

Original Article

# Evaluation of active pulmonary tuberculosis among women with diabetes



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## Article info

Received: 07 Sep 2021

Revised: 09 Nov 2021

Accepted: 14 Feb 2022

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## Keywords:

Chest radiography,  
Diabetes mellitus,  
Tuberculosis,  
Reticulonodular,  
Radiological findings

## ABSTRACT

Diabetes is one of the most common non-contagious diseases in the world. This disease is the fourth or fifth cause of death in most developed countries. The relationship between tuberculosis and diabetes had been introduced years ago and diabetes is considered a threatening factor in tuberculosis in the research history. Not only tuberculosis is prevalent among diabetic persons, but also diabetes can affect the appearance of imaging of tuberculosis. This is a kind of analytic study, a case-control study, which was carried out between the years 2014 and 2015 in Zabol City. In this study, the radiographic findings from the patients suffering from pulmonary tuberculosis in diabetic patients and not diabetic patients are compared. These radiographic were handed to a radiologist and the radiologic findings of these graphs from the anatomic location (upper and lower half of the right and left bellows), Presence or absence of cavities, nodules, density and pleural involvement were recorded and compared with the diabetic and non-diabetic group. After gathering of the data using SPSS software, descriptive statistics were presented in the form of (frequency, percent) graphs and a chi-square test ( $p < 0.05$ ) was used to analyze and comparing of the results of diabetic and un-diabetic patients. The population of the study consisted of Chest radiographs for 124 TB patients which 61 (49.19 %) were suffering from diabetics. In this study, 45 (71.43%) non-diabetic and 42 (65.85%) diabetic patients were women ( $p = 0.7$ ). There were 12 diabetic TB patients (19.67%) and 3 non-diabetic- TB patients (4.76%) with the consolidation of middle part of left lung ( $p = 0.01$ ) and 8 (13.11%) diabetic TB and 1 (1.59%) non-diabetic TB with reticulonodular infiltration of lower part of left lung ( $p = 0.02$ ). There was no significant difference in the rest of the radiographic results. The findings of this study indicate that reticulonodular infiltration and consolidation of lower & middle parts of the lung in TB diabetic patients is more than in TB non-diabetic patients and diabetes can affect the findings of pulmonary tuberculosis radiography.

## 1. Introduction

Recently, finding an effective therapy for hindering bacterial, fungal, and viral

infections have obtained high attention [1-5]. Tuberculosis is a kind of bacterial infection that is caused by *Mycobacterium tuberculosis* [6]. Tuberculosis appears in 85% of the cases

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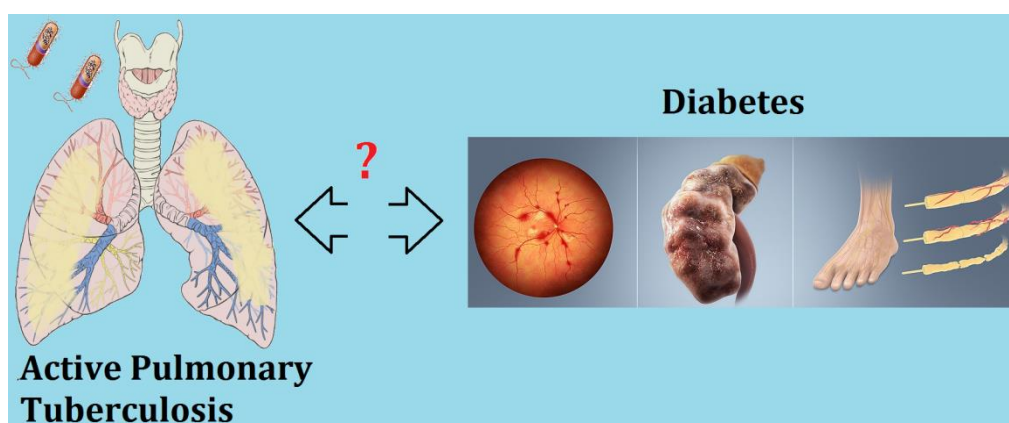
as pulmonary and in 15% of the cases as out pulmonary [7]. Almost one-third of the world population (meant 2 billion) is infected by tuberculosis microbe and they are vulnerable to tuberculosis.

Every year, 9 million and 1.5 to 2 million cases are respectively infected and die through tuberculosis [8]. More than 90% of the disease and death caused by tuberculosis occur in developing countries, and 75% of the cases are in economically active ages (15 to 54 years old) [9]. Diabetes is one of the most common non-contagious diseases in the world. This disease is the fourth or fifth cause of death in developed countries [8]. the relationship between tuberculosis and diabetes has been introduced by Abu Ali Sina hundreds of years ago [10]. in 1950 and 1992, diabetes was proposed as a threatening factor in causing active tuberculosis in literature reviews [11]. The mechanism of cooperation is not much known but researchers believe that diabetes, through repressing immune responses and affecting bacteria-killing activities of white blood cells, activates the hidden infections of mycobacterium and the progress of the disease [12]. Also, tuberculosis infection is very prevalent among diabetic people [13].

There are contradictory results in the case of the effects of diabetes mellitus on radiologic

features of pulmonary tuberculosis [14] (Figure 1). in some studies about the distribution of pulmonary involvement in TB, no differences between diabetic people and non-diabetic people is observed [15]. however, some other studies indicated that, in diabetic people, Lower lobe involvement is more prevalent [16]. Cavitory lesions especially nodular cavitory lesions in diabetic patients are more prevalent [17]. Furthermore, there is a relationship between lower lob involvement and the female gender and age above 40 years old [18].

Even, in a study, diabetes mellitus was reported as the only cause of cavitation or other decrements at the base of the lungs [19]. However, paying attention to the change in the radiographic finding of tuberculosis in diabetic patients can contribute to its diagnosis [20]. According to the high prevalence of pulmonary tuberculosis in the Sistan region and the high potential of diabetic patients to catch tuberculosis due to weakness of their immune system and also according to different findings on the effects of diabetes mellitus on radiological features of tuberculosis, this study was carried out to compare the findings of the chest radiography of pulmonary tuberculosis among diabetic and non-diabetic patients of the Zabol city.



**Fig. 1.** There are contradictory results in the case of the effects of diabetes mellitus on radiologic features of pulmonary tuberculosis.

## 2. Material and methods

As an analytic case-control study, radiography of the patients suffering from pulmonary tuberculosis whose diabetics was proven and the same number of radiographs

of the patients suffering from just tuberculosis without diabetics (as approved and recorded in the profile of the patients) were collected from tuberculosis center of Zabol city and will be delivered to the radiologists with no

information about patients and she reports chest radiography. Finally, the bellows findings of diabetic and non-diabetic TB patients from the anatomic position (upper and lower zone of the right and left bellows) existence or not the existence of cavitation, nodules, consolidation and pleural involvement are compared to each other [21].

### 2.1. Statistical analysis

After gathering the data, using SPSS software, descriptive statistics are presented in the form of (frequency, percent) graphs. For the analysis and comparison of the results in diabetic and non-diabetic people, the  $\chi^2$  test with level 0.05 of significance is operated.

### 3. Results

The sample population of this study consisted of 124 chest radiography of TB patients and 61 of them (49.19%) were suffering from diabetics (Table 1-5). Forty-five persons (71.43%) were non-diabetic and 42 persons (65.85%) of diabetic people were women. Seven persons (11.48%) of the TB diabetic patients and ten persons (15.87%) of non-diabetic TB patients had upper parts consolidation in their chest radiography (p=0.5) (Table 1-5).

Three persons (4.92%) of diabetic- TB patients and four persons (6.35%) of non-diabetic- TB had right upper zone cavitory lesions in their chest graph (p=1). Six persons (9.84%) of the diabetic-TB patients and five persons (7.94%) of non-diabetic-TB patients had right upper zone nodular infiltration in their chest graph (p=0.5). four persons (6.56%) of non-diabetic-TB patients had right upper zone reticulonodular infiltration in their chest graph (p=0.2) (Table 1-5).

Three persons of diabetic-TB patients and 1 (1.59%) of non- diabetic-TB patients had Right upper zone fibrosis in their chest graph (p=0.3). Twelve persons (19.67%) of diabetic-TB patients and 7 (11.11%) of non- diabetic-TB patients had consolidation of the right middle t zone in their chest graph (p=0.1). Seven persons (11.48%) of diabetic-TB patients and 6 persons (9.52%) of non-diabetic-TB patients had middle zone nodular infiltration in their chest graph (p=0.5). Six persons (9.84%) of the diabetic- TB patients

and five persons (7.94%) of non-diabetic-TB patients had right middle zone reticulonodular infiltration in their chest graph (p=0.5) (Table 1-5).

Nine persons (14.75%) of the diabetic-TB patients and eight persons (12.7%) of non-diabetic- TB patients had left upper& lower consolidation in their chest graph (p=0.5). 5 persons (8.2%) of the diabetic-TB patients and two persons (3.17%) of non-diabetic-TB patients had left upper& lower cavitation in their chest graph (p=0.3). five persons (8.2%) of the diabetic-TB patients and five persons (7.94%) of non-diabetic-TB patients had left upper& lower nodular infiltration in their CXR (p=0.1) (Table 1-5).

Three persons (4.92%) of the diabetic-TB patients and 1 person (1.59%) of non-diabetic-TB patients had upper lower left part reticulonodular infiltration in their chest graph (p=0.4). One person (1.64%) of the diabetic-TB patients had left upper and lower zone fibrosis in their chest radiography and none of the non-diabetic-TB patients had left upper& lower zone fibrosis (p=0.5) (Table 1-5).

Twelve persons (19.67%) of the diabetic-TB patients and three persons (4.76%) of non-diabetic-TB patients had left middle zone consolidation in their chest radiography (p=0.01). One person (1.64%) of the diabetic-TB patients had left middle zone cavitation in his chest radiography and none of the non-diabetic-TB patients had left middle zone cavitation (p=0.5). Six persons (9.84%) of diabetic-TB patients and five persons (7.94%) of non-diabetic-TB patients had left middle zone Nodular infiltration in their chest radiography (p=0.8) (Table 1-5).

Five persons (8.2%) of the diabetic-TB patients and one person (7.94%) of the non-diabetic-TB patient had left middle zone reticulonodular infiltration in their chest radiography (p=0.1). sixteen persons (26.23%) of diabetic-TB patients and 15 persons (23.81%) of non-diabetic-TB patients had left middle zone consolidation in their chest radiography (p=0.7). one person (1.64%) of the diabetic-TB patients and three persons (7.94%) of non-diabetic-TB patients

had left lower zone cavitation in their chest radiography (p=0.6) (Table 1-5).

Six persons (9.84%) of diabetic-TB patients and five persons (9.52%) of non-diabetic-TB patients had lower zone Nodular infiltration in their chest radiography (p=0.8). Eight persons (13.11%) of the diabetic-TB patients and one person (1.59%) of non-diabetic-TB

patients had left lower zone reticulonodular infiltration in their chest radiography (p=0.02) (Table 1-5). In the tables (Table 1-5), firstly, radiographic findings were reviewed in general and based on the anatomic location and then in detail.

**Table 1.** Distribution of lung involvement. H: having diabetes D; diabetic and ND: non-diabetic

| H  | Involved lung    |            |            |                     | p-value |
|----|------------------|------------|------------|---------------------|---------|
|    | Without conflict | Right lung | Left lung  | Left and right lung |         |
| D  | 2 (3.3%)         | 20 (32.8%) | 15 (24.6%) | 24 (39.3%)          | 0.4     |
| ND | 1 (1.6%)         | 25 (39.7%) | 9 (14.3%)  | 28 (44.4%)          |         |

**Table 2.** Distribution of the involvement of lung zone. H: having diabetes D; diabetic and ND: non-diabetic

| H  | Involved parts |          |           |           |         |          |          |         | p-value |
|----|----------------|----------|-----------|-----------|---------|----------|----------|---------|---------|
|    | N*             | U*       | M*        | L*        | U-M*    | U-L*     | M-L*     | U-M-L*  |         |
| D  | 2(23.3%)       | 7(11.5%) | 7(11.5%)  | 14(23%)   | 6(9.8%) | 5(8.2%)  | 9(14.8%) | 11(18%) | 0.1     |
| ND | 1(1.6%)        | 8(12.7%) | 10(15.9%) | 24(38.1%) | 5(7.9%) | 7(11.1%) | 2(3.2%)  | 6(9.5%) |         |

N\*: lack involvement of the lung; U\*: upper zone (region); M\*: middle zone; L\*: lower zone; U-M\*: upper and middle zone; U-L\*: upper and lower zone; M-L\*: middle and lower zone; U-M-L\*: upper& middle and lower zone

**Table 3.** Distribution of the patterns of involvement of zone of lung. H: having diabetes D; diabetic and ND: non-diabetic

| H  | Involvement pattern |            |            |             |                 |          | p-value |
|----|---------------------|------------|------------|-------------|-----------------|----------|---------|
|    | Not involved        | Congestion | Cavitation | Nedolarity  | Reticulonodular | Fibrosis |         |
| D  | 2 (2.1%)            | 46(47.46%) | 13 (13.4%) | 17 (17.5%)  | 13 (13.4%)      | 6 (6.2%) | 0.3     |
| ND | 1 (1.2%)            | 48 (59.3%) | 25 (14%)   | 30 (16.19%) | 19 (10.7%)      | 7 (3.9%) |         |

**Table 4.** Distribution frequency left middle zone consolidation in chest radiography

| Consolidation of the left middle zone | Non-diabetic | Diabetic    | p-value |
|---------------------------------------|--------------|-------------|---------|
| yes                                   | 3(4.76%)     | 12(119.67%) | 0.01    |
| no                                    | 60(95.24%)   | 49(80.33%)  |         |

**Table 5.** Distribution frequency left lower zone reticulonodular infiltration

| Reticulonodular infiltration lower zone decr | Non-diabetic Number (percent) | Diabetic Number (percent) | p-value |
|--|-------------------------------|---------------------------|---------|
| yes  | 1 (1.59%)                     | 8 (13.11%)                | 0.02    |
| no   | 62 (98.41%)                   | 53 (86.89%)               |         |

#### 4. Discussion

Pulmonary tuberculosis is one of the most important medical issues in the world and it has been uncontrollable in some parts of the world. The danger of this disease is very high among vulnerable groups such as diabetic people, HIV-infected patients, and smokers [22]. A previous study has indicated that the prevalence of tuberculosis among diabetic people is ten times more than non-diabetic people [23]. Although the results of many studies point to the coincidence of diabetics and tuberculosis, but they could not determine the sequence of their happening. In another word, they are unable to determine whether diabetics cause tuberculosis or vice versa. But, 40 years of studies by the researchers confirm the effects of diabetics on increasing the danger of tuberculosis [24]. The results of a previous study on 17 empirical studies from 1983-2007 over more than 700000 people that 18000 of them had tuberculosis showed that diabetics increase the danger of tuberculosis up to three times and researchers reported this amount of danger (0.99-7.83) in different studies [24] that can be due to deteriorating immune system by diabetics and consequently widely spreading of tuberculosis and other diseases in these people.

In this study, for diabetic patients, the involvement of upper parts was 7%, middle parts were 7%, lower parts were 14%, and upper and middle parts were 6%, upper and lower parts were 5%, and middle and lower parts were 9%, and upper lower middle parts were 6% and in non-diabetic patients also the involvement of lower parts was more than other parts but there was no significant relationship ( $p < 0.05$ ).

In our study, the radiographic changes of the chest in the lower parts of bellows, only based on the reticulonodular decrement of the lower left part, there was a significant difference ( $p < 0.05$ ) (table 5) which is consistent with the studies of Moriss [25] and Janmeja from the reticulonodular decrement of lower left part [26]. In a study was carried out on 4430 people suffering from pulmonary tuberculosis in India during the years 1998-2001, tuberculosis of lower lobes was observed in 10.5 percent of the case which was more

obvious among diabetic patients (18.49%) and HIV infected patients (58.71%) [27]. That the involvement of lower lobes can be due to weakness of the immune system.

In diabetic and non-diabetic patients, there was no significant relationship between the involvement of left and right bellows. However, in a previous study, a little difference was observed between these groups [28].

In this study, the chest of two persons with diabetes (2.1%) and one person without diabetes was completely normal which can be attributed to the issue of the involvement of the middle lobe of the right bellows. There were is a blind spot in the chest radiography and spreading of tuberculosis and it must be taken into account that the normality of the type does not reject tuberculosis.

In the case of clinical doubt, performing a track cell CT scan for discovering tree patterns which is the indicator of tuberculosis endobronchial or discovering other hasty changes can be helpful [29].

In this study, 6 persons (6.2%) of the diabetic patients and 7 persons (3.9%) of the non-diabetic patients had fibrotic changes. In this study diabetic patients, 47.4% congestion, 13.4% hole, 17.5% nodularity, 13.4% reticulonodular and 6.2% fibrosis were observed in comparison to diabetic patients no meaningful relationship was observed.

In the case of radiologic changes in the middle parts of bellows in diabetic and non-diabetic patients, there was a significant relationship between congestion of the middle left part ( $p < 0.05$ ) (table 4). No significant relationship was observed between diabetic and non-diabetic patients, via the radiography features of the chest in the upper part of the bellows ( $p > 0.05$ ) (table 1).

In total, most of the radiological findings of the TB patients are like that of TB non-diabetic patients which is consistent with previous studies [8, 11, 12, 14], but it is not consistent with the findings of in previous study [30] that various fragmented and pitted distribution in bellows radiography in diabetic patients is more which its cause can

be a good control of diabetics in the patients and lack of much effects on the process of tuberculosis [26].

## 5. Conclusion

The findings of this study indicate that most of the radiological findings of the TB patients are like non-diabetic TB patients. Distribution frequency of congestion of middle left part (Left Middle Zone Consolidation) and left lower zone reticulonodular based on having diabetics had a meaningful relationship with each other. In future studies, to investigate the radiographic findings of the TB diabetic patients, based on diabetics type (type 1 and 2), the length of illness and type of treatment of the diabetics and anatomic location of it CT scan is suggested.

## Conflict of Interests

All authors declare no conflict of interest.

## Ethics approval and consent to participate

No human or animals were used in the present research.

## Consent for publications

All authors read and approved the final manuscript for publication.

## Availability of data and material

All the data are embedded in the manuscript.

## Authors' Contribution

All authors had an equal role in study design, work, statistical analysis and manuscript writing.

## Informed Consent

The authors declare not to use any patients in this research.

## Funding/Support

This work was supported by the Zabol University of Medical Sciences.

## Acknowledgment

The authors would like to acknowledge funding from Zabol University of Medical Sciences.

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Behzadmehr R, Rezaie-Keikhaie K (2022) Evaluation of active pulmonary tuberculosis among women with diabetes. *Cellular, Molecular and Biomedical Reports* 2(1):56-63. doi:10.55705/cmbr.2022.336572.1036

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