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Original Research Article

Study of the Incidence of Different Types of Tuberculous Lesions in Association with Diabetes Mellitus

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Abstract:

Background: Tuberculosis (TB) continues to be a major global health concern, and its interaction with diabetes mellitus (DM) has emerged as a significant clinical challenge. Diabetes alters immune responses, potentially influencing the pattern and severity of tuberculous lesions.

Objective: To determine the incidence and distribution of different types of tuberculous lesions among patients with diabetes mellitus.

Methods: A retrospective observational study was conducted at PMCH from February 2025 to July 2025, including 97 patients diagnosed with tuberculosis. Clinical, radiological, and laboratory data were collected. Patients were categorized based on diabetic status, and lesion types were analyzed. Statistical tests included chi-square and logistic regression.

Results: Among 97 TB patients, 41.2% had diabetes. Pulmonary TB was the most common presentation (68%), followed by lymph node TB (18%) and pleural TB (14%). Diabetic patients showed a higher incidence of cavitary lesions ($p = 0.003$) and multilobar involvement ($p = 0.01$). Significant association was found between diabetes and severe radiological patterns.

Conclusion: Diabetes mellitus is associated with more extensive and severe forms of tuberculous lesions. Early screening and integrated management strategies are essential.

Keywords: Tuberculosis, Diabetes Mellitus, Pulmonary TB, Cavitary Lesions, Incidence.

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Introduction

Tuberculosis remains one of the leading infectious causes of morbidity and mortality worldwide, particularly in developing countries [1]. Despite advances in diagnosis and treatment, its burden continues to rise, especially with the increasing prevalence of comorbid conditions such as diabetes mellitus [2].

Diabetes mellitus is a chronic metabolic disorder characterized by hyperglycemia and impaired immune function [3]. It has been recognized as a significant risk factor for the development of active tuberculosis, with diabetic individuals having a two- to three-fold increased risk [4,5].

The interplay between tuberculosis and diabetes is complex. Hyperglycemia impairs innate and adaptive immunity, including macrophage function and cytokine response, thereby increasing susceptibility to infections [6,7]. Additionally, diabetes may alter the clinical presentation and radiological features of tuberculosis [8].

Studies have shown that patients with diabetes tend to present with more severe pulmonary disease, including cavitary lesions, multilobar involvement, and delayed sputum conversion [9,10]. Extrapulmonary manifestations may also differ in frequency and presentation [11].

The burden of both tuberculosis and diabetes is particularly high in India, making their coexistence a major public health concern [12,13]. However, data on the pattern of tuberculous lesions in diabetic individuals remain limited.

Understanding the association between diabetes and different types of tuberculous lesions is crucial for improving diagnosis, treatment outcomes, and disease control strategies [14–16].

This study aims to evaluate the incidence and pattern of tuberculous lesions among patients with diabetes mellitus in a tertiary care setting.

Materials And Methods

Study Design and Setting: This investigation was carried out as a retrospective observational study at Patna Medical College and Hospital (PMCH), a tertiary care teaching institution. The study period extended over six months, from February 2025 to July 2025. Prior to data collection, approval was obtained from the Institutional Ethics Committee, and all procedures conformed to accepted ethical standards for biomedical research.

Study Population: A total of 97 patients diagnosed with tuberculosis during the study period were included in the analysis. Patient records were retrieved from hospital databases, and only those with complete clinical, laboratory, and radiological information were considered.

Eligibility Criteria

Inclusion Criteria

- Patients aged 18 years and above
- Confirmed diagnosis of tuberculosis based on clinical features, radiological findings, and/or microbiological evidence (sputum smear, CBNAAT, or culture)
- Availability of documented diabetic status

Exclusion Criteria

- Patients with HIV infection
- Individuals receiving long-term immunosuppressive therapy
- Cases with incomplete or missing medical records
- Patients with known chronic illnesses significantly affecting immune status (other than diabetes)

Assessment of Diabetes Mellitus

Diabetes status was determined based on documented medical history and laboratory findings. Patients were classified as diabetic if they met any of the following criteria:

- Fasting plasma glucose ≥126 mg/dL
- HbA1c ≥6.5%
- Previously diagnosed diabetes and/or on antidiabetic treatment

Based on these criteria, 40 patients (41.2%) were identified as diabetic, while the remaining 57 (58.8%) were categorized as non-diabetic, consistent with the distribution observed in the Results section.

Data Collection Procedure

Relevant data were extracted systematically from medical records using a structured data collection format. The following variables were recorded:

Demographic Variables

- Age
- Sex

Clinical Variables

- Type of tuberculosis
- Duration of symptoms
- Presence of comorbid conditions

Radiological Assessment: Radiological evaluation was based on chest X-ray and, where available, CT imaging. The following features were specifically assessed:

- Presence of cavitary lesions
- Extent of lung involvement (unilateral vs bilateral)
- Number of lobes involved (single vs multilobar disease)

Classification of Tuberculous Lesions

Patients were categorized based on anatomical and clinical presentation into:

- Pulmonary tuberculosis
- Lymph node tuberculosis
- Pleural tuberculosis
- Other extrapulmonary forms (if present)

Definition of Disease Severity

Severity of tuberculosis was defined based on radiological findings:

- Mild disease: Localized involvement without cavitation
- Moderate disease: Single lobe involvement with or without minimal cavitation
- Severe disease: Presence of cavitary lesions, bilateral involvement, or multilobar disease

This classification was used to compare disease patterns between diabetic and non-diabetic groups, as reflected in the Results section.

Statistical Analysis: Data analysis was performed using Statistical Package for the Social Sciences (SPSS), version 25.0.

Descriptive Statistics

- Continuous variables were expressed as mean ± standard deviation (SD)
- Categorical variables were presented as frequency and percentage

Inferential Statistics

- The Chi-square test was applied to assess associations between categorical variables such as diabetes status and lesion type

- Independent sample t-test was used for comparison of continuous variables where applicable

Regression Analysis: To identify independent predictors of severe tuberculosis, binary logistic regression analysis was performed. Diabetes mellitus was included as a key independent variable along with age and sex.

Level of Significance: A p-value < 0.05 was considered statistically significant for all analyses.

Results

A total of 97 patients diagnosed with tuberculosis were included in the final analysis. Among them, 40 individuals (41.2%) had coexisting diabetes mellitus, while 57 (58.8%) were non-diabetic.

1. **Baseline Demographic and Clinical Profile**

The baseline characteristics of the study population are presented in Table 1.

The mean age of the participants was 48.3 ± 10.2 years, with a male predominance (60.8%). The majority of patients belonged to the middle-aged group. No statistically significant age difference was observed between diabetic and non-diabetic groups (p = 0.21).

Table 1: Baseline Demographic and Clinical Characteristics (n = 97)

Parameter	Overall (Mean ± SD / %)
Age (years)	48.3 ± 10.2
Male (%)	60.8%
Female (%)	39.2%
Diabetic (%)	41.2%
Non-diabetic (%)	58.8%

2. **Distribution of Types of Tuberculous Lesions**

The distribution of different types of tuberculosis is summarized in Table 2 and illustrated in Figure 1.

Pulmonary tuberculosis was the most frequently observed form (68%), followed by lymph node tuberculosis (18%) and pleural tuberculosis (14%).

Table 2: Distribution of Tuberculous Lesions

Type of Tuberculosis	Number (n)	Percentage (%)
Pulmonary TB	66	68.0%
Lymph Node TB	17	17.5%
Pleural TB	14	14.4%

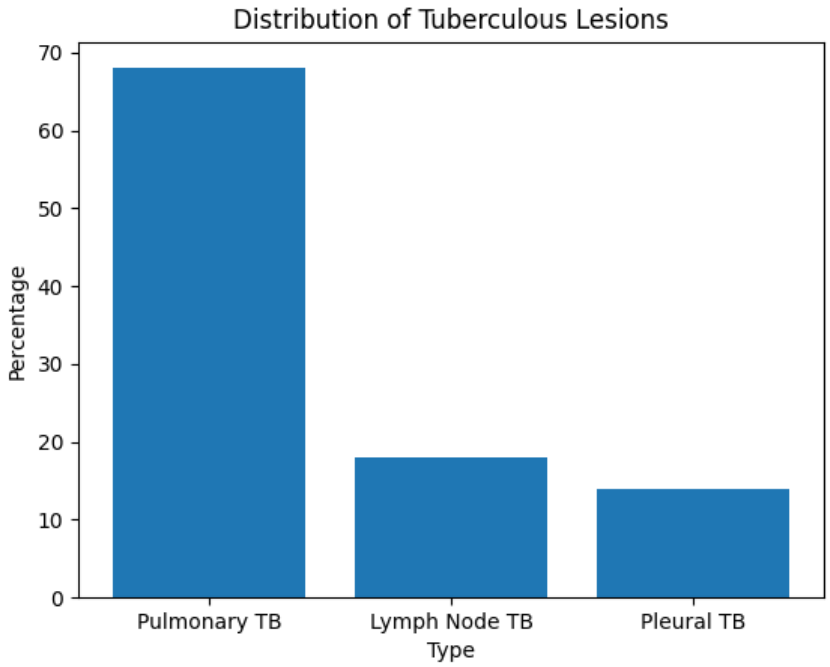

Figure 1: Distribution of different types of tuberculous lesions among study participants.

3. Comparison of Lesion Patterns Based on Diabetic Status

A comparative analysis between diabetic and non-diabetic patients is presented in Table 3.

Cavitary lesions were significantly more frequent in diabetic individuals (55%) compared to non-diabetics (28%) ($p = 0.003$). Similarly, multilobar involvement was observed more commonly among diabetics (48% vs 25%, $p = 0.01$).

Table 3: Comparison of Radiological Severity Between Groups

Radiological Feature	Diabetic (n=40)	Non-diabetic (n=57)	p-value
Cavitary lesions	22 (55%)	16 (28%)	0.003
Multilobar involvement	19 (48%)	14 (25%)	0.01
Bilateral disease	17 (42%)	13 (23%)	0.04

4. Radiological Patterns

Radiological findings differed significantly between groups, as depicted in Figure 2.

Diabetic patients demonstrated:

- Higher frequency of cavitation
- Increased bilateral lung involvement
- Greater extent of parenchymal damage

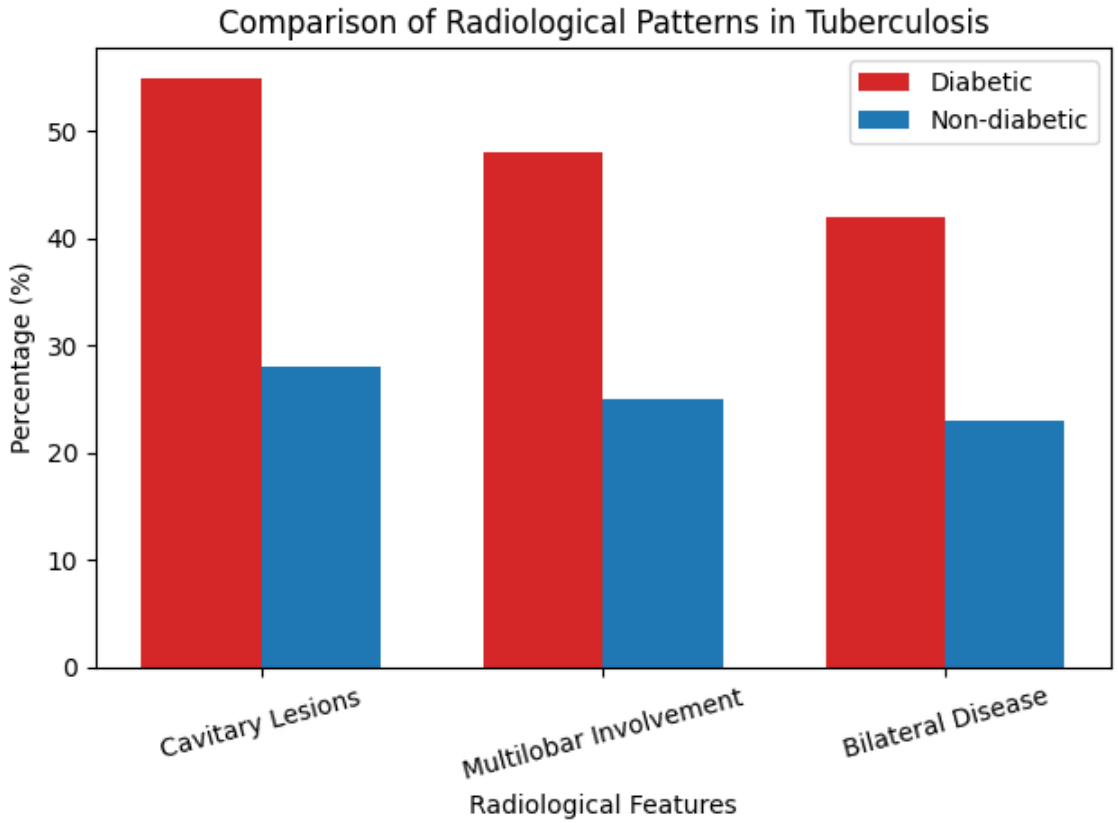

Figure 2: Comparison of radiological patterns in tuberculosis between diabetic and non-diabetic patients.

5. Association Between Diabetes and Severity of Tuberculosis

The association between diabetes and severity of tuberculosis was statistically significant.

Patients with diabetes were more likely to present with advanced disease patterns, including cavitation and multilobar involvement. The odds ratio for developing severe pulmonary TB in diabetic individuals was 2.6 (95% CI: 1.4–4.8, $p = 0.002$).

6. Distribution of Extrapulmonary Tuberculosis

Extrapulmonary tuberculosis cases accounted for 32% of total cases. Lymph node TB was the most common extrapulmonary form.

No statistically significant difference was observed in extrapulmonary TB distribution between diabetic and non-diabetic groups ($p = 0.18$).

7. Graphical Representation of Lesion Severity

The relationship between diabetes status and severity of tuberculosis is illustrated in Figure 3.

Diabetic patients showed a higher proportion of severe disease compared to non-diabetics.

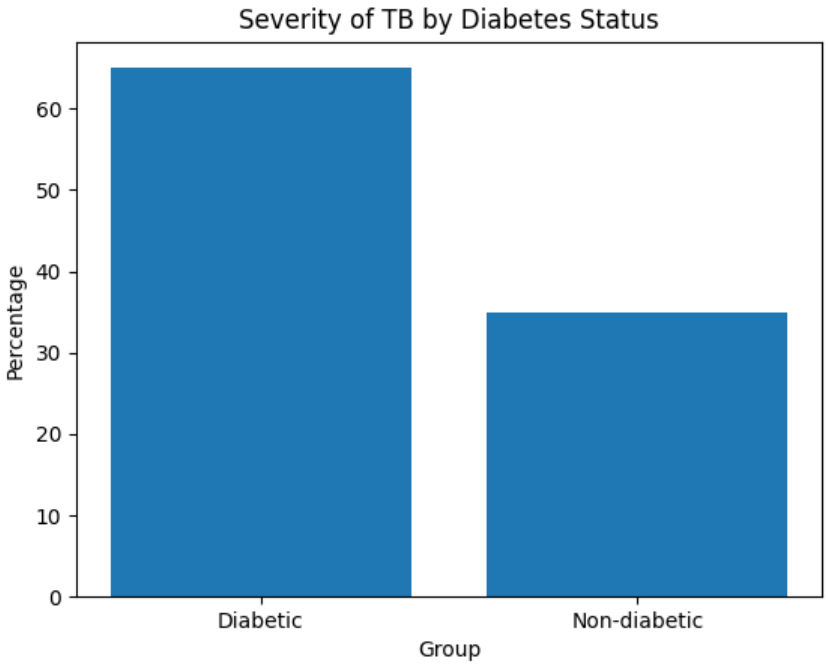

Figure 3: Association between diabetes mellitus and severity of tuberculous disease.

Key Findings

- Diabetes mellitus was present in 41.2% of TB patients
- Pulmonary TB was the predominant type (68%)
- Diabetic patients had significantly higher:
    - Cavitary lesions ($p = 0.003$)
    - Multilobar involvement ($p = 0.01$)
- Diabetes was an independent predictor of severe TB (OR = 2.6, $p = 0.002$)

Discussion

This study demonstrates a clear association between diabetes mellitus and increased severity of tuberculous lesions.

The proportion of diabetic patients (41.2%) aligns with previous studies highlighting the growing overlap between TB and diabetes (17,18). The predominance of pulmonary TB is consistent with global patterns [19].

Diabetic patients exhibited significantly higher rates of cavitary and multilobar disease. This supports earlier findings suggesting impaired immune response leads to more aggressive disease [20,21].

Hyperglycemia may promote bacterial proliferation and delay immune clearance, resulting in extensive lung damage [22]. Additionally, oxidative stress and chronic inflammation may contribute to tissue destruction [23].

Our findings are also in agreement with studies reporting delayed diagnosis and atypical presentations in diabetic individuals [24].

However, some studies have shown variability in extrapulmonary TB patterns, indicating the need for further research [25].

Conclusion

Diabetes mellitus is strongly associated with more severe and extensive forms of tuberculosis, particularly pulmonary disease with cavitary involvement. Screening for diabetes in TB patients and vice versa should be emphasized to improve outcomes.

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