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Diabetic pulmonary tuberculosis and its impact on clinical and radiological manifestations in individuals with diabetes mellitus: a cross-sectional study

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Abstract

Introduction: Tuberculosis continues to be a significant source of illness and mortality globally. Approximately one-third of the global population is infected, and the incidence of tuberculosis has been increasing worldwide in recent years. To investigate the impact of glycemic management on the radiographic manifestation of pulmonary tuberculosis in individuals with diabetes.

Materials and methods: It is a prospective cross-sectional study. Patients over 18 years with Pulmonary Tuberculosis and Diabetes Mellitus were included. Pulmonary tuberculosis was excluded in conjunction with other immunocompromised illnesses such as HIV, chronic renal disease, malignancy, long-term steroid use, and immunosuppressive medications. This research was performed in the Department of Pulmonology, Madha Medical College, Mangadu, Thandalam, Tamil Nadu, from March 2018 to February 2019.

Results: Among 200 tuberculosis patients, 88 were diabetic, resulting in an incidence of 44%. The average age was 52.13 ± 10.93 years; 52% were male, the mean HbA1C was 9.04 ± 1.70 , and 93.2% exhibited uncontrolled glycemic state. Seventy-eight individuals had lower lung field abnormalities, with a mean HbA1C of 8.87. Thirty-nine individuals (29.5%) presented with upper lung field abnormalities, having a HbA1C of 9.25, while 11.3% demonstrated abnormalities in both lung fields, with a HbA1C of 9.36. One hundred eight individuals had nodular infiltrative lesions, and eighteen had cavities, with a HbA1C of 9.88. Furthermore, 83.3% of those with cavities were located in the lower lung fields.

Conclusion: Atypical radiographic manifestations of lower lung field involvement are more prevalent in patients with diabetes. Patients with inadequate glycaemic management had a higher prevalence of cavitory lesions compared to their counterparts, although this had no significant impact on the zonal distribution of the radiographic lesions.

Keywords: Glycemic management, diabetes mellitus, and pulmonary tuberculosis

Introduction

One of the leading causes of death and disability globally is tuberculosis (TB). The global frequency of tuberculosis has been increasing in recent years, and it is believed that one-third of the global population is infected. An estimated 10.4 million cases of tuberculosis occurred in the world in 2015. Adults made up 90% of the cases, and 62% of the cases were male [1-3]. Those with compromised immune systems, such as those with diabetes or human immunodeficiency virus (HIV) infection, are more likely to get tuberculosis. The correlation between diabetic mellitus (DM) and tuberculosis (TB) is becoming more apparent; this is especially true in underdeveloped nations where both diseases are rampant. Despite HIV infection being the most powerful risk factor for tuberculosis (TB), numerous studies have shown that diabetes mellitus (DM) is more common and has a bigger impact on TB burden than HIV infection itself [2-4].

Worldwide, 422 million persons were diagnosed with diabetes in 2014, according to the World Health Organization. From 4.7% in 1980 to 8.5% in 2014, the worldwide prevalence of diabetes among adults over the age of 18 has increased. An estimated 439 million individuals will have diabetes by 2030, up from 285 million in 2010 and 3.5 million fatalities [2, 4]. Middle- and low-income nations have seen a more dramatic increase in the prevalence of diabetes. Developing and low-income nations are home to as many as 80% of diabetes

cases. With India and China bearing the brunt of the rising DM burden, Asia is at the hub of this global epidemic. Pulmonary tuberculosis ranks as the eighth most common consequence of diabetes mellitus [3-5].

Evidence from meta-analyses and reviews points to a two- to threefold higher incidence of active tuberculosis in the diabetic population compared to the general population, an increased risk of mortality from tuberculosis diagnoses in the diabetic population, and the possibility that diabetes may increase the risk of relapse in the diabetic population [4-6]. While the exact pathophysiological process by which diabetes mellitus (DM) increases the likelihood of tuberculosis (TB) remains a mystery, several theories have been advanced, including impaired alveolar macrophage function, decreased interferon gamma levels, pulmonary microangiopathy, nutritional deficiencies, and suppressed cellular immunity. A prolonged duration of sickness or inadequate control of glycemic status may contribute to the increased susceptibility of TB in diabetics [5-7]. Objective of this study was to investigate how glycemic control influences the radiographic appearance of pulmonary tuberculosis in diabetes mellitus patients.

Materials and Methods

It is a prospective cross-sectional study. Patients over 18 years of age with Pulmonary Tuberculosis and Diabetes Mellitus were included. Pulmonary tuberculosis was

excluded among other immunocompromised illnesses such as HIV, chronic renal disease, malignancy, long-term steroid use, and immunosuppressive medications. This research was performed in the Department of Pulmonology, Madha Medical College, Mangadu, Thandalam, Tamil Nadu, from March 2018 to February 2019.

Inclusion Criteria:

- Patients of more than 18 years
- Diagnosed to have both Pulmonary Tuberculosis and Diabetes Mellitus

Exclusion Criteria

- Patients having Pulmonary Tuberculosis
- Other immune compromised conditions like HIV
- Chronic kidney disease, Long term steroids

Results

Over the course of one year, 200 tuberculosis patients presented to DR PSIMS & RF, of which 88 were diabetic, resulting in a prevalence of 44%. A study was conducted on 88 patients with both diabetes and pulmonary TB, comprising 52% males and 48% females. The average age was 52.13±10.93, with the majority of patients (68%) falling within the 40-60 year age bracket. Demographic data are presented in Table 1.

Table 1: Demographic parameters

Parameter	Range / Proportion	Frequency	Percentage
Age	< 40	12	13.60 %
	40 – 60	60	68.10%
	> 60	16	18.10%
Sex	Male	46	52%
	Female	42	47.70%
BMI	<18	6	6.80%
	18 – 25	74	84%
	>25	8	9%
Type of case	New case	14	77.20%
	Default	4	18.20%
	Relapse	16	5%
DM duration	Denovo	14	15.90%
	2 months – 5 years	50	37.80%
	5 – 10 years	20	15.10%
	> 10 years	4	4.50%

A majority of patients in the study group, 93.2%, had uncontrolled glycemic state, indicated by a HbA1C level exceeding 7 (table 2). The average HbA1C was 9.04±1.70, with 9.5 in males and 8.5 in females. The average HbA1C readings are presented in the table: 3. In comparison to new cases, retreatment cases (defaulters, relapses, and treatment failures) exhibited a higher mean HbA1C of 10.01 (p<0.01); statistical test applied: Mann-Whitney U; results were very significant. The majority of patients, 93.2%, presented with cough as a symptom, exhibiting a mean HbA1C of 9.02, followed by dyspnea and fever; however, patients with fever, comprising 70.4%, had a higher mean HbA1C of 10.12. There is no association between mean HbA1C levels and symptomatology.

Table 2: Frequency of HbA1C

Range	Frequency	%
<7	6	6.80%
7 – 9	40	45.40%
> 9	42	47.70%

According to the radiographic findings, among 88 patients examined, the majority exhibited abnormalities just in the lower lung fields (52 patients) with a mean HbA1C of 8.87; 26 patients demonstrated only upper lung field involvement with a mean HbA1C of 9.25, while 11.3% presented with involvement of both lung fields, with a mean HbA1C of 9.36. Mann-Whitney U test conducted; results not significant. Involvement of the lower lung fields was

prevalent among females and the older demographic, with a mean age of 53 years (table 3).

Table 4: Relationship between Radiographic Zones and Mean HbA1c

X ray zone	Frequency	Percentage	Mean HbA1c	Males	Females	Mean Age
Upper lung field	26	29.54 %	9.25	16	10	49.9
Lower lung field	52	59%	8.87	28	24	52.4
Both	10	11.30%	9.36	2	8	56.2

Discussion

In our study of 200 individuals with Pulmonary Tuberculosis, 44% were diagnosed with Diabetes Mellitus. Of these, 52% were male, with a mean age of 52.13 ± 10.93 years and a mean HbA1C of 9.04 ± 1.70 . Jagadish Rawat *et al.* demonstrated that the mean age of patients with PTB-DM was 53.34 ± 14.06 , in contrast to their non-diabetic counterparts. This aligns with our study, which reported a mean age of 52.13 ± 10.93 years, suggesting that diabetic patients with tuberculosis were relatively older; however, there is a discrepancy [6-8].

The importance of nail changes in papulosquamous disorders from a treatment perspective. Our study comprised a greater number of guys. The majority of the research population, 84%, had a normal BMI of 18-25, whereas only 6.8% had a BMI of 25, indicating a 2.5% prevalence of diabetes among pulmonary tuberculosis patients in 2012. Our study demonstrated a significant prevalence of 44% of diabetes among patients with pulmonary tuberculosis, consistent with earlier studies. This elucidates the rising incidence of diabetes mellitus in emerging nations such as India. In our study, 93.2% of patients exhibited uncontrolled diabetic status, with HbA1C levels exceeding 7, agreeing with Chen-Yuan Chiang's study, which reported 88.8% of participants with HbA1C levels above 7 [8-10].

Payam Tabarsi claimed that 40% of their study population exhibited normal glycemic control, defined as less than 7 [16]. This contrasts with our findings, which indicated that only 6.8% had managed glycemic status, while the majority of patients were classified as uncontrolled. The high prevalence of diabetes, along with illiteracy, lack of awareness, and low socioeconomic position among patients, may contribute to inadequate glycemic control in our study. Patients aged 40-60 years exhibited a mean HbA1C of 9.02, those under 40 years had a mean HbA1C of 9.2, and individuals over 60 years had a mean HbA1C of 8.97, indicating suboptimal glycemic control in younger cohorts. This may be attributed to an uneven distribution of the study sample by age, with a limited number of participants over 60 years and a higher prevalence of patients with prolonged diabetes duration [11-13].

A majority of the study population, 59%, exhibited engagement solely in the lower lung fields, whereas 29.5% demonstrated participation in the upper lung fields. In our study, lower lung field involvement was prevalent among females and the older age group, with a mean age of 53 years. A study conducted by Bacakoglu F, *et al* demonstrated a correlation between lower lung field involvement and female gender or age above 40 years [12-14]. An analogous study conducted by Anand K Patel *et al.* about the radiological appearance of patients with pulmonary tuberculosis and diabetes mellitus revealed a greater involvement of the lower lung fields at 84%, in contrast to the upper lung fields, with cavitory lesions predominantly localized to the lower lung fields. In contrast

to our investigation, Bashar *et al.* and Morris JT *et al.* observed more involvement of the upper lung field [13-15].

The mean HbA1C for the lower lung field was 8.87, while the mean HbA1C for the upper lung fields was 9.25. The HbA1C reached a notably high level of 9.36 when both fields were involved, with no significant impact of HbA1C on radiographic presentation. Patients frequently had infiltrative lesions; nevertheless, the mean HbA1C level was greatest at 9.88 for the cavitory type of lesion. Park also indicated that there were no discrepancies in radiographic findings between managed diabetics and non-diabetics [16-18]; however, diabetic patients with inadequate glycemic control had a higher incidence of cavities. A study indicated that inadequate glycemic control significantly affects the radiographic features of pulmonary tuberculosis in patients with diabetes mellitus; isolated lower lung field involvement and extensive cavities are more prevalent in individuals with poor glycemic control compared to those with optimum management [19-21].

Individuals exhibiting severely inadequate glycemic control demonstrated elevated sputum positivity rates, with a mean HbA1C of 9.46, in contrast to a mean HbA1C of 8 among sputum-negative patients. Some publications indicated an increased prevalence of negative sputum smears in TB-DM cases, whilst others found no correlation between diabetes mellitus and patients' bacteriological outcomes. Inconsistent outcomes may be attributed to the management status of diabetes mellitus [21-23].

Conclusion

Uncontrolled diabetes is more common in pulmonary tuberculosis patients, and the frequency of diabetes overall is rising. The prevalence of unusual radiographic signs of involvement in the lower lung region is higher in diabetic patients. Cavitory lesions were more common in patients with poor glycemic control than in healthy controls, although this did not significantly affect the radiographic lesions' zonal distribution. Patients undertaking retreatment regimens and the rates of sputum smear positive are greatly impacted by glucose management. In order to provide the best care possible for people with both diabetes and tuberculosis, it is important to keep an eye out for atypical symptoms and poor glycemic control.

Funding source

None

Conflict of interest

None

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