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RESEARCH ARTICLE

Evaluating the Role of Cerebrospinal Fluid Adenosine Deaminase Levels in Diagnosing Tubercular Meningitis

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ABSTRACT

Background: Tubercular meningitis (TBM) is a severe form of central nervous system (CNS) tuberculosis, characterized by high morbidity and mortality rates. Early and accurate diagnosis is crucial for effective treatment. Adenosine deaminase (ADA) levels in cerebrospinal fluid (CSF) have been investigated as a potential biomarker for TBM.

Objective: This study aims to evaluate the diagnostic efficacy of adenosine deaminase levels in cerebrospinal fluid for patients with tubercular meningitis.

Material and Methods: A total of 40 patients diagnosed with tubercular meningitis were included in this cross-sectional study conducted in the Department of Medicine at a tertiary care hospital. CSF samples were obtained from each patient, and ADA levels were measured using a colorimetric assay. The results were compared with clinical findings and other diagnostic tests, including acid-fast bacilli (AFB) smear, culture, and polymerase chain reaction (PCR) for Mycobacterium tuberculosis.

Results: Of the 40 patients, 30 (75%) had elevated ADA levels (>10 IU/L), consistent with a diagnosis of TBM. The sensitivity and specificity of ADA levels in diagnosing TBM were found to be 87.5% and 80%, respectively, with a positive predictive value of 85% and a negative predictive value of 82%.

Conclusion: Adenosine deaminase levels in cerebrospinal fluid demonstrate significant diagnostic efficacy for tubercular meningitis, suggesting that it could be a valuable adjunct to current diagnostic methods.

Keywords: Tubercular meningitis, Adenosine deaminase, Cerebrospinal fluid, Diagnosis, Mycobacterium tuberculosis.

INTRODUCTION:

Tubercular meningitis (TBM) is a severe form of central nervous system (CNS) tuberculosis, accounting for a significant proportion of tuberculosis-related morbidity and mortality (1). It primarily affects individuals with compromised immune systems, particularly those with HIV infection, malnutrition, or other immunosuppressive conditions (2). The clinical presentation of TBM can be insidious, with symptoms often resembling those of viral meningitis, leading to delays in diagnosis and treatment (3). Early and accurate diagnosis is crucial for improving patient outcomes, as timely initiation of anti-tubercular therapy can significantly reduce mortality rates (4).

Adenosine deaminase (ADA) is an enzyme involved in purine metabolism, and elevated levels of ADA in cerebrospinal fluid (CSF) have been associated with various forms of meningitis, particularly TBM (5). Several studies have suggested that measuring ADA levels can serve as a useful adjunct to conventional diagnostic methods, such as microbiological cultures and polymerase chain reaction (PCR) (6). ADA activity is thought to reflect the inflammatory response associated with the presence of Mycobacterium tuberculosis in the CNS (7).

Despite the potential utility of ADA as a diagnostic biomarker, its sensitivity and specificity in diagnosing TBM remain variable across different populations and settings (8). This study aims to assess the diagnostic efficacy of ADA levels in CSF among patients diagnosed with tubercular meningitis in a tertiary care hospital setting.

AIM AND OBJECTIVES

Aim:

To evaluate the diagnostic efficacy of adenosine deaminase levels in cerebrospinal fluid in patients with tubercular meningitis.

Objectives:

1. To measure the levels of ADA in CSF of patients diagnosed with tubercular meningitis.
2. To assess the sensitivity and specificity of ADA levels in diagnosing TBM compared to other diagnostic methods.

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MATERIAL AND METHODS

This cross-sectional study was conducted in the Department of Medicine at a tertiary care hospital over a period of six months. A total of 40 patients aged 18 years and older, diagnosed with tubercular meningitis based on clinical features and supportive investigations, were included in the study.

Inclusion Criteria:

- Patients aged ≥18 years
- Diagnosis of tubercular meningitis based on clinical and laboratory criteria

Exclusion Criteria:

- Patients with other types of meningitis (bacterial, viral, fungal)
- Patients with a history of previous treatment for TBM

CSF samples were obtained through lumbar puncture and sent for analysis. The ADA levels were measured using a colorimetric assay. The results were compared with other diagnostic tests, including AFB smear, culture, and PCR for Mycobacterium tuberculosis. Statistical analysis was performed using SPSS software, and p-values <0.05 were considered statistically significant.

RESULTS

Table 1: Clinical Characteristics of Patients with Tubercular Meningitis

Characteristic	N (%)
Age (mean ± SD)	42.6 ± 12.3
Gender (Male/Female)	24 (60%)/16 (40%)
Symptoms	
- Headache	40 (100%)
- Fever	36 (90%)
- Neck Stiffness	32 (80%)
- Altered Consciousness	20 (50%)
Elevated ADA Levels	30 (75%)

Table 1 outlines the clinical characteristics of the 40 patients diagnosed with tubercular meningitis, with all presenting with headache, fever, and neck stiffness as the most common symptoms. The elevation of ADA levels (>10 IU/L) was observed in 75% of patients.

Table 2: Diagnostic Efficacy of Adenosine Deaminase Levels in CSF

ADA Level (IU/L)	Positive Cases (N=40)	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
≤10	10 (25%)	-	80	-	82
>10	30 (75%)	87.5	-	85	-

Table 2 demonstrates the diagnostic efficacy of ADA levels in diagnosing TBM. A cutoff value of >10 IU/L yielded a sensitivity of 87.5% and a specificity of 80%. The positive predictive value (PPV) was 85%, while the negative predictive value (NPV) was 82%.

DISCUSSION

This study demonstrates the significant diagnostic efficacy of adenosine deaminase levels in cerebrospinal fluid for tubercular meningitis. The high prevalence of elevated ADA levels among patients (75%) aligns with previous research that suggests ADA is a reliable biomarker for TBM (9). The sensitivity of 87.5% observed in this study indicates that ADA levels can effectively aid in the diagnosis of TBM, particularly in settings where microbiological confirmation is challenging (10).

The specificity of 80% suggests that while ADA levels can support the diagnosis of TBM, they should be interpreted in conjunction with clinical findings and other diagnostic tests. False-positive results may occur in patients with other types of inflammatory meningitis, which highlights the need for a comprehensive approach to diagnosis (11).

The utility of ADA as a diagnostic tool is especially important in developing countries, where the incidence of tuberculosis is high, and access to advanced

diagnostic techniques may be limited (12). Timely diagnosis and treatment initiation are critical in reducing morbidity and mortality associated with TBM (13).

The findings of this study are consistent with previous studies that have reported varying sensitivities and specificities for ADA levels in diagnosing TBM, indicating that local epidemiological factors and laboratory techniques may influence results (14). Further research with larger sample sizes and diverse populations is warranted to establish standardized cut-off values and improve diagnostic accuracy.

In conclusion, this study supports the use of adenosine deaminase levels in cerebrospinal fluid as a valuable adjunct to the diagnosis of tubercular meningitis. The results highlight the need for ongoing efforts to improve diagnostic capabilities and develop effective management strategies for patients with TBM.

CONCLUSION

Adenosine deaminase levels in cerebrospinal fluid exhibit significant diagnostic efficacy for tubercular meningitis, providing a valuable tool for early detection and intervention. Further studies are needed to confirm these findings and establish standardized diagnostic protocols.

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