Glycemic Status in Pulmonary Tuberculosis Patient

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Abstract

Background: Tuberculosis (TB) is the leading infectious disease causing of death among adults worldwide. Chronic infections like TB, can induce transient hyperglycemia, TB cases are also more likely to have diabetes mellitus (DM) than the general population. Tuberculosis and altered glycemic status complicate each other at numerous levels**.** Prolonged hyperglycemic state doubles or triples the incidence of active tuberculosis and increases the risk of tuberculosis treatment failure and death, there may be altered glycemic status in patients with PTB. Currently world health organization (WHO) also recommends for such bi-directional screening as detecting early the co-existence of these diseases can lead to better management of both cases. So this study is aimed to assess the association of tuberculosis with the presence and persistence of hyperglycemia.

Objective: To assess the glycemic status in pulmonary tuberculosis patients.

Methods: This was a cross-sectional study conducted in department of Medicine and Department of Endocrinology, Rangpur Medical College Hospital and Tajhat Chest disease Hospital, Rangpur for 2 years (2021 - 2022). After careful history taking, examination and appropriate investigations fulfilling inclusion and exclusion criteria, total 100 patients with pulmonary tuberculosis, irrespective of their sex, race and ethnic group were included in this study. A semi-structured questionnaire was developed by using the selected variables according to the specific objectives. Data analysis was carried out by using SPSS (version 24).

Results: On assessing glycemic status, 45% patients were diabetic. BMI of PTB patients of the study was statistically associated with diabetic status (p=0.021). Smoking had significant relation with diabetic status (p=0.012). Most of the patients were primary smoker. Most of the diabetic patients had history of diabetes in their family. Family history of diabetes was significantly associated with diabetic status (p<0.001). According to post hoc analysis non-diabetic patients were significantly younger than prediabetic and diabetic patients (p<0.001).

Conclusion: In this study, the glycemic status of patient with pulmonary TB revealed that diabetes is quite prevalent in TB patients and factors such as age, family history of diabetes, BMI, smoking history had an influence in glycemic status of the patients.

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Introduction

Tuberculosis (TB) is the leading infectious disease causing of death among adults worldwide. Globally, the incidence of tuberculosis was approximately 10 million in 2019 and is decreasing by only 1-2% per year.[1] Despite a declining trend of tuberculosis (TB), the incidence in WHO

Southeast Asia Region (WHO SEAR) remains high.[2] The prevalence is estimated to be 434 per 100,000 populations. Chronic infections like TB, can induce transient hyperglycemia, TB cases are also more likely to have diabetes mellitus (DM) than the general population, and the prevalence of DM in adults with newly diagnosed pulmonary TB (PTB) in endemic settings is 5% to 35%.[3] World Health Organization (WHO) reported that approximately 10% of TB cases worldwide are associated with DM and poor glycemic control is significantly associated with the occurrence of TB.[4] The symptoms of active TB are long term cough with blood-containing sputum, fever, night sweats, and weight loss.[5] PTB is usually diagnosed by history (fever, cough for 3 weeks or more, weight loss) & bacteriological confirmation by sputum for Acid Fast Bacilli or Gene-Xpert.[6] In patients with diabetes, macrophage function, including phagocytic and bactericidal functions, is reduced.[7] Hyperglycemia is a marker of illness severity and a well-recognized predictor of mortality across a diverse spectrum of conditions.[8] Glycemic status is assessed by oral glucose tolerance testing (OGTT) or fasting blood glucose (FBG) & post-prandial blood glucose (2HABF) assessments after initiation of anti-tuberculosis treatment and glycated hemoglobin (HbA1c). HbA1c is the most commonly used index for reflecting blood glucose status. It is potentially serving as a stable test for DM screening during the initial phase of TB.[3]

Tuberculosis and altered glycemic status complicate each other at numerous levels**.** Currently world health organization (WHO) recommends for bi-directional screening as detecting early the co-existence of these diseases can lead to better management of both cases.[6] So we aimed to assess the association of tuberculosis with the presence and persistence of hyperglycemia.

Objectives

To assess the glycemic status in pulmonary tuberculosis patients.

Methods

This was a cross-sectional study conducted in department of Medicine and Endocrinology, Rangpur Medical College Hospital, and Tajhat Chest Disease Hospital, Rangpur for 2 years (January,2021-December,2022). Ethical clearance was obtained from Ethical Review Committee of Rangpur Medical College. The sample was collected by purposive sampling technique. A semi-structured questionnaire was developed by using the selected variables according to the specific objectives. After enrollment, details regarding demography, glycemic status, factors affecting the glycemic status, categories of treatment of TB and relevant investigations was recorded in the case recording form. All patients diagnosed as having active TB was screened for DM through their history, previous medical records, and measurement of oral glucose tolerance test (OGTT) and HbA1c. Blood was collected from every patient with strict aseptic precautions and was sent for OGTT and HbA1c. Blood sugar status was classified based on the American Diabetes Association cut-off points. According to the ADA, patients were classified into three groups: normal, pre-diabetes and diabetes. Current glycemic status was assessed with OGTT and HbA1c and last three-month blood sugar was assessed with FBS, 2hABF and HbA1c. Weight of the patients was measured using a digital weight scale. BMI was calculated, and weight status was classified using the WHO cut off points for Asian people. Sputum for AFB and gene X-pert were done. Following data collection, the collected data was assessed for completeness, accuracy and consistency before analysis was commenced. Data analysis was carried out by using SPSS (version 24). Qualitative or

categorical variables were described as frequencies and proportions and quantitative or continuous variables were expressed as means and standard deviations. Student's *t*-test and chi-square test was used to compare continuous and categorical variables, respectively

Results

For the total participants, the mean age of all patients was 46.63±16.53years. Among them, male (70%) preponderance was observed. Most of participants lived in rural area. A higher proportion of the participants had education below SSC, while only 6% were graduate and above. Most of the participants (38%) were business men, 29% were housewife, Govt employee only 2% and unemployed were 3%. Most of the participants had monthly income less than 10000 taka and only 5% had more than 40000 taka. Mean BMI of the patients was 17.95±3.00 kg/m^2 , most (69%) of the participant were under nutrient and only 4% were obese. Regarding smoking history 42% were primary smoker , 30% were ex- smoker 26% had no smoking history. Most (71%) of the participant had family history of DM. Forty percent participant had preexisting DM, 29% had COPD and/or bronchial asthma, 21% had HTN, 4% had IHD and 2% had CKD.

Table II: Demographic details

Variables		Number(n=100)	Percentages (%)
Age(46.63±16.53)	18-30	23	23
	31-40	16	16
	41-50	12	12
	51-60	33	33
	61-70	12	12
	>70	4	4
Gender	Male	70	70
	Female	30	30
Residence	Urban	14	14
	Rural	86	86
Education	No schooling	16	16
	Below SSC	57	57
	SSC	12	12
	HSC	9	9
	Graduate and above	6	6
Occupation	Govt. employee	2	2
	Non Govt. employee	7	7
	Business man	38	38
	Housewife	29	29
	Unemployed	3	3
	Others	21	21
Monthly income(Taka)	<10000	48	48
	10000 to 20000	17	17
	20000 to 40000	30	30
	>400000	5	5

Considering clinical features 93% had night sweats, 86% had cough up phlegm, 66% had weight loss, 50% had fever, 18% had cough up blood, 18% had chest pain and 2% had insomnia. Mean ESR was 80.83±27.69 in 1st hour and Hb was 10.72±1.97 gm/dl. Mean of FBS was 7.55±3.11 mmol/dl, 2 hour after OGTT was 10.17±4.57 mmol/dl, and HbA1c was 6.23±1.97%. Most of the patients were diabetic (45%), among rest (38%) were non-diabetic, and (17%) were prediabetic.

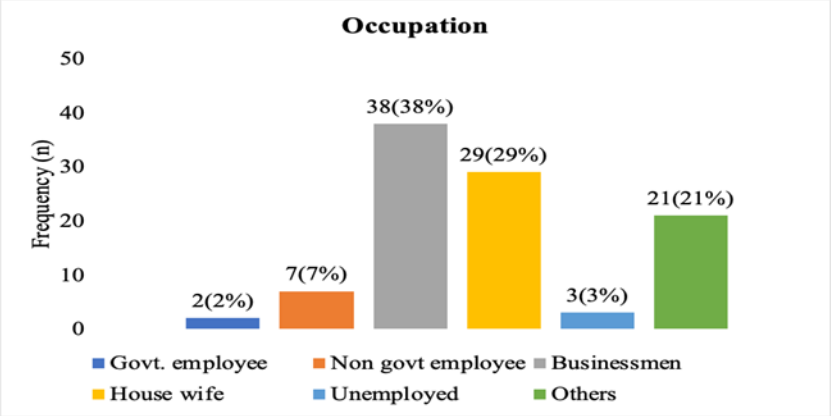

Figure 1. Occupational status of the study participants (n=100)

Table II: BMI of the study participants (n=100)

Variable	Frequency (n)	Percentage (%)
<18.5	69	69
18.5 –22.9	23	23
23 –24.9	4	4
>25	4	4
Mean±SD	17.95±3.00 kg/m^2	

Table III: Smoking history of the study participants (n=100)

Variable	Frequency (n)	Percentage (%)
Never smoked	26	26
Ex-smoker	30	30
Primary smoker	42	42
Secondary smoker	2	2
Total	100	100

Table IV: Co-morbidity of the study participants (n=100)

Variable*	Frequency (n)	Percentage (%)
Diabetes	40	40
Asthma/COPD	29	29
HTN	21	21
IHD	4	4
CKD	2	2

*Multiple response considered, HTN=Hypertension, IHD=Ischemic heart disease, CKD=Chronic kidney disease

Table V: Clinical presentation of the study participants (n=100)

Variable*	Frequency (n)	Percentage (%)
Night sweats	93	93
Cough up phlegm	86	86
Fever	50	50

Weight loss	66	66
Cough up blood	18	18
Chest pain	17	17
Insomnia	2	2

*Multiple response considered.

Table 6: Investigation profile of the study participants (n=100)

Variable	Mean±SD
Hb (gm/dl)	10.72±1.97
Total WBC* count (/mm^3)	10209.60±3187.618
ESR** (in 1st hour)	80.83±27.69
S. Creatinine(mg/dl)	1.23±1.85

*WBC-white blood cell, **ESR-erythrocyte sedimentation rate

Table VI showed that mean of Hb was 10.72±1.97 gm/dl, Total WBC count was 10209±3187.618 per mm^3, ESR was 80.83±27.69 in 1st hour, and S Creatinine was 1.23±1.85 mg/dl.

Table VII: Blood sugar level in the study participants (n=100)

Variable	Mean±SD
FBS (mmol/dl)*	7.55±3.11
2-h PG mmol/dl**	10.17±4.57
HbA1c (%)	6.23±1.97

*FBS = Fasting blood sugar, **2-h PG= 2 hour post prandial glucose

Table VIII: Diabetic status of the study participants (n=100)

Variable	Frequency (n)	Percentage (%)
Non-diabetic	38	38
Prediabetic	17	17
Diabetic	45	45

Table IX: Factors associated with diabetic status (n=100)

Variable	Non-diabetic n=38	Prediabetic n=17	Diabetic n=45	p-value
BMI (kg/m^2)				
<18.5	34	8	27	
18.5 – 22.9	4	6	13	0.021*
23 – 24.9	0	1	3	
>25	0	2	2	
Smoking history				
Never smoke	10	3	13	
Ex-smoker	12	11	7	0.012*
Primary smoker	16	3	23	
Secondary smoker	0	0	2	
Family history of diabetes	4	1	24	<0.001*
Age (Mean±SD)	39.15±19.36	56.53±12.4	49.20±12.11	<0.001**

*p-value were determined by Chi square test
** p-value were determined by Bonferroni test

Table IX showed that most of the patients BMI was <18.5 kg/m^2 (34 non-diabetic, 8 prediabetic, and 27 diabetic). Smoking had significant relation with diabetic status (p=0.012). Most of the patients were primary smoker. Family history of diabetes was significantly associated with diabetic status (p<0.001). According to post hoc analysis non-diabetic patients were significantly younger than prediabetic and diabetic patients (p<0.001).

Discussion

Tuberculosis (TB) is one of the important causes of death worldwide and also considered as a major public health burden in many developing countries.[10] Tuberculosis and diabetes mellitus have a bi-directional relationship with each condition that has adverse impact on the other.[11] So this study assessed the glycemic status among pulmonary tuberculosis patients.

This study was conducted among 100 pulmonary tuberculosis patients (age range 18 to 75 years of age). Mean age of all patients was 46.63±16.53years. Majority of the patients belonged to age group 51-60 years (33%). This may be related to the fact that type 2 DM is more frequently in the older age group of tuberculosis patients. Mamun et al., in their study found the mean age of the participants was 45.2 ± 16.5 years of age[12] which was consistent to the current study findings.

Male predominance was observed in the current study (70% male and 30% female patients). However, Similar finding was established by Zhang et al., where male was 62.4% and female were 37.6%.[13]

Mean of BMI was 17.95±3.00 kg/m^2 with range 11.18 kg/m^2 to 26.73 kg/m^2. Most of the patients BMI was <18.5 kg/m^2 (69%).Our age group suggests more prevalent type 2 DM, where we expect BMI to be higher, but co- existence with tuberculosis was probably the reason behind our findings of low BMI in tuberculosis-DM cases. Similar findings were reported by Kumar et al., where 59.8% patients had a BMI of <18.5 kg/m^2.[14]

Smoking has a great influence on TB and it increases the risk of contracting TB, recurrent TB and hamper TB treatment too. In the present study, majority of the study participants were smoker (44%). So it is suggested that smoking has an influence to

occur DM in tuberculosis patients. A cross sectional study by Lin et al., found that 58.3% of their study participants were smoker[15] which is quite similar to this study.

Majority of the pulmonary tuberculosis patients had asthma in 29%, hypertension in 21%, IHD in 4%, and only 2% had history of CKD. Yoo et al., in a study among Korean adults established that 8.3% participants had CKD and 3% had IHD which is in agreement with the current study.[7] Another study By Peltzer et al., found their 8.9% patients had history of HTN and 3.5% had asthma which is similar to my study.[16]

The most common symptoms of tuberculosis is cough, chest pain, coughing up blood, feeling tired all the time, night sweats, chills, fever, loss of appetite, weight loss. In the current study, pulmonary tuberculosis patients complained of night sweats (93%), Cough up phlegm was in 86%, unexpected weight loss (66%), low grade fever (50%), cough up blood (18%), chest pain (17%) and insomnia (2%).

In this study, it is evident that most of the patients have night sweats than other symptoms. Similarly Luies and Preez., found 85% patient with cough of phlegm in their study.[17] In a study among 1,594 patients it was reported that 83% of the patients had cough, 10.3% of the patients had hemoptysis, 8.7% complained of tiredness, and 28.3% weight loss which is in agreement with the current study findings.[18]

In the current study, mean of FBS was 7.55±3.11 mmol/dl, 2 hour post prandial glucose was 10.17±4.57 mmol/dl, and HbA1c was 6.23±1.97%. Mamun et al., in their study found the mean FBS among TB patients was 7.9 ± 5.3[12] which was comparable to this study findings.

Glycemic status assessment revealed that most of the patients with pulmonary TB were diabetic (45%). In a cohort study by Buasroung et al., prevalence of diabetes was 42.6% [19] which was in agreement with the current study.

Family history of diabetes was significantly associated with diabetic status ($p<0.001$) in the present study. Annis et al., in their study reported that the prevalence of diabetes for individuals with a positive family history was more than four times higher than individuals without a family history ($p<0.001$).[20]

By performing post hoc analysis in the present study, it was found that non-diabetic patients were significantly younger than prediabetic and diabetic patients ($p<0.001$). Krishnappa et al., in their prospective study reported that patients with DM were older than non-diabetic patients (45.6 vs. 31 years of age, $p<0.001$).[11]

The strength of the study is that glycosylated heamoglobin (HbA1c) and fasting blood sugar (FBS) levels were measured on all patients. HbA1c measurement provides blood glucose levels over a period of 2-3 months and is not subjected to the rapid wings. Both are separately the diagnostic criteria for diagnosis of diabetes mellitus.[9]

Conclusion

In this study, the glycemic status of patient with pulmonary TB revealed that diabetes is quite prevalent in TB patients and factors such as age, family history of diabetes, BMI, smoking history had an influence in glycemic status of the patients, thus screening tuberculosis patients for fasting blood sugar values will aid in the early diagnosis of diabetes and will lead to a better prognosis, improved diabetes control, and improved tuberculosis treatment result.

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