Clinical and Radiological Profile of Central Nervous System Tuberculosis: A Prospective Observational Study

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Abstract: *Background: Central nervous system tuberculosis (CNS TB) is one of the most severe forms of extrapulmonary tuberculosis and is associated with significant morbidity and mortality, particularly in tuberculosis-endemic countries like India. Early diagnosis is often challenging due to its subacute onset and heterogeneous clinical and radiological features [1, 2]. Objectives: To evaluate the clinical profile, radiological findings, and short-term outcomes of patients diagnosed with CNS tuberculosis. Methods: A prospective observational study was conducted over one year at a tertiary care centre. Fifty-two adult patients diagnosed with CNS tuberculosis were included. Clinical features, cerebrospinal fluid (CSF) analysis, and neuroimaging findings were recorded and analysed. Results: The mean age of patients was 34.5 years with a female predominance (53.85%). Tuberculous meningitis was the most common presentation (46.15%), followed by intracranial tuberculoma (42.3%). MRI brain commonly revealed basal meningeal enhancement, hydrocephalus, infarcts, and ring-enhancing lesions. Conclusion: CNS tuberculosis predominantly affects young adults and presents with a wide clinical and radiological spectrum. Early clinical suspicion supported by timely neuroimaging is essential to reduce neurological sequelae and mortality [3].*

Keywords: Central nervous system tuberculosis; Tuberculous meningitis; Tuberculoma; MRI brain; Extrapulmonary tuberculosis

1. Introduction

Tuberculosis continues to be a major public health concern worldwide. According to the World Health Organization, India contributes nearly one-quarter of the global tuberculosis burden [1]. While pulmonary tuberculosis is the most common manifestation, extrapulmonary tuberculosis accounts for 10–40% of cases, with central nervous system involvement seen in approximately 5–10% [2].

CNS tuberculosis encompasses a spectrum of diseases including tuberculous meningitis, intracranial tuberculoma, spinal arachnoiditis, and tuberculous abscess. Tuberculous meningitis is the most common and severe form, characterized by basal meningeal inflammation, vasculitis, hydrocephalus, and cerebral infarction [3,4]. Delayed diagnosis is associated with high mortality and permanent neurological deficits.

Neuroimaging plays a pivotal role in early diagnosis. MRI brain is superior to CT scan in detecting basal exudates, infarcts, and small parenchymal lesions [5]. The present study was undertaken to describe the clinical and radiological profile of patients with CNS tuberculosis and to compare findings with existing literature.

2. Materials and Methods

This prospective observational study was conducted in the Department of General Medicine at a tertiary care teaching hospital from November 2023 to December 2024. Adult patients aged more than 18 years with newly diagnosed CNS tuberculosis were included. Diagnosis was based on clinical features, CSF analysis, and radiological findings.

Patients with Pott's spine without CNS involvement and those unwilling to provide informed consent were excluded.

Detailed history regarding constitutional symptoms, neurological manifestations, past history of tuberculosis, comorbidities, and addictions was recorded. A thorough neurological examination was performed in all patients.

Laboratory investigations included complete blood count, ESR, CRP, renal and liver function tests, HbA1c, and HIV status. CSF examination included total cell count, protein, glucose, adenosine deaminase, AFB stain, culture, and CBNAAT where feasible. Neuroimaging with CT or MRI brain was performed in all cases.

Ethical approval was obtained from the Institutional Ethics Committee, and written informed consent was taken from all participants. Data were analysed using descriptive statistics.

3. Results

A total of 52 patients with CNS tuberculosis were included in the study. The demographic and clinical distribution is shown in Tables 1 and 2.

Table 1: Age distribution of patients (n = 52)

Age Group (years)	Number of Patients	Percentage
18–30	23	44.2%
30–39	13	25.0%
40–49	5	9.6%
50–60	8	15.4%
>60	3	5.8%

The majority of patients were young adults aged 18–30 years, indicating that CNS tuberculosis commonly affects the economically productive age group, similar to findings reported in earlier Indian studies [6].

Table 2: Spectrum of central nervous system tuberculosis

Type of CNS Tuberculosis	Number of Patients	Percentage

Tuberculous meningitis	24	46.15%
Tuberculoma	22	42.3%
Mixed presentation	4	7.7%
Others (abscess/suprasellar TB)	2	3.8%

Tuberculous meningitis was the most common presentation, followed by intracranial tuberculoma. Similar distribution has been reported by Wasay et al. and Chandra et al. [6,7].

4. Discussion

The present study demonstrates that CNS tuberculosis predominantly affects young adults, with a slight female predominance. Comparable age distribution has been reported in previous studies from the Indian subcontinent [6,7]. The variation in gender distribution across studies may be related to differences in healthcare access and sociocultural factors.

Tuberculous meningitis remained the most frequent clinical entity, emphasizing its importance in clinical practice. MRI brain proved to be the most sensitive imaging modality, detecting basal meningeal enhancement, hydrocephalus, and infarcts, which are hallmark features of advanced disease [5,8]. Early radiological diagnosis allows prompt initiation of antitubercular therapy, thereby reducing complications such as stroke, vision loss, and permanent neurological deficits [3,4].

5. Conclusion

Central nervous system tuberculosis remains a diagnostic and therapeutic challenge in endemic regions. Young adults are commonly affected, and tuberculous meningitis is the predominant manifestation. A high index of clinical suspicion, supported by CSF analysis and early MRI brain imaging, is crucial for timely diagnosis and improved patient outcomes.

6. Limitations

This was a single-centre study with a relatively small sample size. Long-term neurological outcomes were not assessed. Larger multicentric studies with long-term follow-up are required.

Ethical Approval
The study was approved by the Institutional Ethics Committee. Written informed consent was obtained from all participants.

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