International Journal of Community Medicine and Public Health
Thayyullathil ST et al. Int J Community Med Public Health. 2026 May;13(5):2231-2235
http://www.ijcmph.com
pISSN 2394-6032 | eISSN 2394-6040

DOI: https://dx.doi.org/10.18203/2394-6040.ijcmph20261403

Original Research Article

Clinical profile, etiology and outcomes of meningoencephalitis in a tertiary care centre in Kerala

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Received: 20 November 2025
Revised: 08 April 2026
Accepted: 17 April 2026

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ABSTRACT

Background: Meningoencephalitis remains a serious public-health issue in many low- and middle-income countries due to its potential for rapid neurological deterioration and preventable mortality. Limited diagnostic tools at peripheral hospitals often lead to delayed referral and empirical treatment. Understanding the regional etiology and identifying predictors of poor outcomes are essential for early case recognition, prioritisation of high-risk patients and strengthening surveillance and diagnostic pathways.
Methods: A prospective observational study was conducted among 129 patients (>13 years) admitted with meningoencephalitis to Government Medical College, Kozhikode from January 2019 to June 2020. Clinical features and CSF serological/molecular diagnostics were analysed. Patient outcomes at discharge were recorded and compared across etiological categories.
Results: Among 129 patients, 56% were male and 61% were aged <40 years. Common symptoms were fever (96%), headache (86%), vomiting (64%), altered sensorium (53%) and seizures (34%). Etiology was identified in 39.5%, with viral meningoencephalitis most common; HSV-1 was the leading viral agent. ICU care was required in 24.8% and ventilatory support in 7%. Overall, 83.7% recovered completely, 6.2% had sequelae and 10.1% died. Mortality was highest in tuberculous and fungal meningitis. Seizures, low GCS and delayed presentation were associated with poor outcomes.
Conclusions: Viral meningoencephalitis was the leading etiology, while tuberculous and fungal infections contributed disproportionately to mortality. Improved access to molecular diagnostics and early recognition of high-risk clinical indicators could reduce preventable deaths. Strengthening surveillance and referral pathways is essential to improving neurological outcomes in the community.

Keywords: Diagnostics, Epidemiology, Etiology, Meningoencephalitis, Outcomes, Public health

INTRODUCTION

Meningoencephalitis remains a major public health concern in developing countries due to its substantial contribution to neurological disability and mortality. The disease represents a continuum of inflammation involving both the meninges and the brain parenchyma, resulting in a rapidly progressive clinical presentation that requires urgent diagnosis and management. Although viral and bacterial agents account for the majority of cases in immunocompetent adults, tuberculosis, fungal pathogens and parasitic infections continue to be important etiologies in regions with high infectious disease burdens.[1,2] Globally, the epidemiology of meningoencephalitis displays significant regional variability influenced by climate, vaccination coverage, socioeconomic status, HIV prevalence and access to medical care. Studies from India show rising trends in

viral encephalitis and persistent endemicity of tuberculous meningitis, both of which demand coordinated surveillance and preventive strategies. Delayed diagnosis remains a major challenge due to overlapping clinical presentations and the limited availability of rapid molecular diagnostic facilities in many healthcare settings.[3,4] Diagnostic accuracy is particularly critical because the etiological agent strongly determines prognosis and therapeutic requirements. Viral meningoencephalitis often follows a benign course with supportive treatment, whereas bacterial, tuberculous and fungal meningitis require prompt targeted therapy to prevent long-term neurological sequelae and death. In low-resource areas, empirical therapy is frequently initiated without confirmatory testing, leading to diagnostic uncertainty and difficulty in predicting outcomes.[5,6] Despite the significant burden of disease, only a limited number of studies from India comprehensively evaluate clinical profiles, etiological patterns and short-term outcomes among adults with meningoencephalitis. Understanding the profile of affected populations and predictors of poor outcomes is essential to prioritise early referral, optimize resource allocation and strengthen hospital-based surveillance systems.[7]

The present study was conducted to assess the clinical, epidemiological and etiological characteristics of meningoencephalitis in a tertiary care centre in Kerala and to evaluate patient outcomes at the time of discharge.

METHODS

Study design and setting

This was a hospital-based prospective observational study conducted in the Department of General Medicine at Government Medical College, Kozhikode, a tertiary care referral centre in Kerala, India. The study period was from January 2019 to June 2020.

Study population

All patients aged >13 years admitted to the medical wards with a clinical diagnosis of meningoencephalitis were screened. A total of 129 patients who fulfilled the inclusion criteria were enrolled consecutively.

Inclusion criteria

Patients >13 years of age. Clinical features suggestive of meningitis or meningoencephalitis (fever, headache, neck stiffness, altered sensorium, seizures). CSF abnormalities supporting central nervous system infection

Exclusion criteria

Known malignancy with CNS involvement. Post-traumatic meningitis. Post-neurosurgical meningitis. Alternative confirmed non-infectious neurological disorders

Data collection

A structured proforma was used to record demographic details & clinical features. All patients underwent lumbar puncture unless contraindicated. Investigations included CSF culture, AFB smear and culture, CBNAAT / GeneXpert for Mycobacterium tuberculosis, PCR panels for viral pathogens (HSV, VZV, CMV, enterovirus), Fungal culture and cryptococcal antigen. Toxoplasma IgM/IgG where clinically suspected. Clinical outcomes at discharge were recorded under complete recovery, neurological sequelae, death.

Statistical analysis

Data were entered in Microsoft Excel and analysed using SPSS software. Categorical variables were expressed as percentages. Continuous variables were expressed as mean±standard deviation. A p value <0.05 was considered statistically significant.

Ethical considerations

Institutional ethical approval was obtained from the Institutional Ethics Committee of Government Medical College, Kozhikode. Written informed consent was taken from all participants or their legal guardians.

RESULTS

A total of 129 patients with meningoencephalitis were included in the study. Of these, 72 (56%) were male and 57 (44%) were female. The mean age was 36.4±15.7 years and the majority of patients (61%) belonged to the age group <40 years. Of the 129 meningoencephalitis patients, 45 (34.9%) had pre-existing comorbidities, including diabetes mellitus, hypertension, ischemic heart disease, chronic kidney disease or chronic liver disease.

Clinical features

The most common presenting symptoms were fever (96%), headache (86%), vomiting (64%), altered sensorium (53%) and seizures (34%). Neck stiffness was recorded in 49% of patients.

Etiological distribution

Etiology could be confirmed in 39.5% of patients using routine culture techniques along with molecular and serological methods. Viral meningoencephalitis was the most common etiology. Among bacterial cases, Streptococcus pneumoniae (n=9) and Neisseria meningitidis (n=5) were most frequently detected. Among viral cases, HSV-1 accounted for the highest proportion (n=23, 32%), followed by VZV (n=18, 25%),

enteroviruses (n=17, 24%) and dengue-associated encephalitis (n=9, 12%).

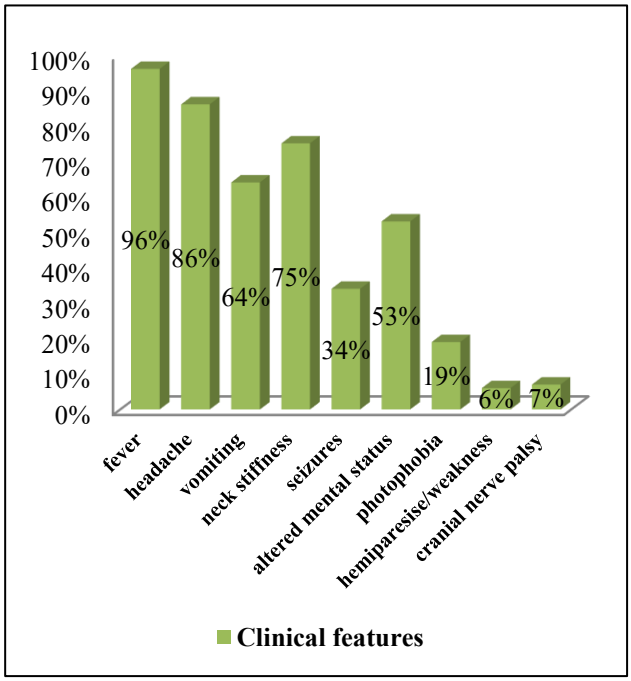

Figure 1: Clinical presentation among patients (n=129).

All four fungal meningitis cases occurred in HIV-positive individuals. Seizures during hospital stay were reported in 35% of TB and 50% of fungal meningitis cases versus 18% of viral cases. Raised intracranial pressure requiring osmotic therapy occurred in 41 patients (31.8%). Twenty-three patients (17.8%) required ICU admission and 9 (7%) required ventilatory support.

Outcome

Of 129 patients, 108 (83.7%) recovered completely, 8 (6.2%) survived with neurological sequelae, 13 (10.1%) died. Mortality was highest among tuberculous (35.7%) and fungal (25%) meningitis patients. Patients presenting with seizures ($o<0.01$), low GCS at admission ($p<0.001$), delayed hospital presentation >5 days ($p<0.01$) and immunosuppression ($p<0.05$) had significantly worse outcomes. Most meningioencephalitis cases received empirical therapy with a combination of antibiotics and acyclovir, given the absence of a definitive regimen for viral infections. Fourteen patients diagnosed with tuberculous meningitis were treated with ATT and adjunctive corticosteroids. Both scrub typhus cases were managed with doxycycline and the H1N1 case received oseltamivir. All four cryptococcal meningitis cases were treated with antifungal therapy, while five cerebral toxoplasmosis cases received a regimen of sulfadiazine, pyrimethamine and leucovorin.

Table 1: Etiological diagnosis among study participants (n=129).

Diagnosis summary	Frequency (%)
TBM	14 (10.9)
Bacterial	20 (15)
Viral meningoencephalitis	72 (56)
Fungal	4 (3)
Protozoa	5 (4)
Others	14 (10.9)
Total	129 (100)

Table 2: Outcome by etiological group.

	Outcome			
Diagnosis	**Improved**	**Died**	**Improved with Sequelae/no change**	**Total**
TB	7	3	4	14
Viral	65	4	3	72
Bacterial	20	0	0	20
Protozoa	3	2	0	5
Fungus	1	3	0	4
Others	12	1	1	14
Total	108	13	8	129

DISCUSSION

Meningoencephalitis continues to pose a substantial public-health challenge in low- and middle-income countries because of its high potential for disability and mortality, particularly among young and economically productive individuals. The majority of affected individuals were young adults, highlighting that meningoencephalitis is not only a pediatric disease but a significant cause of neurological morbidity among the productive age group. Similar age distribution has been

reported in previous studies from India and Southeast Asia, reflecting regional epidemiological patterns.[7,8]

The etiological pattern observed reflects the epidemiology of infectious diseases in the region, with viral meningoencephalitis representing the majority of cases. While outcomes for viral infections were largely favourable, the relatively high proportion of viral cases indicates an increasing burden of neurotropic viruses in the community. This trend has been reported across several Asian regions and supports the need for stronger regional surveillance systems and early-warning mechanisms for emerging and re-emerging viral pathogens.[7,9]

Although bacterial meningitis accounted for a smaller proportion of cases, the associated mortality and morbidity remain critical from a public-health perspective which was similar to many studies conducted worldwide.[9] Many patients presented late in the course of disease, suggesting delays in seeking care or referral from primary-level facilities. Strengthening awareness among frontline healthcare workers regarding early symptom recognition and prioritizing timely referral could help reduce preventable neurological sequelae and deaths

Tuberculous meningitis and fungal meningitis, though less frequent, contributed disproportionately to mortality in this study. This emphasizes the intersection between neurological infectious diseases and comorbidities such as HIV, malnutrition and immunosuppression.[10] Integrating screening for HIV and other immunocompromised states into meningitis protocols at secondary and tertiary levels may improve early identification of high-risk patients. From a public-health policy perspective, the strong association between adverse outcomes and TBM reinforces the urgency of expanding access to rapid tuberculosis diagnostics and ensuring uninterrupted treatment availability.[8,11]

A major challenge highlighted by this study is the difficulty in confirming etiology, with diagnosis established in only 39.5% of patients despite extensive workup. This reflects systemic limitations in diagnostic capacity, including delayed access to molecular panels, culture facilities and CSF-based immunoassays. Improving laboratory networks and subsidizing molecular testing could reduce empirical therapy, enable precision treatment and allow clearer disease mapping. Public-health decision-makers may consider integrating tiered diagnostic capacity into district-level hospitals to minimize delays.

The presence of seizures during illness emerged as an independent predictor of poor outcome, reinforcing a need for early identification and intensified monitoring of high-risk patients. Incorporating seizure surveillance and standardized neurological scoring into meningitis management protocols at all levels of care may further reduce mortality.[12]

Overall, this study strengthens the evidence that meningoencephalitis is not only a neurological emergency but also a significant public-health threat with preventable mortality. Improving regional disease surveillance, enhancing diagnostic access and establishing clear referral pathways could enable earlier intervention and better clinical outcomes. Coordination between clinicians, public-health authorities and laboratory networks is essential to reduce disease burden, protect vulnerable populations and optimize health-system preparedness for future outbreaks.

CONCLUSION

Meningoencephalitis continues to be a major public-health threat affecting predominantly young adults and resulting in preventable neurological disability and mortality. In this study, viral infections accounted for the majority of cases, while tuberculous and fungal etiologies were associated with the highest risk of death. Seizures emerged as an important clinical marker of adverse outcomes. Strengthening regional surveillance systems, improving access to molecular diagnostics and establishing efficient referral pathways from peripheral centres to tertiary care facilities are critical to improving survival and reducing disease burden. Early recognition of high-risk individuals and timely initiation of targeted therapy can significantly optimise clinical outcomes at the population level.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Thayyullathil ST, Mathew S, Basheer B. Clinical profile, etiology and outcomes of meningoencephalitis in a tertiary care centre in Kerala. Int J Community Med Public Health 2026;13:2231-5.