High-resolution computed tomography thorax evaluation of sputum positive/CBNAAT positive pulmonary tuberculosis in diabetic and non-diabetic patients

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ABSTRACT

Background: Diabetes mellitus (DM) and pulmonary tuberculosis (TB) are major health problems in India. Diabetes being an immunosuppressive state is thought to be a risk factor for acquisition of TB. However, very few researches provide evidence demonstrating whether DM affects radiological diagnostic findings of pulmonary TB. Hence, this novel cross-sectional study was undertaken to find the difference between the high-resolution computed tomography (HRCT) findings of TB patients with diabetes to that from non-diabetics. **Material and Methods:** HRCT thorax scans were performed in patients diagnosed as pulmonary TB on the basis of sputum positivity or CBNAAT positivity. Patients were divided into diabetic and non-diabetic group. Patient details and clinical history were recorded and HRCT thorax findings were then compared in both groups. **Results:** Compared to non-diabetic patients (26.5%), the diabetic patients (53.1%) showed a higher detection rate of lesions at the lower lung lobe ($p < 0.05$), non-segmental consolidation was also higher in diabetic group (28%) compared to non-diabetic group (2%) $p < 0.01$), cavitary lesion was noted in 37.5% of diabetic group compared to 8.1% of non-diabetic group ($p < 0.01$). **Conclusion:** CT findings of TB in diabetic patients are different from those in non-diabetic patients, with a higher occurrence of non-segmental distribution, cavitary lesion and lower lobes are more commonly affected in TB patients with diabetes.

Key words: *Diabetes, High-resolution computed tomography thorax, Pulmonary tuberculosis*

Tuberculosis (TB) is huge public health problem in India with an estimated incidence of 2.69 million cases, as evidenced by the World Health Organization TB statistics for India in 2018. We know that the manifestations of TB are the result of a complex dynamic balance between the microorganisms (mycobacterium TB) and host immune system. As there is alteration in the host immune system in patients suffering from diabetes mellitus (DM), it can be theorized that the manifestations, both clinical and radiological, may alter. The present study was planned to analyze the different lesions detected by computed tomography (CT) scan in patients with active pulmonary TB. We focused on differences in the pattern and distribution of lesions in diabetic patients which were compared to those demonstrated in patients without DM. This novel study was undertaken with an intention to provide baseline data for future guidelines regarding diagnosis, treatment, and response to treatment in TB patients with DM

MATERIALS AND METHODS

This cross-sectional study was carried out in the Department of Radiodiagnosis at SCB Medical College and Hospital, Manglabag, Cuttack, Odisha, from September 2017 to September 2019. On purposive sampling, a total of 81 subjects aged >14 years of either sex diagnosed with pulmonary TB referred for high-resolution CT (HRCT) thorax from the department of pulmonary medicine were included in this study. Sputum positivity or CBNAAT positivity was considered for the diagnosis of TB. The patients <14 years age, having HIV or any other congenital or acquired immunodeficiency disorder, patients with underlying chronic lung disease, with underlying lung mass were excluded from the study. Ethical committee approval was obtained and an informed consent was taken from all patients before the study. Among the included patients, the patients with pulmonary TB with diabetes were compared with TB patients without diabetes. A structured case pro forma was with patient details, clinical history and HRCT thorax findings of the patients were used to record the data.

Non-contrast volumetric HRCT of thorax of all eligible patients was carried out. A scout was taken with KV 120 and mA 120, and then helical scanning was done in caudocranial direction to minimize respiratory artifacts, with 0.625 mm thickness in supine position at end inspiration. Various imaging parameters such as consolidation – homogenous

opacity obscuring vessels, satellite lesions (SL) – smaller similar appearing lesion surrounding the consolidation/large nodule, nodules – small rounded opacities within pulmonary parenchyma, tree in bud (TIB) – centrilobular nodules in branching pattern, traction bronchiectasis (BTX) – abnormal dilatation of bronchial tree, ground glass opacity (GGO) – homogenous opacities not obscuring vessels, cavities – air filled lucent areas, lymph nodes (LN) – mediastinal LN, parenchymal calcification – parenchymal calcific foci, tuberculoma – single circumscribed pulmonary nodule, non-segmental distribution (NSD) of consolidation – involvement of multiple lobe by consolidation, and miliary TB – multiple small random nodules and lobe involvement (laterality is not taken into account) were considered.

The obtained data were tabulated on Microsoft word and Microsoft Excel spread sheet. SPSS version 16 (IBM corp., Armonk, N.Y., USA) was used for statistical analysis. Chi-square test of independence was performed to find relationship between HRCT findings of TB with respect to the presence and absence of DM.

RESULTS

A total of 81 patients diagnosed as pulmonary TB by means of sputum positivity for MTB or by CBNAAT positivity presenting to pulmonary medicine clinic or admitted to pulmonary medicine ward were included in the study, of which 32 patients are found out to be also suffering from diabetes. The patients belonged to the age group of 27–70 years, with a mean age of 48.08 years. The present study observed that majority of the subjects lie in the age group of 41–50 years (33.3%) closely followed by 51–60 years group (30.8%) (Fig. 1). Among the study population, 77.7 % subjects comprised males. Among patients with diabetes 75% were males, 25% were females and among non-diabetic group 79.5% were males and 20.4% were females (Fig. 2). Cough and sputum production appeared to be dominant clinical symptoms in TB patients followed by fever and few number of patients presented with chest pain and dyspnea. The incidence of clinical symptoms showed no significant difference between the two groups. Fever, cough, sputum, chest pain, and dyspnea between diabetic TB group and non-diabetic TB group were 69.3% versus 68.7%, 93.8% versus 96.8%, 85% versus 81%, 30.6% versus 25%, and 20.4% versus 6%, respectively ($P > 0.05$) (Table 1).

Among the HRCT findings in diabetic group, consolidation was most common 78.1%, followed by TIB (75%), SL (71.8%), and nodules (62.5%). Other findings like GGO were found in 46.8%, BTX in 31.2%, cavitary lesion in 37.5%, mediastinal LN in 8.1%, parenchymal calcification in 6%, NSD in 28%, and miliary TB in 3.1% population. Among non-diabetic population, consolidation was found in 67.1% of cases and was segmentally distributed in most of the patients. Satellite nodules were found in 63.2%, nodules in 73.4%, tree in budding phase pattern in 61.2%, BTX in 40.8%, GGO in 51%, mediastinal nodes in 24.4%, parenchymal calcification in 20.4%, and tuberculoma and miliary TB in 2% of cases. Cavities occurred in 8.1% of cases and most of them are single cavitary lesion (Table 2). Lower lobe involvement was commonly seen in diabetic 53.1% and non-diabetic group 26.5%, middle lobe was least commonly involved (9.3% in diabetic group and 6.1% in non-diabetic group). Lobe involvement in both groups is described in Table 2. Figs. 3-5 depict the HRCT thorax images of subjects included in the study.

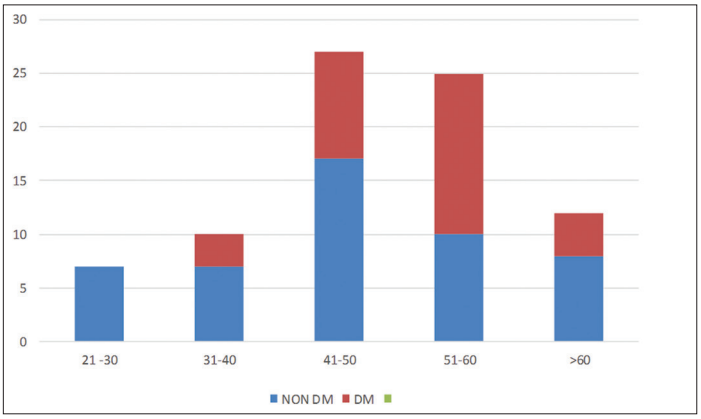

Figure 1: Age distribution of subjects

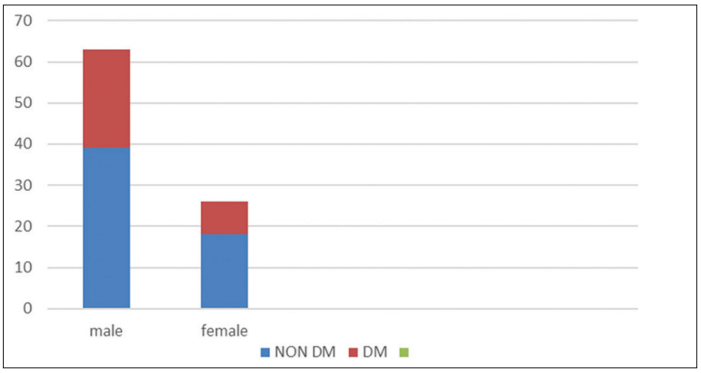

Figure 2: Sex distribution of subjects

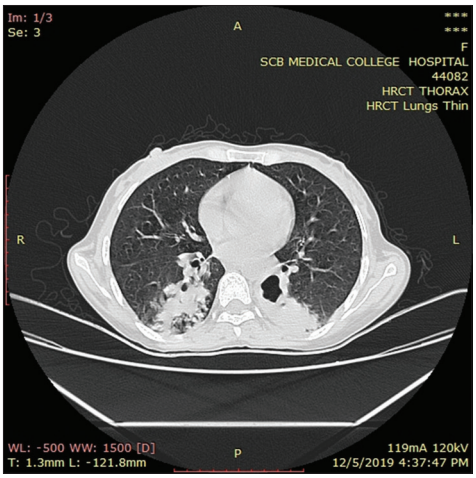

Figure 3: Axial section of high-resolution computed tomography thorax of a 60-year-old male diabetic patient presented with cough showing B/L lower lobe consolidation with the left lower lobe cavitary lesion

Table 1: Distribution of clinical symptoms in subjects

Symptoms	Number of patients (n=81)	Percentage	non-diabetic group (n=49)	Percentage w	diabetic group (n=32)	Percentage
Fever	56	69.1	34	69.3	22	68.7
Cough	77	95	46	93.8	31	96.8
Chest pain	23	28.3	15	30.6	8	25
Sputum production	68	83.9	42	85	26	81
Dyspnea	12	14.8	10	20.4	2	6

Table 2: Different pattern of HRCT thorax finding and involvement of lobes in tuberculosis

HRCT evaluation	TB with DM group (n–32) (in percentage)	TB without DM group (n–49) (in percentage)	p
CT findings			
Consolidation	25 (78.1)	33 (67.3)	0.293
Satellite lesions	23 (71.8)	31 (63.2)	0.422
Nodules	20 (62.5)	36 (73.4)	0.296
Tree in bud	24 (75)	30 (61.2)	0.199
Bronchiectasis	10 (31.2)	20 (40.8)	0.383
GGO	15 (46.8)	25 (51)	0.715
Cavitary lesion	12 (37.5)	4 (8.1)	0.001
Mediastinal lymph nodes	7 (8.1)	12 (24.4)	0.786
Parenchymal calcification	2 (6)	10 (20.4)	0.080
Tuberculoma	0	1 (2)	0.416
Non-segmental distribution of consolidation	9 (28)	1 (2)	0
Miliary TB	1 (3.1)	1 (2)	0.759
Lobe involvement			
Upper lobe	6 (18.7)	16 (32.6)	0.169
Middle lobe	3 (9.3)	3 (6.1)	0.585
Lower lobe	17 (53.1)	13 (26.5)	0.015
Upper and middle lobe	3 (9.3)	6 (12.2)	0.688
Middle and lower lobe	0	3 (9.3)	0.154
Upper middle and lower lobe	1 (3.1)	5 (10.2)	0.234
Upper and lower lobe	2 (6.2)	3 (6.1)	0.981

HRCT: High-resolution computed tomography, DM: Diabetes mellitus, TB: Tuberculosis

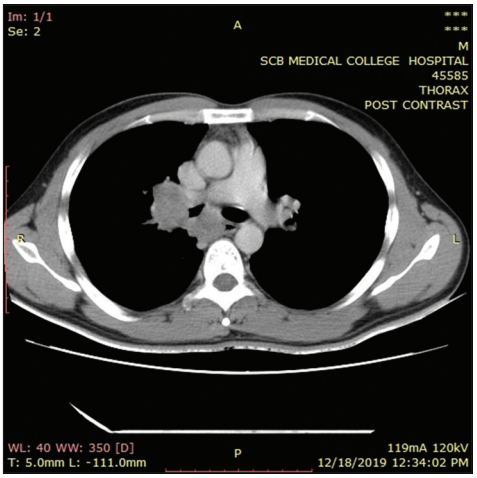

Figure 4: Axial section of Non contrast computed Tomography scan of thorax of a 44 year non-diabetic male patient presented with cough, fever, and sputum production in mediastinal window showing hilar lymphadenopathy

DISCUSSION

Incidence of TB among elderly is rising and globally may be due to the inherent decline in immunity with age [1]. The patients from diabetic TB group were significantly elder than non-diabetic TB group and overall the elderly are more likely to be infected by TB. The majority of our study population comprised males, possibly due to their more outdoor activity than female population. However, similar clinical symptoms were observed in both groups. The previous studies such as by Al-Wabel *et al*. [2] and Bacakoğlu *et al*. [3] also support this inference of our study.

In our study, cavities occurred in 37.5% of the patients with diabetes within the tuberculous consolidative lesions, when compared to non-diabetic patients (p=0.001). Cavities appears to be more common in diabetic patients in our study which was in accordance with the past studies [4-6]; however, contradictory results were observed by Al-Wabel *et al*. intheor

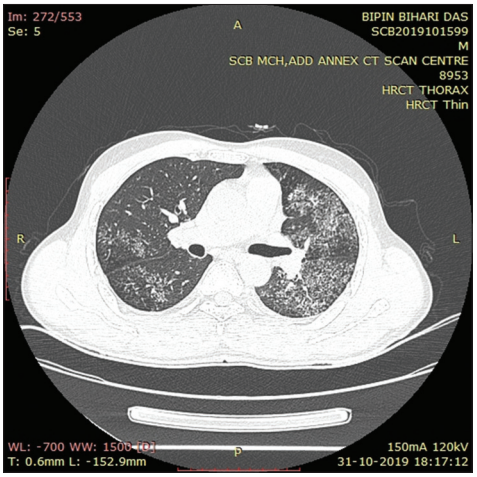

Figure 5: Axial section of high-resolution computed tomography of a 48-year-old diabetic male presented with cough, fever, and sputum production thorax showing bilateral lung field areas of nodules in tree in budding phase pattern

study [2]. Cavities could be a favorable diagnostic sign, but no specific correlation between the CT appearance of cavities and disease activity has been demonstrated. Small foci of parenchymal cavitation, both in areas of confluent pneumonia and in areas of disease associated with distortion of the underlying lung parenchyma, can be favorably detected on CT scan. Studies have shown that NSD of consolidations is more common among TB patients with diabetes [6,7]. Similarly, NSD of consolidations was common in diabetic patients (28%) when compared to non-diabetic patients, the results were statistically significant (p=0.136).

In this study, we found nodules in 62.5% of diabetic patients and 73.4% of non-diabetic patients. Micronodules are most often detected in the acute early stage of the active TB. They are commonly poorly defined with a tendency to coalesce. The lesions are usually <5 mm in diameter, and are generally located at the peripheral areas of consolidations or cavities and however are not observable by standard chest radiography. Micronodules thus appear to be a useful diagnostic sign of TB, and the detection of these discrete foci is indeed highly suggestive of active TB. Poey *et al* emphasized that these micronodules can be completely cured after treatment [8] and hence is a very important HRCT finding though there is no statistical significance of increased frequency in diabetic patients with TB.

The bud-in-tree patterns on CT were first used by Im *et al*. [9] to describe the appearance of the endobronchial spread of M. TB. It represents a form of bronchiolar impaction in which branching linear structures have more than one contiguous branching site. Terminal tufts of the bud-in-tree structure might represent caseation necrosis within the bronchioles and alveolar ducts, while the stalk might represent a lesion that affected the last order bronchus within the secondary lobule. This bud-in-tree sign is characteristic but non-specific that cannot help to define the diagnosis of active TB. During our study, the bud-in tree sign was present in both diabetic patients (75%) and non-diabetic patients (61.2%) and however was not statistically significant (p=0.199). In the proper clinical setting, the bud-in-tree sign is believed to be a reliable sign for the diagnosis of active disease, and the pattern can be distinguished from old fibrotic lesions.

In our study, consolidation was found in 78.1%, SL in 71.8%, traction BTX in 31.1%, GGO in 46.8%, mediastinal nodes in 21.8%, parenchymal calcification in 6%, and miliary TB in 3.1%, and no cases of tuberculoma in diabetic patient were observed. These lesions showed no statistical significance when compared to non-diabetic group and p value was found out to be 0.293, 0.422, 0.715, 0.786, 0.080, 0.759, and 0.416, respectively. Location of radiological finding of pulmonary TB has been described as atypical or unusual among diabetic patients, mainly to indicate the locations of lesions other than the common upper lung regions observed in TB. For instances, an increased occurrence of lower lung field involvement in diabetic patients has been reported by some researchers, along with a higher occurrence of multilobar involvement. In our study, unusual localization in the lower lobe was found with an occurrence of 53.1% in diabetic TB group compared to 26.5% in non-diabetic TB group showing statistical significance having p=0.015 [6,7,10-13]. Bilateral and multi-lobar involvement was also found in our patients in both groups but not as commonly shown in other previous studies [14-16].

CONCLUSION

The results of our study show that lower lobes are found out to be more commonly affected among TB with diabetes group. From all the HRCT findings of pulmonary TB, NSD of consolidation and cavitary lesions appears to be significantly more common in patients with diabetes than patients without diabetes.

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