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Original Article

Clinical Profile and Outcomes of Pulmonary Tuberculosis in Diabetic Patients versus Non-Diabetic Patients

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ABSTRACT

Background: Tuberculosis (TB) remains a major global health burden, and diabetes mellitus (DM) is an important comorbidity that adversely affects its clinical presentation and treatment outcomes. The dual burden of TB and DM is increasingly recognized, particularly in developing countries. This study aimed to compare the clinical profile and treatment outcomes of pulmonary tuberculosis in patients with and without diabetes mellitus.

Methods: A hospital-based comparative observational study was conducted over a period of one year in a tertiary care teaching hospital. A total of 100 patients with newly diagnosed, microbiologically confirmed pulmonary tuberculosis were included and divided into two groups: 50 patients with diabetes mellitus and 50 patients without diabetes mellitus. Clinical features, radiological findings, sputum status, and treatment outcomes were assessed and compared between the two groups. Data were analyzed using appropriate statistical tests, and a p-value <0.05 was considered statistically significant.

Results: Diabetic patients with pulmonary tuberculosis were older compared to non-diabetic patients (52.6 ± 10.8 vs 41.3 ± 12.5 years, $p < 0.001$). Clinical symptoms were comparable between the groups. Cavitary lesions and extensive radiological involvement were more frequent in diabetic patients. Sputum smear positivity was similar in both groups; however, delayed sputum conversion was significantly higher among diabetics (36% vs 16%, $p = 0.02$). Favourable treatment outcomes were significantly lower in diabetic patients compared to non-diabetics (68% vs 88%, $p = 0.02$), while unfavourable outcomes were higher in the diabetic group.

Conclusion: Diabetes mellitus is associated with poorer treatment outcomes and delayed microbiological response in patients with pulmonary tuberculosis. Early screening and optimal glycaemic control may improve TB management outcomes in diabetic patients.

Keywords: Pulmonary tuberculosis; Diabetes mellitus; Treatment outcome; Sputum conversion; Comorbidity; Clinical profile; Tuberculosis control.

INTRODUCTION

Tuberculosis (TB) remains one of the leading infectious causes of morbidity and mortality worldwide, caused by *Mycobacterium tuberculosis*. Despite the availability of effective chemotherapy under national and global control programmes, TB continues to pose a major public health challenge, particularly in low- and middle-income countries[1]. The clinical course of pulmonary tuberculosis is influenced not only by the pathogen but also by host-related factors such as nutritional status, immune suppression, and comorbid conditions. Among these, diabetes mellitus (DM) has emerged as a significant risk factor that alters both susceptibility to infection and treatment response[2]. Diabetes mellitus is a chronic metabolic disorder characterized by persistent hyperglycaemia, which impairs innate and adaptive immune responses, including macrophage function and T-cell mediated immunity. These immunological alterations increase the risk of progression from latent TB infection to active disease and may also contribute to more severe disease presentation and poorer outcomes[3].

The global burden of tuberculosis remains substantial, with the World Health Organization estimating approximately 10.6 million new TB cases and 1.3 million deaths annually. India contributes a significant proportion of this burden, accounting for nearly one-fourth of global TB cases. At the same time, the prevalence of diabetes is rising rapidly, with India being termed the "diabetes capital of the world," harboring an estimated 77 million adults with diabetes[4]. The co-existence of TB and DM represents a growing dual epidemic, especially in countries like India where both diseases are highly prevalent. Studies suggest that individuals with diabetes have approximately two to three times higher risk of developing active tuberculosis compared to non-diabetics. Several studies have demonstrated the adverse impact of diabetes on tuberculosis outcomes. Dooley and Chaisson (2009) reported that diabetic patients with TB are more likely to present with cavitary lesions and delayed sputum conversion[5]. Bacakoglu et al. (2001) observed higher rates of treatment failure and relapse among diabetic TB patients compared to non-diabetics[6]. Similarly, a systematic review by Jeon and Murray (2008) confirmed that diabetes significantly increases the risk of active TB and worsens treatment outcomes[7].

In Indian studies, Viswanathan et al. and Balakrishnan et al. have also reported that diabetic TB patients tend to have more severe radiological disease, higher bacillary loads, and prolonged infectiousness[8,9]. However, some studies have shown variability in outcomes depending on glycaemic control and duration of diabetes. Despite increasing evidence linking diabetes mellitus and tuberculosis, there remains variability in clinical presentation and treatment outcomes across different populations. In India, where the burden of both diseases is high, region-specific hospital-based comparative data are essential for better understanding this association. Moreover, early identification of differences in clinical profile and treatment response between diabetic and non-diabetic TB patients can help clinicians optimize management strategies, improve glycaemic control, and reduce adverse outcomes. Hence, this study was undertaken to compare the clinical profile and treatment outcomes of pulmonary tuberculosis in diabetic and non-diabetic patients in a tertiary care setting.

AIM AND OBJECTIVES

Aim of the Study

To compare the clinical profile and treatment outcomes of pulmonary tuberculosis (PTB) in diabetic patients versus non-diabetic patients attending a tertiary care hospital.

Objectives of the Study

1. To describe and compare the clinical manifestations of pulmonary tuberculosis in diabetic and non-diabetic patients.
2. To assess and compare the treatment outcomes (cure rate, treatment completion, default, failure, and mortality) between diabetic and non-diabetic PTB patients.
3. To evaluate the association between diabetes mellitus and adverse tuberculosis outcomes such as delayed sputum conversion, treatment failure, and relapse.

MATERIALS AND METHODS

Study Design

This was a hospital-based comparative observational study conducted to evaluate and compare the clinical profile and treatment outcomes of pulmonary tuberculosis (PTB) in patients with diabetes mellitus and those without diabetes mellitus.

Study Setting

The study was conducted in the Department of Pulmonary Medicine and Department of General Medicine of a tertiary care teaching hospital in South India.

Study Duration

The study was carried out over a period of 12 months, including patient recruitment, follow-up during treatment, and data analysis.

Study Population

Patients diagnosed with newly registered, microbiologically confirmed pulmonary tuberculosis attending the outpatient and inpatient services were enrolled.

Study Groups

Participants were divided into two groups:

- Group A (Cases): Pulmonary tuberculosis patients with diabetes mellitus
- Group B (Controls): Pulmonary tuberculosis patients without diabetes mellitus

Each group consisted of 50 patients, making a total sample size of 100 participants.

Inclusion Criteria

1. Age ≥ 18 years
2. Newly diagnosed, microbiologically confirmed pulmonary tuberculosis (sputum AFB smear and/or CBNAAT positive)

3. Willingness to participate and provide informed consent
4. For Group A: Patients diagnosed with diabetes mellitus (known case or newly diagnosed based on ADA criteria)

Exclusion Criteria

1. Extrapulmonary tuberculosis
2. HIV-positive patients
3. Patients on immunosuppressive therapy (e.g., long-term steroids, chemotherapy)
4. Previously treated or drug-resistant tuberculosis cases
5. Critically ill patients not able to complete follow-up

Diagnosis of Diabetes Mellitus

Diabetes mellitus was diagnosed based on **American Diabetes Association (ADA) criteria (2024)**:

1. Fasting plasma glucose ≥126 mg/dL, or
2. Random plasma glucose ≥200 mg/dL with symptoms, or
3. HbA1c ≥6.5%, or
4. Known case on antidiabetic treatment

Data Collection

A predesigned and structured proforma was used to collect data including:

1. Demographic details (age, sex, socioeconomic status)
2. Clinical presentation (cough, fever, weight loss, hemoptysis, etc.)
3. Comorbidities (duration and control of diabetes, hypertension, etc.)
4. Radiological findings (chest X-ray patterns)
5. Microbiological data (sputum smear grading, CBNAAT results)
6. Treatment outcomes as per Revised National Tuberculosis Control Programme (RNTCP/NTEP) definitions

Treatment and Follow-Up

All patients were treated under the **National Tuberculosis Elimination Programme (NTEP)** with standard first-line anti-tubercular therapy (ATT). Patients were followed up monthly during the intensive and continuation phases to assess:

1. Symptomatic improvement
2. Sputum conversion status
3. Treatment adherence
4. Adverse drug reactions
5. Final treatment outcome

Outcome Definitions

Treatment outcomes were classified according to WHO/NTEP guidelines:

1. Cured
2. Treatment completed
3. Treatment failure
4. Default/lost to follow-up
5. Died

For analysis, outcomes were also grouped as:

- Favourable outcome: Cure + treatment completed
- Unfavourable outcome: Failure + default + death

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using appropriate statistical software (SPSS version 25).

- Categorical variables were expressed as proportions and compared using Chi-square test or Fisher's exact test.
- Continuous variables were expressed as mean ± standard deviation and compared using Student's t-test.
- A p-value <0.05 was considered statistically significant.

RESULTS

A total of 100 patients diagnosed with pulmonary tuberculosis were included in the study. They were divided into two groups: 50 patients with diabetes mellitus (Group A) and 50 patients without diabetes mellitus (Group B). The findings are presented below.

Table 1: Baseline demographic characteristics of study population

Characteristic	TB with Diabetes (n=50)	TB without Diabetes (n=50)	p-value
Mean age (years)	52.6 ± 10.8	41.3 ± 12.5	<0.001*

Male sex	32 (64%)	30 (60%)	0.68
Female sex	18 (36%)	20 (40%)	
Rural residence	28 (56%)	30 (60%)	0.68
Smokers	22 (44%)	20 (40%)	0.68

*Significant difference observed in age distribution between groups.

Table 2: Clinical presentation of pulmonary tuberculosis

Clinical Feature	TB with Diabetes (n=50)	TB without Diabetes (n=50)	p-value
Cough	48 (96%)	46 (92%)	0.39
Fever	42 (84%)	40 (80%)	0.60
Weight loss	44 (88%)	38 (76%)	0.11
Night sweats	30 (60%)	28 (56%)	0.68
Hemoptysis	14 (28%)	10 (20%)	0.33
Dyspnea	20 (40%)	12 (24%)	0.08

Table 3: Radiological findings (Chest X-ray patterns)

Radiological Pattern	TB with Diabetes (n=50)	TB without Diabetes (n=50)	p-value
Upper lobe infiltrates	34 (68%)	40 (80%)	0.18
Cavitary lesions	26 (52%)	18 (36%)	0.11
Lower/middle zone involvement	10 (20%)	6 (12%)	0.26
Miliary pattern	4 (8%)	2 (4%)	0.40
Pleural effusion	6 (12%)	4 (8%)	0.51

Table 4: Microbiological profile and sputum status

Parameter	TB with Diabetes (n=50)	TB without Diabetes (n=50)	p-value
Sputum smear positive	42 (84%)	38 (76%)	0.32
High-grade smear positivity (2+/3+)	24 (48%)	16 (32%)	0.10
CBNAAT positive	46 (92%)	44 (88%)	0.50
Delayed sputum conversion (>2 months)	18 (36%)	8 (16%)	0.02*

*Statistically significant delayed sputum conversion in diabetic TB patients

Table 5: Treatment outcomes

Outcome	TB with Diabetes (n=50)	TB without Diabetes (n=50)	p-value
Cured	26 (52%)	34 (68%)	0.10
Treatment completed	8 (16%)	10 (20%)	0.59
Treatment failure	6 (12%)	2 (4%)	0.14
Default/Lost to follow-up	6 (12%)	2 (4%)	0.14
Death	4 (8%)	2 (4%)	0.40
Favourable outcome	**34 (68%)**	**44 (88%)**	**0.02***
Unfavourable outcome	**16 (32%)**	**6 (12%)**	**0.02***

*Significant association between diabetes mellitus and unfavourable TB outcomes.

DISCUSSION

The present study compared the clinical profile and treatment outcomes of pulmonary tuberculosis (PTB) in diabetic and non-diabetic patients. A total of 100 patients were included, with 50 in each group. The findings were analyzed and compared with relevant published literature to understand the influence of diabetes mellitus on tuberculosis. In the present study, diabetic patients with PTB were significantly older than non-diabetic patients. This observation is consistent with the study by Bacakoglu et al., who also reported that TB patients with diabetes tend to be older due to the higher prevalence of diabetes in the middle-aged and elderly population[6]. Similar age distribution patterns were also reported by Dooley and Chaisson, emphasizing that the dual burden of TB and diabetes is more common in older age groups[5]. Regarding gender distribution, no significant difference was observed between the two groups. Comparable findings were reported by Jeon and Murray in their systematic review, where sex distribution did not significantly modify the association between diabetes and tuberculosis[7]. This suggests that diabetes-related susceptibility to TB is independent of gender.

In the present study, respiratory symptoms such as cough, fever, and weight loss were common in both groups, with no statistically significant difference. However, dyspnea and hemoptysis were slightly more frequent among diabetic patients. Similar clinical presentations were described by Viswanathan et al., who observed that diabetic TB patients often present with more symptomatic and prolonged disease, although differences may not always reach statistical significance[9]. Radiologically, cavitary lesions and extensive lung involvement were more frequent in diabetic patients in this study. This finding is in agreement with Restrepo et al., who reported that diabetes is associated with more advanced pulmonary disease

and higher bacillary burden[10]. Bacakoglu et al. also demonstrated a higher incidence of lower lung zone involvement and cavitation among diabetic TB patients, supporting altered immune response and impaired disease containment in diabetics[6].

Microbiologically, sputum smear positivity was slightly higher in diabetic patients, though not statistically significant. However, delayed sputum conversion was significantly more common in diabetics (36% vs 16%, p = 0.02). Similar results were reported by Baker et al., who observed delayed culture conversion in diabetic TB patients compared to non-diabetics[11]. Poor glycaemic control has been suggested as a major factor contributing to persistent bacillary load and delayed response. Regarding treatment outcomes, favourable outcomes were significantly lower in diabetic patients (68% vs 88%), while unfavourable outcomes were higher. This is consistent with the findings of Dooley and Chaisson, who reported increased rates of treatment failure, relapse, and mortality among diabetic TB patients[5]. Likewise, Baker et al. demonstrated that diabetes adversely affects TB treatment success rates and increases risk of poor outcomes[11]. The higher proportion of unfavourable outcomes in diabetic patients in the present study may be attributed to impaired immune response, higher disease severity, and possible pharmacokinetic interactions affecting anti-tubercular drug efficacy. Additionally, poor glycaemic control may further delay microbiological clearance and prolong infectiousness. Overall, the findings of this study reinforce the evidence that diabetes mellitus negatively influences the clinical course and treatment outcomes of pulmonary tuberculosis.

CONCLUSION

The present study demonstrates that diabetes mellitus has a significant adverse impact on the clinical course and treatment outcomes of pulmonary tuberculosis. Although the presenting symptoms were largely similar in both diabetic and non-diabetic patients, diabetic patients showed a higher tendency for more extensive radiological involvement and delayed sputum conversion. Importantly, favourable treatment outcomes were significantly lower in diabetic patients compared to non-diabetics, indicating poorer overall prognosis. These findings highlight the need for early screening for diabetes in all tuberculosis patients and strict glycaemic control during anti-tubercular therapy to improve treatment outcomes and reduce disease transmission.

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