Inclusion Criteria: Patients aged 18 years or older with clinical features suggestive of acute meningitis and supported by cerebrospinal fluid, microbiological, or neuroimaging findings were included.

Patients requiring ICU admission because of altered sensorium, seizures, respiratory failure, shock, or other neurological complications were eligible.

Exclusion Criteria: Patients with chronic meningitis, postoperative or device-associated meningitis, isolated encephalitis without meningeal involvement, incomplete medical records, or refusal to participate were excluded.

Data Collection: Demographic details, comorbidities, duration of symptoms, prior antibiotic use, clinical manifestations, Glasgow Coma Scale score, hemodynamic status, and neurological findings were recorded at admission.

Laboratory investigations included complete blood count, serum electrolytes, renal and liver function tests, blood glucose, inflammatory markers, blood culture, and arterial blood gas analysis when indicated. Lumbar puncture was performed unless contraindicated. Cerebrospinal fluid was assessed for opening pressure, cell count, protein, glucose, Gram staining, culture, acid-fast staining, cartridge-based nucleic acid amplification testing, and other microbiological tests as clinically indicated.

Computed tomography or magnetic resonance imaging of the brain was performed in patients with focal neurological deficits, papilledema, new-onset seizures, severely altered consciousness, or suspicion of raised intracranial pressure.

Treatment and Monitoring: Patients received empirical antimicrobial therapy according to the suspected etiology and institutional protocol. Antibiotics were modified after availability of culture or molecular test results.

Adjunctive corticosteroids, antitubercular treatment, antiviral drugs, antifungal therapy, antiepileptic drugs, mechanical ventilation, vasopressors, and measures to control raised intracranial pressure were administered when required.

Patients were monitored for seizures, shock, respiratory failure, hydrocephalus, cerebral infarction, cranial nerve deficits, acute kidney injury, and multiorgan dysfunction.

Outcome Measures: The primary outcome was in-hospital mortality. Secondary outcomes included duration of ICU stay, need for mechanical ventilation or vasopressors, neurological complications, and functional status at discharge.

Patients were categorized as survivors and non-survivors for comparison of demographic, clinical, laboratory, and treatment-related variables.

Statistical Analysis: Data were analyzed using SPSS version 26.0. Continuous variables were expressed as mean ± standard deviation or median with interquartile range, while categorical variables were presented as frequencies and percentages.

The independent Student's t-test or Mann–Whitney U test was used for continuous variables, and the Chi-square or Fisher's exact test was used for categorical variables. Multivariable logistic regression was performed to identify independent predictors of mortality. A p-value of less than 0.05 was considered statistically significant.

Results

A total of 120 patients with acute meningitis admitted to the intensive care unit (ICU) were included in the study. The mean age of the study

population was 42.8 ± 16.4 years, with a predominance of males (66.7%).

The overall in-hospital mortality was 24.2% (29/120), while 91 patients (75.8%) survived to hospital discharge.

Table 1. Baseline Demographic and Clinical Characteristics of Study Participants (n=120)

Variable	Number	Percentage (%)
Age Group (years)		
18–30	32	26.7
31–45	39	32.5
46–60	30	25.0
>60	19	15.8
Gender		
Male	80	66.7
Female	40	33.3
Comorbidities		
Diabetes mellitus	24	20.0
Hypertension	20	16.7
Chronic kidney disease	8	6.7
HIV infection	10	8.3
No comorbidity	58	48.3
Etiology		
Acute bacterial meningitis	72	60.0
Tuberculous meningitis	28	23.3
Viral meningitis	16	13.3
Fungal meningitis	4	3.4

Most patients were between 31 and 45 years of age, and males constituted two-thirds of the study population. Acute bacterial meningitis was the commonest etiology (60%), followed by tuberculous meningitis (23.3%).

Table 2. Clinical Presentation and Laboratory Findings at ICU Admission

Variable	Number	Percentage (%)
Fever	112	93.3
Headache	104	86.7
Neck stiffness	90	75.0
Altered sensorium	82	68.3
Vomiting	61	50.8
Seizures	39	32.5
Focal neurological deficit	22	18.3
Glasgow Coma Scale ≤8	31	25.8
Positive CSF culture	46	38.3
Elevated CSF protein	95	79.2
Low CSF glucose	88	73.3
CSF neutrophilic pleocytosis	70	58.3
CSF lymphocytic pleocytosis	50	41.7

Fever, headache, and neck stiffness were the most common presenting symptoms. More than two-thirds of patients had altered sensorium, while approximately one-fourth presented with severe neurological impairment (GCS ≤8). Cerebrospinal fluid abnormalities typical of meningitis were observed in the majority of patients.

Table 3: ICU Management, Complications, and Clinical Outcomes

Variable	Number	Percentage (%)
Mechanical ventilation	34	28.3
Vasopressor support	22	18.3
Raised intracranial pressure	28	23.3
Septic shock	20	16.7
Hydrocephalus	12	10.0
Cerebral infarction	10	8.3
Acute kidney injury	15	12.5
Mean ICU stay (days)	8.6 ± 4.2	—
Survivors	91	75.8
Non-survivors	29	24.2

Nearly one-third of patients required mechanical ventilation, while septic shock and raised intracranial pressure were common complications. The overall mortality rate was 24.2%, with an average ICU stay of 8.6 days.

Table 4: Comparison of Survivors and Non-Survivors

Variable	Survivors (n=91)	Non-survivors (n=29)	p-value
Mean age (years)	40.2 ± 15.3	51.6 ± 17.2	0.003*
GCS ≤8	15 (16.5%)	16 (55.2%)	<0.001*
Mechanical ventilation	17 (18.7%)	17 (58.6%)	<0.001*
Septic shock	8 (8.8%)	12 (41.4%)	<0.001*
Positive CSF culture	31 (34.1%)	15 (51.7%)	0.091
Raised intracranial pressure	15 (16.5%)	13 (44.8%)	0.002*
Mean ICU stay (days)	7.8 ± 3.6	11.2 ± 5.1	<0.001*

***Statistically significant (p < 0.05)**

Non-survivors were significantly older and had lower Glasgow Coma Scale scores, higher rates of mechanical ventilation, septic shock, raised intracranial pressure, and longer ICU stays than survivors ($p<0.05$). These findings suggest that severe neurological impairment and critical illness at presentation were strongly associated with increased mortality in acute meningitis patients admitted to the ICU.

Discussion

The present prospective observational study evaluated the clinical profile and outcomes of patients with acute meningitis admitted to the intensive care unit. Acute bacterial meningitis was the predominant etiology, with fever, headache, neck stiffness, and altered sensorium being the most common presenting features. The overall mortality was 24.2%, and patients with low Glasgow Coma Scale (GCS) scores, septic shock, raised intracranial pressure, and the need for mechanical ventilation had significantly poorer outcomes.

Brouwer et al. [8] reported that bacterial meningitis continues to be associated with substantial mortality and neurological morbidity despite advances in antimicrobial therapy and intensive care. Similarly, nearly one-fourth of patients in the present study died during hospitalization, reflecting the severity of illness among critically ill meningitis patients.

Neurological status at presentation is an important determinant of prognosis. Lucas et al. [9] demonstrated that patients presenting with a low GCS have significantly higher mortality.

Consistent with this finding, GCS ≤8 was significantly more common among non-survivors in the present study. Furthermore, neurological complications remain frequent among survivors, as highlighted by Lucas et al., [10] emphasizing the importance of early diagnosis and timely management. Thomas et al. [11] observed that classical meningeal signs have limited sensitivity and should be interpreted together with cerebrospinal fluid findings. In the present study, fever, neck stiffness, and altered sensorium were the predominant clinical manifestations. Appropriate neuroimaging before lumbar puncture in selected patients, as recommended by Hasbun et al., [12] facilitated safe diagnosis and management.

Current guidelines emphasize early empirical antimicrobial therapy, adjunctive corticosteroids, and comprehensive intensive care as the cornerstone of treatment. [13]

The present findings support these recommendations, as patients with severe neurological dysfunction and systemic complications experienced significantly poorer outcomes.

Chekrouni et al. [14] identified advanced age, mechanical ventilation, septic shock, and low GCS as independent predictors of mortality among ICU patients with bacterial meningitis.

Similar predictors were observed in the present study, where older age, mechanical ventilation, raised intracranial pressure, septic shock, and prolonged ICU stay were significantly associated with mortality. Thigpen et al. [15] also reported that bacterial meningitis remains associated with considerable mortality despite improvements in vaccination and critical care.

Overall, the study highlights that neurological impairment at presentation and systemic complications are the major predictors of adverse outcomes in acute meningitis. Early diagnosis, prompt antimicrobial therapy, and aggressive intensive care management remain essential for improving survival and reducing neurological sequelae.

Conclusion

Acute meningitis remains a life-threatening neurological emergency among patients admitted to the intensive care unit. Acute bacterial meningitis was the predominant etiology, while fever, headache, neck stiffness, and altered sensorium were the most frequent presenting features.

Patients with low Glasgow Coma Scale scores, septic shock, raised intracranial pressure, and the need for mechanical ventilation had significantly poorer outcomes. Early diagnosis, prompt initiation of appropriate antimicrobial therapy, and comprehensive intensive care management are essential for reducing mortality and improving neurological outcomes.

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