

Does diabetes alter the radiological presentation of pulmonary tuberculosis

Mohammad A. Shaikh, DTCD, DTM, Rupak Singla, DNB, MD, Nazeer B. Khan, MSc, PhD, Nasser S. Sharif, DThM, DTMH, Mohammad O. Saigh, MD.

ABSTRACT

Objectives: The aim of this study is to determine whether diabetes mellitus (DM) alters the radiological manifestations of pulmonary tuberculosis (TB).

Methods: A retrospective review of the medical records and skiagrams of 692 consecutive smear positive pulmonary TB patients admitted in the Sahary Chest Hospital, Riyadh, Kingdom of Saudi Arabia, from January 1998 to December 1999, was performed. One hundred and eighty-seven (27%) patients had an associated DM. The radiographic findings of pulmonary TB patients with DM (PTB DM group) were compared to those without DM (PTB group).

Results: The PTB DM group of patients had increased frequency of lung lesions confined to lower lung field compared to PTB group (23.5% versus 2.4%, $p < 10^{-4}$). The PTB DM group of patients had significantly higher frequency

of cavitory lung lesions compared to PTB group (50.8% versus 39.0%, $p = 0.005$). Also cavitory lesions were more frequently confined to lower lung field in PTB DM group compared to PTB group (28.9% versus 2.5%, $p < 10^{-4}$). Logistic regression analysis showed that diabetes was the only independent significant risk factor associated with lung lesions or cavities in the lower lung fields (lung lesions [odds ratio {OD}] = 12.63, 95% confidence interval {CI} = 6.50-24.56]; cavitory lesions [OD = 15.66, 95% CI = 5.82-42.16]).

Conclusion: The PTB DM group are more likely to present with atypical radiological images. Among diabetic patients presenting with lower lung field lesions or cavities possibility of TB should always be considered for prompt diagnosis and management.

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Increased incidence of diabetes mellitus (DM) among tuberculosis (TB) patients is well known.^{1,2} Pulmonary TB patients with diabetes mellitus (PTB DM group) have been reported to have atypical or unusual radiological features. Some authors have described an increased frequency of lower lung field involvement.³⁻⁷ A higher frequency of multi-lobar involvement has also been described among PTB DM patients.⁸ Some authors have found a higher frequency of cavitory lesions.^{3,9,10} Some other studies reported no radiological differences^{11,12} between PTB DM group and TB patients without associated diabetes (PTB group). However, most of the previous studies included a relatively small number of diabetic patients and some even lacked proper

statistical analysis.⁶⁻¹² Thus, whether diabetic subjects present atypical radiological presentation of pulmonary TB is still controversial. The present study was aimed to determine whether association of diabetes mellitus alters the radiological manifestations of pulmonary TB.

Methods. The present study was conducted in the Sahary Chest Hospital, Riyadh, Kingdom of Saudi Arabia (KSA). This is the only referral hospital for the management of TB patients and suspects from the Central region of KSA. Clinical records and skiagrams of all the consecutive patients admitted with the diagnosis of smear positive pulmonary TB from January

From the Department of Tuberculosis and Chest Diseases (Shaikh, Singla, Sharif, Saigh), Sahary Hospital, and the Department of Biostatistics (Khan) College of Dentistry, King Saud University, Riyadh, Kingdom of Saudi Arabia.

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Address correspondence and reprint request to: Dr. Mohammad A. Shaikh, Department of Tuberculosis and Chest Diseases, Sahary Hospital, PO Box 7966, Riyadh 11472, Kingdom of Saudi Arabia. Tel. +966 (1) 4081095. Fax. +966 (1) 4631608. E-mail: drmashaikh@hotmail.com

1998 to December 1999 were reviewed retrospectively. Patients with extra-pulmonary TB or miliary TB were excluded. Seven hundred and eighteen sputum smear positive pulmonary TB patients reported during the study period. The medical records and skiagrams of 26 patients were missing. Six hundred and ninety-two patients were available for review and were analyzed. Among them 592 patients had at least one documented positive culture for *Mycobacterium tuberculosis*. Out of 692 patients in the study, 187 patients had associated DM. Diabetes mellitus was diagnosed by demonstrating at least 2 fasting blood sugars over 140 mg/dl. All postero-anterior and lateral chest skiagrams were reviewed by one of the pulmonologists participating in the study. The reviewers were blinded on the diabetic status of the patients. Tuberculous lesions and cavities were stated to be present in the upper or lower lung fields when they appeared mostly in the upper or lower half. Cavity was considered to be present when its diameter was more than 2 centimeters. In PTB DM group, 25 out of 505 patients (4.9%) and in TB group, 9 out of 187 patients (4.8%) had a doubtful or difficult images ($p=0.94$). These skiagrams were jointly reviewed with the help of another reviewer.

Statistical Package for Social Sciences, version 10, was used for statistical analysis. Difference of percentages between the 2 groups were analyzed using chi-square method. Statistical significance was set at $p<0.05$. Spearman correlation test was performed to determine the significant factors associated with the occurrences of various radiological findings. The significant variables, obtained from the correlation test, were entered in a multivariate logistic regression analysis to develop a risk model for radiological findings. Odds ratio (OR) and its 95% confidence interval (CI) were also calculated.

Results. A total of 692 patients were included in this study. There were 187 (27%) patients with co-existing diabetes (PTB DM group) and 505 (73%) were controls without diabetes (PTB group). The demographic profile of the patients is shown in **Table 1**. Mean age of PTB DM group was 48.2 (± 12.0) years and of PTB group was 32.3 (± 12.4) years ($p<0.001$). In PTB DM group, the male:female ratio was 3.1:1 compared to 1.5:1 in PTB group indicating male population to be twice as common in PTB DM group. Among PTB DM group 43.3% of the patients were Saudi nationals while in the PTB group, the Saudis comprised only 28.1% ($p<0.001$). Thirty four percent of the diabetes patients had type-1 diabetes while 66% had type-2 diabetes. At the time of discharge 48% of the diabetic patients were using insulin, 44% were on oral agents and 8% were diet controlled. Diabetic patients had an average duration of diabetes for approximately 5.2 years (ranging from 1.4-13 years). Twenty-three patients (12.3%) were diagnosed as DM for the first time. The frequency of location of lung lesions in PTB DM group and PTB

group is shown in **Table 2**. The PTB DM group had a lower frequency of upper lung field lesions (31.6%) compared to PTB group (54.5% $p<10^{-4}$). When all patients with upper lung field lesions (combining upper and upper + lower) were compared, PTB DM group still had a lower frequency of such lesions than PTB group (76.5% versus 97.7% $p<10^{-4}$). However, isolated lower lung field lesions were significantly more common in PTB DM group than PTB group (23.5% versus 2.4%, $p<10^{-4}$). Also a higher frequency of pooled lower lung lesions (combining lower and upper + lower) was observed in PTB DM group than in PTB group (68.4% versus 45.6%, $p<10^{-4}$). Regarding the extent of lung lesions (bilateral or unilateral) PTB DM group had bilateral lesions in 52.9% of patients, which was not significantly different than in PTB group (51.1%, $p=0.665$). As the cases and control groups differed with regard to their age, gender and nationality, an attempt was made to clarify the association of each of these variables and co-existing diabetes with the development of lesions confined to lower lung field. Spearman correlation showed that besides diabetes other factors such as age and nationality had significant correlation with the development of lower lung field lesions. However, multivariate logistic regression analysis determined that DM was the only significant independent factor associated with the development of lower lung field lesions (OR=12.63, 95% CI= 6.50-24.56, $p<10^{-5}$). The PTB DM group of patients had significantly higher frequency of cavitory lung lesions as compared to PTB group (50.8% versus 39.0%, $p=0.005$). Occurrences of multiple cavitory disease were not found to be significantly different between PTB DM group and PTB group (42.1% versus 34.5%, $p=0.208$). Location of cavitory lesions in PTB DM and PTB groups is shown in **Table 2**. Among the patients with cavitory lesions only, cavities confined to upper lung fields were less common in PTB DM group as compared to PTB group (49.5% versus 79.8%, $p<0.001$). Cavities confined to lower lung fields were significantly more common in PTB DM group than in PTB group (28.9% versus 2.5%, $p<10^{-4}$). When all patients with cavities in upper lung fields (combining upper and upper + lower) were compared, PTB DM group had lower frequency of cavities in upper lung fields than PTB group (71.1% versus 97.5%, $p<0.001$). Reverse was observed for cavities in lower lung fields, being more common in PTB DM group than in PTB group (50.5% versus 20.2%, $p<10^{-4}$). The cavitory lesions involving both, upper as well as lower, lung fields were not statistically different between PTB DM group and PTB group (21.6% versus 17.7%, $p=0.623$). Spearman correlation showed that besides diabetes, age had significant correlation with the development of lower lung field cavities. However, multivariate logistic regression determined that diabetes was the only

Table 1 - Demographic profile of the patients under study.

Characteristic	PTB DM, N=187 n (%)	PTB, N=505 n (%)
Age (years)		
1-20	0	56 (11.1)
21-30	12 (6.4)	244 (48.3)
31-40	46 (24.6)	120 (23.8)
41-50	57 (30.5)	44 (8.7)
51-60	49 (26.2)	21 (4.2)
>60	23 (12.3)	20 (4)
Gender		
Male	142 (75.9)	305 (60.4)
Female	45 (24.1)	200 (39.6)
Nationality		
Saudi	81 (43.3)	142 (28.1)
Non-Saudi	106 (56.7)	363 (71.9)
PTB DM - pulmonary tuberculosis patients with diabetes mellitus, PTB - pulmonary tuberculosis patients without diabetes mellitus		

significant independent factor associated with the development of cavities confined to lower lung fields (OR=15.66, 95% CI=5.82-42.16, $p<10^{-5}$).

Discussion. The present retrospective study included 692 consecutive sputum smear positive pulmonary TB patients admitted in a referral hospital of KSA during the year 1998-1999. Among the total patients, 187 patients had co-existing DM. Most of the previous studies included a relatively small number of diabetic patients and some even lacked proper statistical analysis.⁶⁻¹² Since the number of patients in this study is large enough, this allowed to draw more confident conclusions and to clarify the controversies on radiological manifestations of pulmonary TB among diabetic patients. The present study revealed that Saudi nationals were having co-existing DM more often than non-Saudis. The PTB DM patients were found to be significantly older in age than PTB group. The male: female ratio was almost twice in PTB DM patients compared to control group. In the current study almost three quarters of the diabetic patients and 98% of the non-diabetic patients had upper lung field lesions (either upper lung field alone or combined with lower lung field lesions). Since this pattern includes the classical upper lung field involvement, the radiological suspicion of pulmonary TB still remains feasible. A very important observation in the current study is that almost one quarter (23.5%) of the diabetic patients had lesions confined to lower lung field only, compared to 2.4% in non-diabetic group. Morris et al¹¹ found lower lung field TB in 10% of their diabetic patients, while no lower lung field lesion was noted in non-diabetic patients. Perez-Guzman et al³ described isolated lower lung field lesions in 19% of diabetic patients compared to 7% of

Table 2 - Percentage of patients showing location of lung lesions and cavities.

X-ray type	Upper	Upper + lower	Lower
Lung lesion			
PTB	54.5	43.2	2.4
PTB DM	31.6	44.9	23.5
Cavity			
PTB	79.8	17.7	2.5
PTB DM	49.5	21.6	28.9
PTB - pulmonary tuberculosis patients without diabetes mellitus, PTB DM - pulmonary tuberculosis patients with diabetes mellitus			

non-diabetic patients. Other authors have also reported a higher frequency of lower lung lesions in diabetic patients.^{6,7} Lesions confined to lower lung field only can lead to the consideration of diagnostic possibilities other than TB with consequent delay in diagnosis and institution of proper treatment. The PTB DM group of patients had significantly higher frequency of cavitory lung lesions as compared to PTB group (50.8% versus 39%). Some of the previous studies also reported cavitory lesions to be more common among diabetic patients.^{3,8-10} Some studies have reported higher frequency of multiple cavities among diabetic patients,⁹ but this was not observed in the current study. Regarding the location of cavitory lesion 28.9% of diabetic patients had cavities confined only to the lower lung fields as compared to only 2.5% of non-diabetic group. When association of factors such as age, gender, nationality and diabetes were analyzed together, logistic regression analysis showed DM to be the only independent risk factor associated with lung lesions or cavities confined to the lower lung fields. Other researchers have also observed increased frequency of cavities confined to lower lung field.³ Reasons for atypical radiological images in tuberculosis patients with associated diabetes are not clear. It has been attributed vaguely to an immune abnormality.⁶ Diabetes also causes histological and functional abnormalities resembling those found in older people.^{13,14} Perez-Guzman et al¹⁵ attributed atypical images in PTB DM group mainly to this premature aging of lung.

In conclusion, pulmonary TB patients with associated diabetes frequently present with atypical radiological images. Among diabetic patients presenting with lower lung field lesions or cavities, possibility of tuberculosis should also be considered for prompt diagnosis and management.

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Related Abstract

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Authors: B. Teklu, A. Al-Wabel
Institute: King Saud University, Abha, Kingdom of Saudi Arabia
Title: Resolution of fever in patients on chemotherapy for pulmonary tuberculosis
Source: Annals of Saudi Medicine 1994; September 5: 392-395

Abstract

Thirty-nine febrile and 37 afebrile patients with pulmonary tuberculosis were compared. Fever was defined as oral temperature of more than 37.2°C. Afebrile status on chemotherapy was presumed to have been achieved if patients remained without fever for at least seven consecutive days. Both groups were given short-course supervised chemotherapy in hospital consisting of isoniazid (INH), rifampin, ethambutol and pyrazinamide for the first two months and INH and rifampicin for the next four months. The two groups did not differ demographically or by the presence of cavitory disease. However, more patients with fever had anemia and elevated erythrocyte sedimentation rate (ESR) than afebrile patients. Resolution of fever occurred in 92% by four weeks. However, two female patients had fever lasting more than 60 days even though almost 1/4th of patients were afebrile one day after the start of chemotherapy and 1/3rd after three days.