Research Article

A study to assess the blood glucose level among diagnosed cases of tuberculosis registered at a tuberculosis unit of Bhopal city, Madhya Pradesh, India

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Abstract

Background: The incidence of diabetes mellitus (DM) is increasing worldwide, especially in developing countries where tuberculosis (TB) is most prevalent. Nearly one-third of world's population is infected with *Mycobacterium tuberculosis*. Diabetes and TB may complicate each other at many levels. Systematic review of screening conducted in multiple settings showed that screening of patients with TB for DM also yielded high prevalence of diabetes ranging from 1.9% to 35%.

Objective: This study aimed to assess the blood glucose level among diagnosed cases of TB registered at a District Tuberculosis Center in Bhopal.

Materials and Methods: This study is a cross-sectional study carried out in a TB unit (District Tuberculosis Center), Bhopal, on all registered cases of TB above 18 years. All patients who gave their consent during the study period of October 2013 to March 2014 were included

Results: Out of 260 subjects enrolled for this study, complete details and blood glucose values were available for 220 subjects. Of the 220 subjects, 34 (15.4%) were found to have DM and 25 (11.3%) had previous diagnosis of DM; 9 (4.09%) were newly diagnosed. The prevalence of DM among patients with TB was significantly higher among males aged >50 years and with pulmonary TB.

Conclusion: Results of this study re-echo the need to raise awareness of screening for DM in persons with TB. Study finding shows the high prevalence of DM in patients with TB in Bhopal, and that a significant proportion of patients with DM may not be aware of their glucose status. Screening of patients with TB for DM is feasible, effective, and comprehensive approach that could lead to improved care and better patient outcomes.

KEY WORDS: Tuberculosis, diabetes, tuberculosis unit, pre-diabetes

Introduction

Tuberculosis (TB) is a specific infectious disease caused by *Mycobacterium tuberculosis*. The disease primarily affects lungs and causes pulmonary TB (PTB). It can also affect intestine, meninges, bones and joints, lymph glands, skin, and other tissues of the body. TB remains a global public health problem despite the fact the causative organism was discovered more than 100 year ago and highly effective drugs and vaccine are available making it preventable and curable disease, but the association of other diseases and emergence of extensively drug-resistant and multiple drug-resistant TB pose additional challenge to effective TB control.[1,2]

The incidence of DM is increasing worldwide, especially in developing countries where TB is most prevalent.[3] Nearly one-third of world's population is infected with *M. tuberculosis* and approximately 10% of them are at risk of developing active form of the disease in their lifetime depending, on the interaction of the epidemiological triad.[4,5] In 2012, an estimated 8.6 million people developed TB worldwide and 1.3 million died from the disease.[6] India has the largest number of TB cases, estimated to be 2 million per annum. According to annual status report 2013 of RNTCP, in 2012, the prevalence of TB was 236 per lakh and incidence rate was 168 per lakh.[7]

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In 2011, the International Diabetes Federation estimated that about 366 million people worldwide have diabetes mellitus (DM) and this number is expected to rise to 522 million by 2030. Available reports suggest that 95% of patients with TB live in the low- and middle-income countries and more than 70% of patients with DM also live in the same countries, especially in South East Asia.[8] Recently publish Indian Council of Medical Research national study reported that there are 62.4 million people with type 2 diabetes and 77 million people with prediabetes in India. These numbers are projected to increase to 101 million by the year 2030.[9,10]

Diabetes accounted for 14.8% (range 7.1%–23.8%) of PTB and 20.2% (8.3%–41.9%) of smear-positive (i.e., infectious) TB as per a study conducted in India in 2000.[11] Systematic review of screening conducted in multiple settings showed that screening of patients with TB for DM also had high prevalence of diabetes ranging from 1.9% to 35%[12]. Diabetes and TB may complicate each other at many levels. Among those with active TB, diabetes may adversely affect TB treatment outcomes by delaying the time for microbiological response, thus reducing the likelihood of favorable outcome and increasing the risk of relapse, death, and drug resistance. Screening for diabetes in patients with TB will not only ensure early case detection but also better management of diabetes.[12–14] It could improve DM case detection and early treatment, and indirectly lead to better TB-specific treatment outcomes.[15] This study was conducted with the primary objective to assess the blood glucose level among diagnosed cases of TB along with the sociodemographic factor associated with DM in diagnosed patients registered at District Tuberculosis Center, Bhopal. The ultimate aim of the study was to assess the correct burden of diabetes and prediabetes among patients with TB for better care of both diseases and to lay foundation for further research and more attention toward these comorbidities.

Materials and Methods

This was a cross-sectional study conducted on the registered cases of TB in a tuberculosis unit (District Tuberculosis Center) of Bhopal above the age of 18 years who gave their consent during the period of October 2013 to March 2014. Overall, 250 patients were contacted for study of which 220 patients consented; the response rate was 88%.

All participants were assessed, and information was recorded in a predesigned and pretested proforma composed of three basic sections: the first section consisted of socio-demographic profile including age, sex, weight, height, education, occupation, economic status, dietary habits, housing, physical activity, history of any addiction; the second section consisted of assessment of TB status of patients including type of TB, category, and duration of treatment; and the third section consisted of blood glucose level including both fasting and random blood glucose levels, history of diabetes, and family history of diabetes and treatment history of diabetes.

Diagnosis of TB and diabetes was based on the following criteria:

1. Diagnosis of TB was based on standard diagnostic criteria of RNTCP.[7]
2. Diagnosis of diabetes and prediabetes was based on the standard diagnostic criteria of the American Diabetes Association.[16]

Data analysis and statistics

Data were entered in Microsoft Excel 2007 and analyzed using Epi Info 7. Continuous variable were summarized as frequency, mean and standard error, and categorical variable were analyzed using χ^2-analysis; $p < 0.05$ was considered as statistically significant.

Ethics approval

Ethical approval was received from the institutional ethical committee of Gandhi Medical College, Bhopal.

Results

Out of 260 subjects enrolled for this study, complete details and blood glucose values were available for 220 subjects of which 118 were men (age, $42.8 \pm 2x2.03$ years) and 102 were women (age, $36.2 \pm 2x2.3$ years). Out of 220 subjects, 34 (15.4%) were found to have DM. Out of 34 DM patients, 25 (73.5%) had history of previous diagnosis of DM and 9 (26.5%) were newly diagnosed. The prevalence was found to be more in men (11.3%) as compared to women (4.1%). Prediabetes was observed in 18.2% of patients with TB. Table 1 gives the gender-wise distribution of the certain characteristics of the study population.

The profile of the patients screened and the overall prevalence of DM among TB patients, desegregated by age, sex, smoking status, type of TB, and category of treatment are shown in Table 2. Factors associated with higher prevalence of DM among the TB patients are age >50 years, male gander, and PTB. Further analysis showed that prevalence of DM among TB patients aged >50 years was significantly higher than that among patients aged <50 years ($p < 0.01$). There was also a significantly higher prevalence of DM among patients with PTB as compare to those with extrapulmonary TB ($p = 0.01$), and among men as compare to women ($p = 0.01$). And there were no significant differences observed with respect to smoking status, alcohol consumption, and category II patients (defaulter relapse and failure cases).

Discussion

In this study, we found a high prevalence of DM among the patients with TB treated in Bhopal, and it was significantly higher among those with age >50 years, male gender, and those with TB as compared to those with age <50 years,

Table 1: Prevalence of DM among TB patients according to different variables (DTO Bhopal, India, October–December 2013)

Characteristics	TB patients with DM, *N* (%)	TB patients without DM, *N* (%)	P-value
Total	34 (15.4)	186 (84.5)	
Sex			
Male	25 (73.5)	93 (50.0)	0.01
Female	9 (26.4)	93 (50.0)	
Age group			
<50	20 (58.8)	161 (86.5)	<0.01
>50	14 (41.2)	25 (13.4)	
Disease classification			
Pulmonary	30 (88.2)	127 (68.2)	0.01
Extrapulmonary	4 (11.8)	59 (31.8)	
Treatment category of TB			
I	25 (73.5)	153 (82.2)	0.23
II	09 (26.5)	33 (17.8)	
Smoking status			
Yes	15 (44.1)	66 (35.4)	0.33
No	19 (55.9)	120 (64.5)	
Alcohol consumption			
Yes	8 (23.5)	34 (18.2)	0.47
No	26 (76.5)	152 (81.8)	

TB, tuberculosis; DM, diabetes mellitus.

female gender, and with extrapulmonary TB. The prevalence of DM in TB patients was found to be 15.4%, among which 73.5% had previous diagnosis of DM and 26.5% were newly diagnosed; 18.2% patients were diagnosed as prediabetes. Similar results were reported in earlier studies by Singla et al.,[17] Raghuraman et al.,[18] Khanna et al.,[19] and Balakrishnan et al.,[20] with 25%, 29%, 14.5%, and 44% prevalence of diabetes among TB patients.

This study found a significantly higher prevalence of DM in older TB patients. Similar finding have been reported by studies from other parts of India (Puducherry and Kerela) and other countries such as Malaysia, Saudi Arabia, Taiwan, and

Table 2: Gender-wise distribution of the certain characteristics of the study population

Variable	Category	Males, *N* = 118	Females, *N* = 102	Total, *N* = 220
Age (years)	<30	37 (31.3)	51 (50.0)	88 (40 0)
	31–50	57 (48.3)	36 (35.2)	93 (42.2)
	51–70	23 (19.4)	12 (8.9)	35 (15.9)
	>70	1 (0.8)	3 (2.9)	4 (1.8)
Status of blood glucose	No diabetes	70 (59.3)	76 (74.5)	146 (66.3)
	Prediabetes	25 (21.1)	15 (14.7)	40 (18.1)
	Diabetes	23(19.4)	11 (10.7)	34 (15.4)
Treatment category	I	93 (78.8)	85 (83.3)	178 (80.9)
	II	25 (21.1)	17 (16.6)	42 (19.09)
Type of tuberculosis	Pulmonary	90 (76.2)	67 (65.6)	157 (71.3)
	Extrapulmonary	28(23.7)	35 (34.3)	63 (28.6)
Education status	No school	12 (10.1)	13 (12.7)	25 (11.3)
	Primary/High/Higher Sec	87 (73.7)	85 (83.3)	172 (78.1)
	Graduate/Postgraduate	18 (15.2)	4 (3.9)	22 (10.0)
	Professional degree	1 (0.8)	0 (0.0)	1 (0.4)
Occupation	Unemployed	51(43.2)	66 (64.7)	117 (53.1)
	Unskilled	26 (22.0)	21 (20.5)	47 (21.3)
	Skilled	29 (24.5)	12 (11.7)	41 (18.6)
	Others	12 (10.1)	3 (2.9)	15 (6.8)

Mexico.[21–24] This study also reported the higher association of DM and PTB, which is also reported in many studies including those by Zhang et al.[14] and Guptan and Shah.[23] This study has reported significant association between male gender and diabetes in TB, which is supported by that reported in the study conducted in south India.[25]

This study shows feasibility and importance of screening of TB patients for diabetes as we implemented screening within the routine system with existing staff. The present study shows that screening for DM in TB patients at health facility level results in a higher proportion of previously undiagnosed DM patients being detected, which shows the importance of early screening of patients with TB. Routine screening of TB patients for DM will help in early detection of DM. This will enable us to manage these patients in the early phase and also detect prediabetes early so that primary prevention methods may be initiated early and effectively. The WHO and International Union against Tuberculosis and Lungs Disease in collaboration with other partners developed Collaborative Framework for Care and Control of Tuberculosis and Diabetes, which emphasizes the routine implementation of bidirectional screening of the two diseases. It strongly recommends the surveillance of diabetes among TB in all countries in primary health-care settings.[21] We continue to face a high burden of both TB and DM in our country. We need better information and monitoring system to guide us in managing for this "dual" burden, and we need to strengthen the care of these patients in our health services.

Conclusion

Results of this study re-echo the need to raise awareness of screening for DM in persons with TB. Study finding shows high prevalence of DM in patients with TB in Bhopal, and that a significant proportion of DM patients may not be aware of their status. It can be concluded that screening of TB patients for DM is feasible, effective, and comprehensive approach that could lead to improved care and better patient outcomes.

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