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Pulmonary tuberculosis patients with diabetes mellitus have a more severe degree of chest X-ray compared to pulmonary tuberculosis patients without diabetes mellitus

Los pacientes con tuberculosis pulmonar con diabetes mellitus tienen un grado más severo de radiografía de tórax en comparación con los pacientes con tuberculosis pulmonar sin diabetes mellitus

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SUMMARY

Introduction: *Pulmonary tuberculosis (TB) cases increase along with the increase in diabetes mellitus (DM) cases. The purpose of this study is to compare the description of Thorax X-ray severity between pulmonary TB patients without DM and pulmonary TB patients with DM.*
Methods: *The design of this study was cross-sectional. Observations were made with medical record data and X-Ray Thorax results which three different radiology specialists then classified. Classification of X-Ray Thoracic Lung TB is divided into 3, including minimal lesions, medium lesions, and extensive lesions.*
Results: *The results showed that TB patients without DM had a thorax X-Ray severity degree of at least 9 patients (30.0 %), moderate as many as 12 patients (40.0 %), and an area of 9 patients (30.0). Whereas in TB patients with DM who had a thorax X-Ray severity degree of at least 3 patients (10.0 %), moderate as many as 9 patients (30.0 %), and an area of 18 patients (60.0 %). There was a significant difference in the chest X-ray severity between TB patients without DM and with DM (p=0.040).*
Conclusion: *Patients with pulmonary TB and DM have a more severe chest X-ray than patients with pulmonary TB who do not have DM.*

Keywords: *Thoracic x-ray classification, pulmonary tuberculosis, diabetes mellitus.*

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RESUMEN

Introducción: *Los casos de tuberculosis pulmonar (TB) aumentan junto con el aumento de casos de diabetes mellitus (DM). El propósito de este estudio es comparar la descripción de la gravedad de la radiografía de tórax entre pacientes con TB pulmonar sin DM y pacientes con TB pulmonar con DM.*
Métodos: *El diseño de este estudio fue transversal. Las observaciones se realizaron con los datos de la historia*

clínica y los resultados de los rayos X de tórax que luego clasificaron tres especialistas en radiología diferentes. La clasificación de la tuberculosis pulmonar torácica por rayos X se divide en 3, que incluyen lesiones mínimas, lesiones medianas y lesiones extensas.
Resultados: *Los resultados mostraron que los pacientes con tuberculosis sin DM tenían un grado de gravedad de la radiografía de tórax, de al menos 9 pacientes (30,0 %), moderado hasta 12 pacientes (40,0 %) y un área de 9 pacientes (30,0). Mientras que en los pacientes con TB con DM que tenían un grado de gravedad de la radiografía de tórax de al menos 3 pacientes (10,0 %), moderada hasta 9 pacientes (30,0 %) y un área de 18 pacientes (60,0 %). Hubo diferencia significativa en la gravedad de la radiografía de tórax entre los pacientes con tuberculosis sin DM y con DM (p= 0,040).*
Conclusión: *Los pacientes con TB pulmonar y DM tienen una radiografía de tórax más grave que los pacientes con TB pulmonar que no tienen DM.*

Palabras clave: *Clasificación radiográfica de tórax, tuberculosis pulmonar, diabetes mellitus.*

INTRODUCTION

Pulmonary tuberculosis (TB) is a respiratory infection caused by the bacteria *Mycobacterium tuberculosis* (1). *M. tuberculosis* is divided into ancient and modern bloodlines (2). M. tuberculosis bacteria have aerobic, gram-positive, non-motile properties and are acid-resistant bacteria. Diseases caused by these bacteria are often found in densely populated environments because these bacteria are easy to breed in humid places. Symptoms caused by the *M. tuberculosis* bacteria include a prolonged cough which is sometimes accompanied by blood, fever, night sweats, drastic weight loss, and often feeling tired (3). TB has an impact not only on their physique but also on their quality of life (4).

Pulmonary TB in Indonesia ranks 3rd in the world by contributing 8 % of all TB cases in the world so that pulmonary TB disease is the leading health problem faced by Indonesia (5). New cases of pulmonary TB in Indonesia reached 420,994 cases in 2018 (6). In Sidoarjo, Indonesia, there are quite a lot of pulmonary TB sufferers. Based on data recapitulated by the Sidoarjo Health Office, in 2017, there were 890 new TB BTA (+) cases, while the total number of TB cases was 2092 (7). Indonesia through the national pulmonary TB prevention program targets to eliminate TB in 2035 and free from pulmonary TB in 2050 (8). However, there are still many problems found in preventing TB including lack of knowledge regarding TB (9) and resistance to the drug such as rifabutin (10).

The prevalence rate of TB increases along with the increase in cases of diabetes mellitus (DM). A study reported that new TB patients were found more in patients suffering from DM compared to patients who did not have a history of DM in Indonesia around 2001-2005 (11) DM causes the patient's immunity to becoming weak so that it can cause serious complications, one of which is susceptibility to infection, including by *M. Tuberculosis* (12) Additionally, a previous study found that the majority of patients with pulmonary TB who had type 2 diabetes have average high blood glucose and uncontrolled diabetes (13). In addition, DM may influence the success of pulmonary TB treatment (14).

Diagnosis in pulmonary TB patients can be made with a sputum smear test, plain X-ray Thorax, and most recently, it can be done with a molecular rapid test (15). The radiological results of pulmonary TB patients without DM and pulmonary TB with DM can be distinguished. In pulmonary TB with DM, atypical lesions are found, the infiltrates are abundant in the lower lobe then followed in the middle, some patients are found in the upper lobe, and pleural effusions can be found. Meanwhile, it is inversely proportional to pulmonary TB without DM. The infiltrates tend to be more found in the upper part of the lung (16). Previous studies concluded that there was no relationship between pulmonary TB patients with DM and without DM based on the Thorax photo image at PKU Muhammadiyah Yogyakarta Hospital, Indonesia (11). Based on the aforementioned research, this study seeks to establish a difference in the severity of the X-Ray Thorax image between pulmonary TB without DM and pulmonary TB with DM.

METHODS

This study used a cross-sectional research design. The population in this study were patients with Lung TB without DM and Pulmonary

TB with DM who were at the Siti Khodijah Muhammadiyah Hospital, Sepanjang, Indonesia. The research subjects were taken by consecutive sampling methods according to the inclusion and exclusion criteria. Observations were made by looking at medical record data and chest X-Ray results of pulmonary TB patients, which were then classified according to the degree of severity of the American TB Association (minimal, moderate, and extensive lesions) by three radiology specialists. Data collection and data collection procedures were carried out after obtaining ethical permission from the Siti Khodijah Hospital. After the data was obtained, it was processed by editing, coding, entry, and tabulating, processed, and analyzed using SPSS for chi-square data.

RESULTS

Subject characteristics

Age

Table 1 explains that the lowest TB patients with DM are 41 years old, the highest age is 68 years, and the average age is 56.50 years with a standard deviation of 7.816 years. Whereas in TB patients without DM, the lowest age was 18 years, the highest age was 71 years, and the average age was 42.267 with a standard deviation of 17.656 years.

Table 1

Description of the age of the pulmonary TB patient

TB Patients	Minimal	Maximum	Average	Standard deviation
With DM	41	68	56.500	7.816
Without DM	18	71	42.267	17.656

DM: diabetes mellitus

Sex

Table 2 shows that that 21 patients (70 %) of pulmonary TB patients with DM were male, while 9 other patients (30 %) were female. Meanwhile, 20 patients with pulmonary TB without DM were male (66.7 %), while the other 10 patients (33.3 %) were female. This shows that male patients dominated pulmonary TB patients in this study.

Table 2

Description of the sex of the pulmonary TB patient

Sex	TB Patients with DM		TB Patients without DM	
	n	Percentage	n	Percentage
Male	21	70.0	20	66.7
Female	9	30.0	10	33.3
Total	30	100.0	30	100.0

Degree of Thorax X-Ray

Based on Table 3, it is known that of the 60 patients in this study were dominated by patients with a wide degree of severity, namely 27 people (45.0 %). 21 patients (35.0 %) had moderate Thorax X-Ray severity and 12 (20.0 %) minimum X-Ray severity.

Table 3

Degree of thorax X-Ray in pulmonary TB patients

Degree X-Ray	n	Percentage
Minimal	12	20.0
Moderate	21	35.0
Wide	27	45.0
Total	60	100

Bivariate analysis

Table 4 explains that TB patients without DM who have a thorax X-Ray severity degree of at least 9 patients (30.0 %), moderate as many as 12 patients (40.0 %), and an area of 9 patients (30.0 %). Whereas in TB patients with DM who had a thorax X-Ray severity degree of at least 3 patients (10.0 %), moderate as many as 9 patients (30.0 %), and an area of 18 patients (60.0 %). There was a significant difference in the chest X-ray severity between TB patients without DM and with DM (p=0.040). The contingency coefficient obtained in the analysis results was 0.311. This shows a linear relationship between TB patients with DM by increasing the severity of X-ray thorax. TB patients with DM are at greater risk of having a chest X-ray severity in the form of extensive lesions than TB patients without DM.

Table 4

Difference the chest X-ray between TB patients without DM and with DM

TB Patient	Degree of Thorax X-Ray			Total	p	Contingency coefficient
	Minimal	Moderate	Wide			
Without DM	9	12	9	30	0.040	0.311
	30.0 %	40.0 %	30.0 %	100.0 %		
With DM	3	9	18	30		
	10.0 %	30.0 %	60.0 %	100.0 %		

DM: diabetes mellitus

DISCUSSION

Age-related patient features imply that TB patients with DM are older than TB patients without DM. This is indicated by the average age of TB patients with DM of 56.5 years, while the average age of TB patients without DM is 42.267. In addition, the characteristics based on sex indicate that male patients dominate TB patients with DM and without DM. This is following the literature where men are at greater risk of developing pulmonary TB disease than women. More men smoke and drink alcohol than women, where smoking and alcohol reduce their immunity so that infection is easier, one of which is an infection due to *M. tuberculosis* (17).

The severity of Thorax X-ray is classified into 3 groups including minimal lesions, moderate lesions, and extensive lesions (18). The number of patients in this study who were included in the minimum group was 12 patients (20.0 %), the moderate group was 21 patients (35.0 %), and the wide group was 27 patients (45 %). This suggests that in this study, TB patients were dominated by the severity of chest x-rays with extensive lesions. The severity of the X-Ray Thorax characteristics in patients with pulmonary TB who did not have DM was as follows: minimum lesions in 9 patients (30 %), moderate lesions in 12 patients (40 %), and extensive lesions in 9 patients (30 %). This shows that the severity of X-Ray Thorax patients without DM tends to have a moderate severity of lesions. In pulmonary TB patients with DM, minimal lesions were found in 3 patients (10 %), moderate lesions in 9 patients (30 %), and extensive lesions in 18 patients (60 %). These results indicate that pulmonary TB patients with

DM tend to have a degree of severity in the form of extensive lesions. The results of the tabulation of the severity of the chest X-ray with the group of TB patients without DM and TB with DM showed that TB patients with DM dominated the severity of the broad lesion chest X-ray.

These results are per the literature that the picture of pulmonary TB in DM differs from the picture of pulmonary TB without DM. Pulmonary TB with DM often has an atypical picture. The infiltrates are primarily found in the lower lobes, followed in the middle and some are found in the upper lobes. This is inversely proportional to pulmonary TB without DM, where the infiltrate is more commonly found in the upper part of the lung. Research conducted in India in 2011 found that 10 out of 50 chest X-Ray photos of pulmonary TB patients with diabetes had cavities with a size of more than 2 cm that occurred in the lower lung. Multiple cavities are also often found. This is because DM patients have a decreased immune system (19). Indirectly from the literature, it can be concluded that a history of DM affects the severity of lesions in the lung fields of patients with pulmonary TB.

A report stated that the degree of severity in minimal lesions was found more in patients with pulmonary TB without diabetes, namely 40 % (20). This result is almost the same as the other studies in that the TB lesions in the upper lobe of the lung were 59 %, more than 24 % of TB patients with DM (21). Indirectly, this study proves that the x-ray lesions of the Thorax in pulmonary TB patients with DM are often atypical. The research above indirectly proves that TB patients with DM have a worse degree of X-Ray Thorax severity than TB patients without DM in the form of extensive lesions. The prevalence of pulmonary TB cases in patients with a history of DM occurs in various age groups but has similarities, namely at the old age group, more than 50 years. DM patients accompanied by increasing age will increase the risk of being infected with TB. In addition, DM is more common in old age patients, so it indirectly affects the incidence of pulmonary TB and affects the degree of severity on the radiological image (22).

DM raises the incidence of pulmonary TB; this is supported by biological evidence indicating DM impairs innate and adaptive immune responses, allowing TB to multiply more rapidly. Studies on mice found higher levels of bacteria. In individuals with DM, reduced IFN- and other cytokines production impairs T cell immunity and neutrophil chemotaxis. This plays an essential role in increasing the patient's tendency to become infected with *M. tuberculosis*. The reaction caused by *M. tuberculosis* can induce glucose intolerance and worsen glycemic control in diabetic patients (23). The increased risk of TB in DM patients may be caused by defects in alveolar macrophages or T lymphocytes. A study found an increase in mature alveolar macrophages in pulmonary TB patients, but no significant difference in the number of T cells between pulmonary TB patients without DM and pulmonary TB patients with DM. The decreased proportion of mature alveolar macrophages in TB patients with DM may explain the more severe expansion of lesions in pulmonary TB patients' lung fields (24).

CONCLUSION

There is a significant difference in the severity of X-ray thorax between pulmonary TB patients without DM and pulmonary TB patients with DM; pulmonary TB without DM tends to cause moderate lesions, whereas pulmonary TB with DM tends to cause extensive lesions.

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