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ORIGINAL RESEARCH

A study of pleocytosis and biochemical abnormalities in Cerebrospinal Fluid of cases of suspected neuro-infection

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ABSTRACT

Introduction: Acute febrile encephalopathy (AFE) is a significant cause of hospital admissions, often associated with high mortality if untreated. This study aims to assess the cytological and biochemical changes in cerebrospinal fluid (CSF) in febrile patients with altered sensorium, helping in early diagnosis and effective management. **Methodology:** A prospective study was conducted at PESIMSR, Kuppam, Andhra Pradesh, including 50 patients with fever and altered sensorium. CSF samples were collected via lumbar puncture and analyzed for cytological and biochemical changes. Parameters like CSF glucose, protein, ADA, cell count, and microbial analysis were correlated with patient outcomes. **Results:** Among the 50 patients, 64% were male, and 36% were female. Most were presented between the 5th and 7th day of fever. The CSF analysis revealed higher cell counts in tuberculosis and bacterial infections than in viral cases. Elevated protein and ADA levels were noted in tuberculosis cases. 88% of patients recovered, while 12% succumbed to the illness. **Conclusion:** CSF cytological and biochemical analysis is crucial for diagnosing febrile encephalopathy. Elevated cell counts, protein, and ADA levels are significant markers of bacterial and tuberculous infections. Early diagnosis and treatment can improve outcomes.

Keywords: Cerebrospinal fluid analysis, Acute febrile encephalopathy, Bacterial meningitis, Tuberculous meningitis, Viral meningitis

INTRODUCTION

Acute febrile encephalopathy (AFE) is characterized by an acute onset of altered mental status, often following a febrile illness. It is associated with a variety of central nervous system (CNS) infections, including bacterial, viral, and tuberculous meningitis. Despite advancements in medicine, diagnosing the cause of AFE remains challenging, especially in resource-limited settings. Cerebrospinal fluid (CSF) analysis is crucial in identifying the etiology, leading to timely and targeted therapy.

CSF analysis provides insights into cytological and biochemical alterations in various types of meningitis and encephalopathies. Elevated white cell count, protein, and adenosine deaminase (ADA) levels are commonly seen in bacterial and tuberculous infections, whereas viral infections present with milder changes.

This study aims to analyze the cytological and biochemical changes in the CSF of febrile patients presenting with altered sensorium in a tertiary care hospital and to correlate these findings with clinical outcomes.

MATERIALS AND METHODS

Study Design

This is a descriptive prospective study conducted over 18 months at the Department of General Medicine, PES Institute of Medical Sciences and Research (PESIMSR), Kuppam, Andhra Pradesh.

Study Population

Fifty patients presenting with fever and altered sensorium were enrolled in the study based on the following inclusion and exclusion criteria:

Inclusion Criteria: Patients aged 18-70 years presenting with fever for less than 14 days and altered sensorium lasting for more than 12 hours, who were willing to give informed consent.

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Exclusion Criteria: Patients under 18 years of age, those with metabolic or hypoxic encephalopathy, diabetic ketoacidosis, substance abuse, or other non-infectious causes were excluded.

Data Collection and Sample Analysis

After obtaining informed consent, CSF was collected via lumbar puncture under sterile conditions. The samples were analyzed for cytological (cell count and type) and biochemical parameters (glucose, protein, ADA). CSF microbiology was performed to identify any infectious pathogens.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using Epi Info software. Descriptive statistics such as means, percentages, and standard deviations were used to present the data. Continuous variables were analyzed using the student t-test, with significance set at $p<0.05$.

RESULTS

The study included 50 patients who were presented with fever and altered sensorium. CSF samples were analyzed to assess cytological and biochemical changes, and the findings were correlated with the clinical outcomes of the patients.

The majority of the patients were male (64%), with the remaining 36% being female. Most patients (50%) were presented with symptoms of fever between 5-7 days of onset, with a mean presentation of 5.76 ± 2.33 days.

All patients (100%) were presented with fever and altered sensorium. Other common symptoms included seizures (42%), headache (38%), and vomiting (24%).The GCS scores indicated that 30% of the patients had a score of less than 8, indicating a more severe presentation, while 70% had a score between 8-13.

The CSF analysis showed significant differences in cytological and biochemical parameters based on the underlying diagnosis. Patients with bacterial and tuberculous infections had higher CSF cell counts, protein levels, and ADA levels compared to those with viral infections.

The mean CSF cell count was highest in tuberculous meningitis (1299.33 ± 2399.76 cells/µL) followed by bacterial infections (754.53 ± 1058.9 cells/µL). In viral infections, the mean cell count was significantly lower (154.52 ± 76.82 cells/µL).

Protein levels were markedly elevated in bacterial meningitis (251.46 ± 10.43 mg/dL) and tuberculous meningitis (198.41 ± 129.3 mg/dL), whereas viral infections had lower levels (93.66 ± 58.61 mg/dL).CSF ADA levels were significantly higher in tuberculous meningitis (76.84 ± 2.57 IU/L) compared to viral infections (44.69 ± 1.08 IU/L).

CSF microbiological tests identified Listeria and Meningococcus in 2% of cases, while 96% of the CSF cultures were negative. Blood cultures identified Scrub Typhus in 4% of cases.Out of the 50 patients, 88% recovered, while 12% succumbed to the illness. Mortality was more frequent in patients with bacterial and tuberculous meningitis.

Table 1: Gender Distribution of Study Participants

Gender	Frequency (%)
Male	32 (64%)
Female	18 (36%)

Table 2: Symptom Distribution Among Study Participants

Symptoms	Frequency (%)
Fever	50 (100%)
Altered sensorium	50 (100%)
Seizures	21 (42%)
Headache	19 (38%)
Vomiting	12 (24%)

Table 3: GCS Scores Among Study Participants

GCS Score	Frequency (%)
<8	15 (30%)
8-13	35 (70%)

Table 4: Mean CSF Findings Based on Diagnosis

Diagnosis	CSF Cell Count (cells/µL)	CSF Protein (mg/dL)	CSF ADA (IU/L)
Bacterial	754.53 ± 1058.9	251.46 ± 10.43	30.45 ± 1.77
Tuberculosis	1299.33 ± 2399.76	198.41 ± 129.3	76.84 ± 2.57
Viral	154.52 ± 76.82	93.66 ± 58.61	44.69 ± 1.08

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Table 5: CSF Microbiology Findings

Microbial Growth	Frequency (%)
Listeria	1 (2%)
Meningococcus	1 (2%)
No growth	48 (96%)

Table 6: Blood Culture Results

Blood Culture	Frequency (%)
No growth	48 (96%)
Scrub Typhus positive	2 (4%)

Table 7: Outcome Distribution

Outcome	Frequency (%)
Recovered	44 (88%)
Death	6 (12%)

DISCUSSION

Acute febrile encephalopathy (AFE) is a critical clinical condition that poses significant diagnostic challenges due to its multifactorial etiology. This study highlights the importance of cerebrospinal fluid (CSF) analysis in distinguishing between various causes of AFE, particularly bacterial, tuberculous, and viral infections.

The study found that CSF cell counts were significantly higher in patients with bacterial (754.53 ± 1058.9 cells/μL) and tuberculous meningitis (1299.33 ± 2399.76 cells/μL) compared to those with viral infections (154.52 ± 76.82 cells/μL). Elevated white blood cell (WBC) counts in the CSF are consistent with previous findings, which indicate that bacterial infections typically elicit a robust inflammatory response characterized by neutrophil predominance. In contrast, viral infections generally result in a lymphocytic predominance and a comparatively lower cell count[1].

The cytological analysis also revealed that all patients presented with fever and altered sensorium, a finding corroborated by earlier studies that emphasize these symptoms as key indicators of CNS infections[2]. The association of seizures, headache, and vomiting further underscores the need for prompt diagnostic evaluation in similar clinical presentations.

Biochemical parameters, including protein levels and adenosine deaminase (ADA), were markedly elevated in patients with bacterial and tuberculous meningitis. Bacterial meningitis showed an average protein level of 251.46 ± 10.43 mg/dL, while tuberculous meningitis demonstrated 198.41 ± 129.3 mg/dL. These findings are in line with the literature, which indicates that elevated protein levels in CSF reflect increased permeability of the blood-brain barrier during infection[3].

ADA levels were significantly higher in patients with tuberculous meningitis (76.84 ± 2.57 IU/L) compared to viral infections (44.69 ± 1.08 IU/L). This supports the utility of ADA as a diagnostic marker for tuberculous meningitis, as elevated ADA levels are often associated with active tuberculosis[4]. The sensitivity and specificity of ADA in diagnosing tuberculous meningitis have been documented extensively, making it a valuable adjunct in the diagnostic workup[5].

The microbiological analysis yielded pathogens in a small percentage of cases, with Listeria and Meningococcus isolated in 2% of CSF cultures. This low yield underscores a well-known challenge in diagnosing CNS infections, where microbiological tests may not always identify the causative organism. The failure to detect pathogens can lead to empirical treatment, which may not be optimal[6]. The identification of Scrub Typhus in blood cultures in 4% of patients highlights the need to consider atypical pathogens in differential diagnoses, particularly in endemic regions.

The overall recovery rate of 88% aligns with findings from other studies indicating favorable outcomes with early intervention in AFE[7]. However, the 12% mortality rate, primarily among patients with bacterial and tuberculous meningitis, highlights the potential severity of these infections. Timely recognition and initiation of appropriate treatment protocols are crucial for improving outcomes in this vulnerable patient population[8].

LIMITATIONS

This study has several limitations. The sample size was relatively small, which may affect the generalizability of the findings. Additionally, the study was conducted in a single center, potentially limiting the diversity of the patient population. Future multicenter studies with larger sample sizes are needed to validate these findings and establish standardized diagnostic protocols for AFE.

CONCLUSION

Cytological and biochemical analysis of CSF is essential in diagnosing the etiology of acute febrile encephalopathy. Elevated WBC counts, protein levels, and ADA in CSF are significant markers of bacterial and tuberculous infections. Early diagnosis and targeted treatment based on CSF analysis can improve patient outcomes and reduce mortality associated with these conditions.

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