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ACUTE FEBRILE ENCEPHALOPATHY DIAGNOSTIC AND PROGNOSTIC DETERMINANTS

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ABSTRACT

Background: Acute febrile encephalopathy (AFE) presents a diagnostic and therapeutic challenge in the emergency department, especially in regions with diverse infectious profiles. This study aims to identify the clinical, laboratory, and radiological features of AFE and evaluate the diagnostic and prognostic determinants in a tertiary care center.

Methods: A prospective, hospital-based study was conducted at Government Medical College Srinagar from April 2021 to March 2022. All adult patients with acute febrile encephalopathy were included. Diagnostic workups included complete blood count, metabolic profile, liver function tests, chest radiography, and cerebrospinal fluid (CSF) analysis in consenting patients.

Results: A total of 91 patients (65.9% male, mean age 57.1 ± 14.91 years) were included. The most common comorbidities were hypertension (39.6%) and diabetes mellitus (29.7%). The primary presenting symptoms were fever, altered sensorium, headache (57.1%), and nuchal rigidity (41.8%). CNS infections were identified in 63.7% of cases, with viral meningoencephalitis (31.9%) being the most common etiology. Mortality was 11%, with higher rates observed in patients over 60 years (16.3%) and those with comorbidities. Mortality was significantly higher in patients with a Glasgow Coma Scale (GCS) score <10 (20.6% vs 5.3%, $p<0.05$). In CSF analysis, lymphocytic predominance was suggestive of viral etiology, while neutrophilic leukocytosis pointed to sepsis-associated encephalopathy.

Conclusions: CNS infections, especially viral meningoencephalitis, are the predominant cause of AFE, associated with higher mortality. Age above 60 years, hypertension, and low GCS scores were significant prognostic factors. Early lumbar puncture and timely initiation of antimicrobial therapy are essential for improving outcomes. Further studies with larger sample sizes are recommended to validate these findings.

Keywords: Acute febrile encephalopathy, viral meningoencephalitis, septic encephalopathy, Glasgow Coma Scale, cerebrospinal fluid analysis.

INTRODUCTION

The management of patients presenting with fever and altered mental status poses a significant challenge for emergency department physicians. Confusion, a key sign of encephalopathy, accounts for approximately 2% of emergency department visits, highlighting the frequency and importance

of addressing this symptom[1]. The differential diagnosis of febrile encephalopathy is extensive, and timely differentiation among various etiologies is crucial, as accurate diagnosis and prompt treatment can significantly impact patient morbidity and mortality. This diagnostic challenge becomes even more complex when dealing with patients with multiple chronic medical conditions[2]. In such cases, distinguishing between infectious processes, autoimmune disorders, and encephalopathies, which are non-inflammatory cerebral dysfunctions primarily triggered by metabolic or toxic factors, is essential[3].

When cerebral dysfunction occurs alongside fever or sepsis syndrome, the possibility of an infectious etiology, particularly a central nervous system (CNS) infection, should be considered[2]. The timely identification and treatment of these infections are critical, as they are associated with significant morbidity and mortality[4,5]. The clinical presentation of febrile encephalopathy can vary depending on demographic and geographical factors[2], making it imperative to understand the local epidemiology and age-specific profiles to inform appropriate management protocols at the regional level.

Acute febrile encephalopathy is a common clinical issue in tropical countries like India, where it is defined as fever combined with an acute deterioration of consciousness or mental status for more than 12 hours, with or without neurological deficits[6]. The causative agents of this syndrome include bacteria, viruses, parasites, and in rare cases, fungi and spirochetes. Non-infectious causes, such as acute disseminated encephalomyelitis, neuroleptic malignant syndrome, and septic encephalopathy, also contribute to the clinical spectrum. The causative agents and their incidence vary by region, with seasonal fluctuations complicating diagnosis[6]. Sepsis-associated encephalopathy (SAE) represents a form of diffuse brain dysfunction secondary to systemic infection without overt CNS involvement. The pathogenesis of SAE is multifactorial, involving altered cerebral circulation, blood-brain barrier disruption, inflammatory cytokine release, and impaired cerebral metabolism[7]. Given the variety of factors at play, SAE presents a complex diagnostic and therapeutic challenge, and early recognition and management are crucial for improving outcomes[8-11].

In febrile illness, encephalopathy can result from direct pathogenic effects on the nervous system or from systemic complications such as hypoglycemia, hypotension, and electrolyte imbalances[12]. Bacterial meningitis remains a significant cause of acute febrile encephalopathy in India, with an annual incidence of 4 to 6 cases per 100,000 adults globally, and approximately 1.2 million cases occurring annually worldwide[13]. Other common causes in India include viral encephalitis, tubercular meningitis, and cerebral malaria. The profile of acute febrile encephalopathy varies geographically and seasonally, with certain pathogens being more prevalent in specific regions[14].

The incidence of acute encephalitis varies worldwide, typically between 3.5 and 7.4 cases per 100,000 person-years, with higher rates observed in the pediatric population[14-17]. However, comparisons between studies are complicated by differences in diagnostic criteria, vaccination coverage, and local epidemiological factors. Despite advances in treatment, encephalitis remains associated with high mortality and long-term neurological sequelae, including cognitive deficits, affective disorders, and seizures[18-22]. The severity of outcomes is influenced by several factors, including the pathogen involved, the patient's age, the level of consciousness at presentation, and the duration of illness, underscoring the need for timely diagnosis and intervention.

AIMS AND OBJECTIVES

- To study diagnostic and prognostic determinants in patient presenting with Acute Febrile encephalopathy to a tertiary care centre.
- To study the clinical and laboratory predictors in diagnosis of etiology of acute febrile encephalopathy.
- To assess the outcome in patients with acute febrile encephalopathy.
- To study the predictors of outcome in patients with acute febrile encephalopathy.

MATERIAL AND METHODS

This was a prospective, hospital-based study conducted at the Emergency Department of Government Medical College (GMC) Srinagar, Jammu and Kashmir. The study aimed to evaluate the clinical, laboratory, and radiological features of patients presenting with acute febrile encephalopathy at GMC Srinagar between April 2021 and March 2022.

The study population included all adult patients (aged 18 years and above) presenting to the Emergency Department with acute febrile encephalopathy during the study period. Acute febrile encephalopathy was defined as the presence of fever lasting less than 15 days in conjunction with altered mental status, either at the onset of fever or following the fever, lasting at least 12 hours. Patients were excluded from the study if they had acute cerebrovascular accidents (hemorrhagic or ischemic), a history of head injury or trauma, space-occupying lesions in the brain, or altered mental status due to deranged metabolic parameters (such as hypoglycemia, hypoxia, hypercarbia, hyponatremia, hypernatremia, renal failure, diabetic ketoacidosis, hyperosmolar coma, or hepatic encephalopathy). Additionally, patients younger than 18 years were excluded from the study. Upon presentation, a detailed history was taken from each patient, focusing on the nature and duration of fever, underlying immune status, any recent drug history, and the presence of neurological symptoms. Following the history, a thorough clinical examination was performed, including a general physical survey, neurological examination, and an assessment of the liver, spleen, and lymph nodes.

All patients underwent a series of investigations. A complete hemogram, metabolic profile, liver function tests, chest radiography, and electrocardiogram (ECG) were performed for all patients. In 84 patients who provided consent, lumbar puncture (LP) was carried out to obtain cerebrospinal fluid (CSF) for analysis. The CSF was sent for cytological examination, protein and glucose levels, Gram stain, Ziehl-Neelsen stain, and CSF adenosine deaminase (ADA) levels. Prior to performing the lumbar puncture, all patients underwent neuroimaging, including a computed tomography (CT) scan of the brain. If required, magnetic resonance imaging (MRI) of the brain with contrast was performed to further assess the cerebral structures. The study protocol, tools for data collection, consent forms, and patient information sheets were reviewed and approved by the Institutional Ethics Committee (IEC) at GMC Srinagar, J&K. The study was conducted in full accordance with the ethical guidelines and regulations. Patient confidentiality was maintained throughout the study, and all data was handled in a manner ensuring anonymity. Any modifications to the protocol were implemented only after approval from the IEC.

For statistical analysis, the collected data were entered into a spreadsheet using Microsoft Excel and exported to SPSS (version 20.0, SPSS Inc., Chicago, Illinois, USA). Continuous variables were expressed as means with standard deviations (SD), while categorical variables were presented as frequencies and percentages. The results were also presented graphically using bar and pie charts for better visualization of the data.

RESULTS

In this study, the most commonly affected age group was 50-59 years, which comprised 24 patients (26.4%), followed by the 60-69 years age group with 22 patients (24.2%). Additionally, 15 patients (16.5%) were in the 70-79 years age range. The mean age of the study population was 57.1 ± 14.91 years, with the youngest patient being 18 years old and the oldest 91 years old. There was a notable male predominance in the study, with a male-to-female ratio of 1.9:1. Males represented 65.9% (n=60) of the patients, while females accounted for 34.1% (n=31). The most common underlying comorbidities included hypertension, present in 39.6% (n=36) of patients, followed by diabetes mellitus in 29.7% (n=27), and hypothyroidism in 16.5% (n=15). Other comorbidities included coronary artery disease (CAD) in 12.1% (n=11), malignancy in 7.7% (n=7), cerebrovascular accidents (CVA) in 6.6% (n=6), chronic obstructive pulmonary disease (COPD) in 5.5% (n=5), and pulmonary tuberculosis (PTB) in 4.4% (n=4). Fewer patients had chronic kidney disease (CKD) (3.3%, n=3), and other conditions like dilated cardiomyopathy (DCM), benign prostatic hyperplasia (BPH), and psychiatric illnesses were observed in 2.2% (n=2) of cases each. Seizure disorders and osteoarthritis (OA) were seen in 1.1% (n=1) of patients each.

All 91 patients presented with fever and altered sensorium. Other presenting complaints included headache in 57.1% (n=52), nuchal rigidity in 41.8% (n=38), nausea/ vomiting in 36.3% (n=33), abdominal pain in 13.2% (n=12), lower urinary tract symptoms (LUTS) in 7.7% (n=7), and chest pain/shortness of breath (SOB) in 2.2% (n=2). Statistically significant associations were found for the presence of nuchal rigidity, headache, and abdominal pain, with p-values <0.05. Notably, all 38 patients with nuchal rigidity had a CNS infection, and headache was present in 92.3% of patients with a CNS infection compared to 7.7% with sepsis-associated encephalopathy (SAE). None of the patients with abdominal pain had a CNS infection, and all such patients were diagnosed with SAE. Leukocytosis was observed in 8.6% of patients with a CNS diagnosis and in 87.9% with SAE, with a statistically significant difference ($p < 0.001$). Neutrophilia was found in 5.2% of patients with CNS infections, but in 72.7% of those with SAE. Out of the 84 patients who underwent lumbar puncture (LP), a diagnosis was achieved in 64.3% (n=54) based on CSF analysis, while in 35.7% (n=30) of patients, no definitive diagnosis was obtained. Seven patients refused consent for the procedure. The focus of infection was identified as CNS in 63.7% (n=58) of patients, while 36.3% (n=33) had SAE.

The most common etiological diagnoses were viral meningoencephalitis, observed in 31.9% (n=29) of patients, followed by bacterial meningoencephalitis in 19.8% (n=18), urosepsis/pyelonephritis with septic encephalopathy in 21.9% (n=20), and tubercular meningitis (TBM) in 12.1% (n=11). Mortality in the study cohort was 11% (n=10). Age-related mortality showed that 16.3% of patients aged over 60 years died, compared to 6.3% of patients under 60 years, though this difference was statistically insignificant. Mortality was higher among patients with comorbidities, with 19.4% of hypertensive patients, 14.8% of diabetic patients, 13.3% of hypothyroid patients, and 9.1% of those with CAD succumbing to their illness. Regarding the type of infection, 13.8% (n=8) of patients with CNS infections died, while 6.1% (n=2) of those with SAE infections died. Mortality rates were highest among patients with cholangitis (33.3%, n=1), followed by TBM (18.2%, n=2), bacterial meningoencephalitis (22.2%, n=4), viral meningoencephalitis (6.8%, n=2), and urosepsis/pyelonephritis with septic encephalopathy (5%, n=1). Mortality was significantly higher in patients with a Glasgow Coma Scale (GCS) score of <10, with a mortality rate of 20.6%, compared to 5.3% in those with a GCS score of >10, and this difference was statistically significant.

DISCUSSION

Acute febrile encephalopathy (AFE) is a common and serious clinical syndrome characterized by the sudden onset of fever followed by altered mental status, often accompanied by various neurological manifestations. It is a leading cause of hospital admission, particularly in developing countries, and can result from a wide range of infectious and non-infectious etiologies. Among infectious causes, central nervous system (CNS) infections, including bacterial meningitis, viral encephalitis (such as Japanese B encephalitis and herpes simplex virus), cerebral malaria, and tuberculous meningitis, are the most common triggers for AFE. Non-infectious causes, such as metabolic disturbances and hepatic encephalopathy, also contribute to the condition. The epidemiology and outcome of AFE vary depending on geographical location, underlying health conditions, and the availability of medical care. Fever with altered mental status is commonly produced by bacterial meningitis, Japanese B encephalitis, cerebral malaria, typhoid encephalopathy, and fulminant hepatic failure due to viral hepatitis[13].

The incidence of AFE has been reported to vary between 2 to 16 per 100,000 population annually, with CNS infections being the predominant etiology. Although non-infectious disorders can cause AFE, infectious diseases, particularly those affecting the CNS, remain the leading cause. Despite this, few studies have systematically investigated the various aspects of AFE, including its etiology, clinical presentation and prognosis[23-25]. In India, AFE is frequently encountered in both adults and children, often leading to critical admissions in emergency departments. The most common age group affected by AFE is older adults, with a male predominance. This observation is consistent with findings from previous studies, including those by Job M et al. (2021)[26], Sajadi S and Naderi H

(2017)[27], and Peidaee E et al. (2018)[28], which similarly noted a higher incidence in males, with the mean age ranging between 40 and 60 years.

Underlying comorbidities such as hypertension, diabetes mellitus, and coronary artery disease (CAD) are frequently observed in patients with AFE, and these factors may influence the clinical outcomes. In our study, the most common comorbidities were hypertension (39.6%), diabetes mellitus (29.7%), and hypothyroidism (16.5%), followed by CAD (12.1%). These findings are in line with studies by Singh Y et al. (2017)[29], Peidaee E et al. (2018)[28], and Job M et al. (2021)[26], which reported a high prevalence of hypertension and diabetes among patients with AFE. The presenting symptoms of AFE often include fever, altered mental status, headache, nausea/vomiting, and neurological signs such as nuchal rigidity. Fever and altered sensorium are universally present, as observed in our study, where these symptoms were seen in all 91 patients. Other symptoms such as headache and nuchal rigidity were also common, with a statistically significant correlation to CNS infections. These findings are consistent with studies by Sen I et al. (2019)[30], Sajadi S and Naderi H (2017)[27], and Bhalla A et al. (2010)[31], where fever, altered mental state, and headache were the most frequent presenting complaints.

In terms of diagnostic investigations, cerebrospinal fluid (CSF) analysis plays a crucial role in differentiating between CNS infections and sepsis-associated encephalopathy (SAE). In our study, 37.7% of patients exhibited leukocytosis, with CSF analysis showing lymphocytic predominance in 37.7% and polymorph predominance in 20% of cases. The majority of cases in our study had a primary CNS focus, with viral meningoencephalitis being the most common etiology (31.9%), followed by bacterial meningoencephalitis (19.8%), urosepsis with septic encephalopathy (21.9%), and tuberculous meningitis (12.1%). These results align with findings from Bhalla A et al. (2010)[31], Clare Huppatz et al. (2009)[32], and Khan R et al. (2015)[33], who also reported a high prevalence of CNS infections, particularly viral and bacterial meningoencephalitis, as the leading causes of AFE.

Mortality in AFE varies depending on several factors, including age, comorbidities, and the severity of the neurological involvement. In our study, the overall mortality rate was 11%, with a significantly higher mortality rate observed in patients over 60 years of age (16.3%). Mortality was also associated with underlying comorbidities, particularly hypertension (19.4%), diabetes mellitus (14.8%), and CAD (9.1%). This pattern is consistent with the findings of Singh Y et al. (2017)[29], who observed that the presence of comorbidities such as hypertension and diabetes mellitus significantly increased the risk of death. Mortality was also influenced by the type of infection, with patients suffering from bacterial meningoencephalitis and tuberculous meningitis showing higher mortality rates. This observation is supported by studies by Bhalla A et al. (2010)[31], Khan R et al. (2015)[33] and Sajadi S and Naderi H (2017)[27], who also noted higher mortality rates in patients with primary CNS infections compared to those with SAE.

Additionally, in our study, patients with a Glasgow Coma Scale (GCS) score of less than 10 had a significantly higher mortality rate (20.6%) compared to those with a GCS score greater than 10 (5.3%). This finding is consistent with studies by Biswas et al. (2021)[34], who reported that a low GCS score was a strong predictor of poor outcome and increased risk of death.

In conclusion, AFE remains a significant cause of morbidity and mortality, particularly in patients with underlying comorbidities and severe CNS infections. The findings of this study contribute to a better understanding of the clinical patterns, etiological factors, and prognostic indicators in AFE, which can guide clinicians in the management and treatment of this life-threatening condition.

CONCLUSION

In our study, the most common presentations in patients with acute febrile encephalopathy (AFE), apart from fever and altered sensorium, were headache, nuchal rigidity, and nausea/vomiting, which indicated that CNS infections were the predominant cause. Lymphocytic predominance in cerebrospinal fluid (CSF) analysis suggested a viral etiology, while leukocytosis with neutrophilia on complete blood count was more suggestive of an extra-CNS cause of AFE. Primary CNS infections, particularly viral meningo-encephalitis, were associated with higher mortality. We observed that age above 60 years was linked to higher mortality, with hypertension being the most

common comorbidity associated with poor prognosis, followed by diabetes mellitus. Additionally, patients presenting with a Glasgow Coma Scale (GCS) score of <10 had a significantly higher mortality compared to those with a GCS score of >10. Given the 11% mortality rate in our study, with viral meningoencephalitis being the most common CNS infection, we recommend maintaining a low threshold for performing lumbar puncture and initiating early treatment with antibiotics and antivirals. However, further studies with larger sample sizes are needed to validate these findings.

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Table 1: Etiological diagnosis of study patients

Etiological diagnosis	Number	Percentage
Urosepsis/Pyelonephritis with septic encephalopathy	20	21.9
TBM	11	12.1
Viral meningo encephalitis	29	31.9
Bacterial meningo encephalitis	18	19.8
Cholangitis	3	3.3
Necrotizing pancreatitis	3	3.3
Lung abscess	2	2.2
Diabetic foot	1	1.1
Bed sore	1	1.1
Intra abdomen	1	1.1
Gut gangrene with mesenteric ischemia with septic encephalopathy	1	1.1
Perpeurial sepsis septic encephalopathy	1	1.1
Total	91	100

Table 2: Outcome of study patients		
Outcome	**Number**	**Percentage**
Mortality	10	11.0
Survived	81	89.0
Total	91	100

Table 3: Mortality associated with age, focus of infection, GCS among study patients						
Variables	**Category**	**Mortality**		**No mortality**		**P-value**
		No.	**%age**	**No.**	**%age**	
Age in Years	< 60	3	6.3	45	93.8	0.234
	≥ 60	7	16.3	36	83.7	
	Total	10	11.0	81	89.0	
Focus of Infection	CNS	8	13.8	50	86.2	0.352
	SAE	2	6.1	31	93.9	
	Total	10	11.0	81	89.0	
GCS	< 10	7	20.6	27	79.4	0.046*
	≥ 10	3	5.3	54	94.7	
	Total	10	11.0	81	89.0	