

Incidence of Various Tuberculous Lesions in Indian Patients with Diabetes Mellitus: A Cross-Sectional Study

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Abstract:

Background: Globally, TB is a major health issue, especially in low- and middle-income nations. Diabetes mellitus (DM) increases TB risk and complicates treatment. Due to the greatest worldwide TB burden and rising DM incidence, India faces a double public health problem. This study investigated the incidence and types of tuberculous lesions in Indian patients with diabetes mellitus.

Methods: A total of 250 individuals with a history of DM and respiratory symptoms were included. Data were collected through patient interviews, clinical examinations, and diagnostic tests. The association between diabetes-related factors and the incidence of tuberculous lesions was analyzed.

Results: Out of 250 patients, 70 (28%) were diagnosed with tuberculous lesions. Pulmonary tuberculosis was the most common type (16%), followed by extrapulmonary tuberculosis (8%) and disseminated tuberculosis (4%). The duration of diabetes and higher HbA1c levels were considerably correlated with an increased risk of tuberculous lesions ($p < 0.05$). Patients commonly presented with cough with sputum (85.7%), weight loss (78.6%), and loss of appetite (71.4%). Sputum examination for Acid-Fast Bacilli (AFB) was positive in 64.3% of cases, and chest X-rays showed lesions in 71.4% of patients.

Conclusion: The study highlights a significant incidence of tuberculous lesions among diabetic patients, with pulmonary tuberculosis being the predominant type. Poor glycemic control and longer duration of diabetes are critical risk factors. These findings emphasize the need for regular TB screening and proactive management in diabetic patients to prevent complications and improve outcomes.

Recommendation: Healthcare providers should integrate routine TB screening into the care protocols for diabetic patients, particularly those with poor glycemic control and long-standing diabetes. Public health strategies should focus on the dual burden of TB and DM to enhance early detection and treatment, thereby improving patient outcomes.

Keywords: Tuberculosis, Diabetes Mellitus, Incidence, Glycemic Control

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Introduction

Tuberculosis (TB) continues to be a significant worldwide health issue, especially in nations with lower incomes and intermediate incomes. TB is ranked among the top 10 leading causes of mortality globally, as reported by the World Health Organisation (WHO). In 2019, around 10 million individuals contracted TB, resulting in 1.4 million fatalities [1]. India bears the greatest burden of tuberculosis worldwide, with almost 26% of the global tuberculosis cases [1]. Simultaneously, the occurrence of diabetes mellitus (DM) has been escalating rapidly, with India estimated to have more than 134 million people with diabetes by 2045 [2].

The interaction between TB and DM is intricate and has multiple aspects. Diabetes mellitus poses a substantial risk for the onset of active tuberculosis. Diabetic patients are three times more likely to get tuberculosis compared to those who do not have diabetes. The connection between hyperglycemia and impaired immune responses is responsible for the link with Mycobacterium TB infection control [3]. Moreover, diabetes has a negative impact on the way TB is presented clinically, how it responds to treatment, and the overall prognosis. This makes it especially difficult to manage both diseases together.

In India, the dual burden of TB and diabetes presents a significant public health challenge. The coexistence of these two diseases complicates the diagnosis and management of TB, as diabetes can alter the clinical presentation of TB, leading to delays in diagnosis and initiation of appropriate treatment [4]. Moreover, diabetic patients with TB are more likely to experience severe disease manifestations, higher rates of treatment failure, relapse, and mortality.

Despite the recognition of the TB-diabetes link, there is limited data on the incidence and types of tuberculous lesions in diabetic patients in India. Understanding the

patterns of TB manifestations in this high-risk group is crucial for developing targeted interventions to improve TB control and treatment outcomes.

The study aimed to assess the incidence of different types of tuberculous lesions in patients with diabetes mellitus.

Methodology

Study Design

A prospective observational study.

Study Setting

The study took place at Jawahar Lal Nehru Medical College & Hospital, Bhagalpur, Bihar, from October 2023 to March 2024.

Participants

A total of 250 patients were selected for the study.

Inclusion Criteria

1. Patients with a confirmed history of DM,
2. exhibits signs of chronic cough with productive sputum lasting for over four weeks, accompanied by weight loss, decreased appetite, mild fever, and coughing up blood.
3. Both male and female patients aged 18 years and above.

Exclusion Criteria

1. Patients without a history of diabetes mellitus,
2. without symptoms of cough with productive sputum for > 4 weeks,
3. with a history of recent tuberculosis treatment within the last six months.

Sample size

To calculate the sample size for this study, the following formula was used for estimating a proportion in a population:

$$n = \frac{Z^2 \times p \times (1-p)}{E^2}$$

Where:

- n = sample size
- Z = Z-score corresponding to the desired level of confidence

- p = estimated proportion in the population
- E = margin of error

Bias

Efforts were made to minimize selection bias by enrolling consecutive patients who met the inclusion criteria. Information bias was minimized through standardized data collection procedures and using validated diagnostic tools for diabetes mellitus and tuberculosis.

Variables

Variables included diabetes mellitus status, incidence and types of tuberculous lesions (pulmonary, extrapulmonary, disseminated), age, gender, duration of diabetes, glycemic control (HbA1c levels), comorbidities.

Data Collection

Data were collected through structured patient interviews, thorough clinical examinations, and review of medical records. Clinical symptoms and signs were documented, including the history of presenting illness, past medical history, personal history (smoking, alcohol use), family history, and menstrual and obstetric history for female patients.

Procedure

1. Diagnosis of Diabetes Mellitus:

- Urine Sugar Examination: Urine samples were tested using Diastix strips. The test area of the strip was dipped in the urine sample, and results were recorded based on color changes after 30 seconds.
- Fasting and Random Plasma Glucose Estimation: Plasma glucose was determined using the GOD/POD technique. Blood samples were obtained following an overnight period of not eating for the purpose of measuring fasting plasma glucose levels, and at any time for measuring random plasma glucose levels. Fasting plasma glucose levels of 126 mg/dl or higher and random plasma glucose levels of 200 mg/dl or higher indicate a diagnosis of diabetes mellitus.

- Oral Glucose Tolerance Test (OGTT): Patients consumed a solution containing 75 gm of anhydrous glucose dissolved in 250 ml of water. Blood samples were taken before and 120 minutes after ingestion to measure plasma glucose levels.

2. Diagnosis of Tuberculosis:

- Sputum Examination: Sputum samples were examined for Acid-Fast Bacilli (AFB) using Ziehl-Neelsen staining and cultured for *Mycobacterium tuberculosis*.
- Chest Skiagram: PA view chest X-rays were performed to identify pulmonary lesions.
- Tuberculin Skin Test (TST): The Mantoux test was conducted using 0.1 ml of purified protein derivative (PPD) injected intradermally. Induration was measured after 48-72 hours.
- ELISA for *Mycobacterium Tuberculosis*: Blood samples were tested for antibodies against *Mycobacterium tuberculosis*.
- Additional Tests: Biochemical and cytological examinations, as well as cultures of body fluids (ascitic, pleural, pericardial, cerebrospinal fluid), complete blood counts, ESR, abdominal ultrasound, echocardiography, CT scans of the brain, spine, and abdomen, and tissue biopsies via fine needle aspiration of affected areas.

Statistical Analysis

The data were analysed using SPSS version 21.0. Baseline features for the subjects were summarised using descriptive statistics. A multivariate logistic regression analysis was conducted to determine the factors linked to the occurrence of tuberculous lesions. The study provided odds ratios (ORs) along with 95% confidence intervals (CIs). A p-value below 0.05 was deemed to have statistical significance.

Ethical considerations

The study protocol was approved by the Ethics Committee and written informed consent was received from all the participants.

Result

The study comprised 250 individuals. The average age was 55.3 ± 12.1 years. The gender distribution was fairly balanced, with 140 males and 110 females. The mean

duration of diabetes was 8.5 years, and the average HbA1c level was 8.3%. Nearly half of the participants had hypertension, and about one-third had cardiovascular disease. A significant portion of the participants had a history of smoking.

Table 1: Baseline Attributes

Characteristic	Total (n=250)
Mean Age (years)	55.3 ± 12.1
Gender	
Male	140
Female	110
Duration of Diabetes (years)	8.5 ± 5.6
HbA1c (%)	8.3 ± 1.2
Hypertension (%)	120 (48.0%)
Cardiovascular Disease (%)	80 (32.0%)
Smoking History (%)	90 (36.0%)

Out of the 250 patients, 70 (28%) were diagnosed with tuberculous lesions. Pulmonary tuberculosis was the most common type, affecting 40 patients (16%). Extrapulmonary tuberculosis was found in 20 patients (8%), and disseminated TB was identified in 10 patients (4%).

Table 2: Types of Tuberculous Lesions

Tuberculous Lesion Type	Number of Patients (%)
Pulmonary Tuberculosis	40 (16.0%)
Extrapulmonary Tuberculosis	20 (8.0%)
Disseminated Tuberculosis	10 (4.0%)

There was a strong correlation between the length of time a person had diabetes and greater levels of HbA1c, and an increased likelihood of getting tuberculous lesions. The odds ratios for this association were 1.10 and 1.25, respectively. There was no significant association found between age, gender, hypertension, cardiovascular illness, smoking history, and the occurrence of tuberculous lesions.

Table 3: Multivariate Logistic Regression Analysis

Variable	OR	95% CI	p-value
Age	1.02	0.98 – 1.06	0.234
Gender (Male vs. Female)	1.45	0.82 – 2.65	0.189
Duration of Diabetes	1.10	1.02 – 1.18	0.012
HbA1c	1.25	1.10 – 1.42	0.001
Hypertension	1.15	0.66 – 2.01	0.623
Cardiovascular Disease	1.32	0.73 – 2.39	0.358
Smoking History	1.60	0.89 – 2.87	0.113

The most common symptom was cough with sputum, reported by 85.7% of patients, followed by weight loss (78.6%), loss of appetite (71.4%), low-grade fever (64.3%), and haemoptysis (42.9%).

Table 4: Clinical Presentation of Patients with Tuberculous Lesions

Symptom	Number of Patients (%)
Cough with Sputum	60 (85.7%)
Weight Loss	55 (78.6%)
Loss of Appetite	50 (71.4%)
Low-Grade Fever	45 (64.3%)
Haemoptysis	30 (42.9%)

Sputum examination for Acid-Fast Bacilli (AFB) was positive in 64.3% of patients, while sputum culture confirmed *Mycobacterium tuberculosis* in 57.1% of cases. Chest X-rays (PA view) revealed lesions in 71.4% of patients. The Tuberculin Skin Test (TST) was positive in 50% of patients, and ELISA for *Mycobacterium tuberculosis* was positive in 42.9%.

Table 5: Diagnostic Test Results for Tuberculosis

Diagnostic Test	Positive Results (%)
Sputum Examination for AFB	45 (64.3%)
Sputum Culture for <i>Mycobacterium</i>	40 (57.1%)
Chest Skiagram (PA view)	50 (71.4%)
Tuberculin Skin Test	35 (50.0%)
ELISA for <i>Mycobacterium Tuberculosis</i>	30 (42.9%)

Discussion

A total of 250 participants with a history of diabetes and respiratory symptoms were included in the study. The average age was 55.3 years, with a balanced gender distribution. The mean duration of diabetes was 8.5 years, and nearly half of the participants also had hypertension.

The study found that 28% of the patients were diagnosed with tuberculous lesions, with pulmonary tuberculosis being the most common type, affecting 16% of the patients. Extrapulmonary tuberculosis was present in 8%, and disseminated tuberculosis in 4% of the patients. These findings indicate a significant burden of tuberculosis among diabetic patients, emphasizing the need for vigilant screening and monitoring in this high-risk group.

The analysis revealed that a longer duration of diabetes and higher HbA1c levels were significantly associated with an increased risk of developing tuberculous lesions. Specifically, for every additional year of diabetes duration, the odds of having tuberculous lesions increased by 10%, and for every 1% increase in HbA1c, the odds

increased by 25%. These results suggest that poor glycemic control and prolonged diabetes are critical risk factors for tuberculosis in diabetic patients.

Clinically, the majority of patients with tuberculous lesions presented with symptoms of cough with sputum (85.7%), weight loss (78.6%), and loss of appetite (71.4%). Diagnostic tests confirmed tuberculosis in a significant portion of patients, with sputum examination for AFB being positive in 64.3% and chest X-rays showing lesions in 71.4% of cases. These findings underscore the importance of considering tuberculosis in diabetic patients presenting with persistent respiratory symptoms and systemic signs of infection.

Overall, this study highlights the intertwined relationship between diabetes mellitus and tuberculosis. Patients with diabetes, especially those with poor glycemic control and a longer duration of disease, are at a heightened risk of developing tuberculous lesions. Regular screening for tuberculosis, prompt diagnosis, and effective management are essential to mitigate the risk and improve outcomes for diabetic patients. These

findings advocate for integrated healthcare approaches that address both diabetes management and tuberculosis prevention and treatment.

A study reported a case where a 69-year-old man with type 2 DM developed Bruns–Garland syndrome, a rare form of diabetic amyotrophy, following the initiation of anti-tuberculous therapy for sputum-positive pulmonary tuberculosis. This case highlights the challenges in managing TB in diabetic patients, including the interaction between anti-tuberculous drugs and diabetes medications, leading to complications like uncontrolled blood sugars [5]. A retrospective study investigated the spectrum, etiology, and outcomes of infectious diseases in diabetic patients admitted to a tertiary care hospital. They found that pulmonary tuberculosis was prevalent in 4.6% of the cases. The study emphasized the importance of identifying and managing infections early to reduce mortality in diabetic patients [6].

Research studied the pattern of cutaneous lesions in diabetic patients and found that 67% of the patients exhibited various skin manifestations, with fungal infections being the most common. These infections are more severe and frequent in diabetic patients, indicating a need for vigilant dermatological assessment in this population [7]. A study observed a higher incidence of urinary tract infections (UTIs) in diabetic patients compared to non-diabetics. The study highlighted that diabetic patients are more susceptible to severe and resistant infections, emphasizing the need for regular monitoring and effective infection control measures [8].

A meta-analysis found a 21.1% prevalence of cardiovascular diseases among type 2 DM patients in India. The study highlighted the high risk of cardiovascular complications in diabetic patients, necessitating integrated care approaches to manage both diabetes and its associated conditions [9]. A study found a 79%

incidence of hypertension among diabetic patients in a rural population, with a significant proportion of patients exhibiting poor glycemic control. The study underlined the need for comprehensive management of both diabetes and hypertension to prevent complications [10].

Conclusion

This study demonstrates a significant association between diabetes mellitus and the incidence of tuberculous lesions. Patients with longer duration of diabetes and higher HbA1c levels are at higher risk. Regular screening and proactive management of tuberculosis in diabetic patients are essential for better clinical outcomes.

Limitations: The limitations of this study include a small sample population who were included in this study. Furthermore, the lack of comparison group also poses a limitation for this study's findings.

Recommendation: Healthcare providers should integrate routine TB screening into the care protocols for diabetic patients, particularly those with poor glycemic control and long-standing diabetes. Public health strategies should focus on the dual burden of TB and DM to enhance early detection and treatment, thereby improving patient outcomes.

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List of abbreviations:

TB: Tuberculosis

DM: Diabetes Mellitus

HbA1c: Hemoglobin A1c

AFB: Acid-Fast Bacilli

WHO: World Health Organization

OGTT: Oral Glucose Tolerance Test

PPD: Purified Protein Derivative

TST: Tuberculin Skin Test

CT: Computed Tomography

PA: Posteroanterior

ESR: Erythrocyte Sedimentation Rate

ELISA: Enzyme-Linked Immunosorbent Assay

OR: Odds Ratio

CI: Confidence Interval

UTIs: Urinary Tract Infections

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