Conference Paper

The Correlation of Chest Radiographic Image of Pulmonary Tuberculosis in Type 2 Diabetes Mellitus Patients with HbA1C Level

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Abstract

Globally, tuberculosis (TB) and diabetes mellitus (DM) are two significant factors of morbidity. Several studies show a bidirectional relation between these two diseases. Diabetes mellitus increases the risk of active TB infection. As a standard procedure, Glycated Hemoglobin (HbA1C) level is used for monitoring patients with DM. This study aimed to identify the correlation of chest radiographic image of pulmonary tuberculosis with the HbA1C level in type 2 DM patients. A descriptive analytical survey with the cross-sectional study was performed in 32 subjects with type 2 DM and pulmonary TB. Statistical analysis was done by using gamma test, and we found a significant (p=0.042) and robust (r= 1) correlation between HbA1C level and pulmonary TB lesion area. It is concluded that chest radiographic images of pulmonary TB are significantly correlated with the HbA1C level in patients with Type 2 DM.

Keywords: Chest radiography, pulmonary TB, HbA1C levels, DM

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1. Introduction

Tuberculosis (TB) and diabetes mellitus (DM) are two critical health issues. Many studies have shown a bidirectional relation between these two diseases [1, 2].The relation between TB and DM is more prominent in developing countries where TB is endemic, and the burden of DM is increasing. This becomes the next challenge for global TB control worldwide [1-4].

TB is known as the leading killer among bacterial infections in the world. The disease is caused by *Mycobacterium tuberculosis* (MTB), which is rod-shaped, aerobic and acid-resistant. In Indonesia, TB is a significant public health problem. Indonesia is a country with the fifth most sufferers in the world after India, China, South Africa, and Nigeria. Pulmonary TB attacks 9.4 million people and has killed 1.7 million people worldwide each year [5].

Diabetes mellitus increases the risk of active TB infection by 3.11 times [2]. With an increase in DM pandemic that is 80% in a TB endemic area, then TB will be a significant problem in the future. Although the incidence rate of TB has decreased, it has not reached the expected rate which is 1 new case per 1 million population [6, 7]. Southeast Asia is a group of countries with a high burden of TB and the rapid growth of DM prevalence, but many researchers report on TB in relation to DM [2, 3].

One of the laboratory tests used to determine early complications and control the compliance of DM treatment is Glycated Hemoglobin (HbA1C). Evaluation of HbA1C level has become the gold standard for monitoring glycemic control in patients with DM. HbA1C is one of the fractions of hemoglobin in the human body which binds to glucose enzymatically. Excessive glucose will always bind to hemoglobin. HbA1C reflects glucose levels over the past three months (according to the viability of human red blood cells are approximately 100-120 days). Thus it can provide information on how high the glucose level in the previous three months. This HBA1C evaluation can see how much the patient's compliance with the treatment [8].

Chest radiographic examination is one of the diagnostic modalities performed when physical examination supported clinical symptoms in the presence of abnormalities in the lung or if there is a history of old pulmonary tuberculosis [9]. The chest radiological features of TB patients are determined by several factors including duration of illness and the immunological status of the patient. Most TB-DM patients have a typical radiological pattern consisting of confluent, cavity, and wedge-shaped lesions spreading from the hilum to the edges, especially in the lower zone of the lung, whereas in non-DM TB patients lesions are usually infiltrates in the upper lobe. In pulmonary TB with DM, TB lesions are found in the lower lung fields more than those in the upper lung field. Some other studies reported that the radiological pattern of pulmonary tuberculosis patients with DM tends to be atypical therefore the finding of the lesions in the lower lung field in DM patients should be considered as the possibility of TB infection so that proper diagnosis and treatment can be performed [10, 11]. This study aimed to determine the correlation between HbA1C levels with chest radiograph images of pulmonary TB in patients with type-2 DM.

2. Method

This was a cross-sectional study conducted in RSUD Cilegon, Banten Province, from January to March 2016. The subjects were patients aged 30 years old and above, diagnosed with type-2 diabetes, and having sputum smear results of positive and negative

results. HbA1C levels were measured and grouped into normal (<5.7%), pre-diabetes (5.7 -6.4%) and diabetes (≥6.5%). In the diabetes group, HbA1C (glycemic control) was divided into: <7%, 7-9%, and> 9%. Pulmonary TB radiography is a typical pattern on chest radiological examination representing to pulmonary tuberculosis. The results of radiological examination were clear X-ray photos of postero-anterior (PA) position interpreted by a radiologist. The measurements of the lesions in the lungs were determined using criteria from the Indonesian Pulmonary and Respirology Doctor Association. Based on the extent of the process seen on chest X-ray (CXR), there are minimal and large lesions [12]. A minimal lesion is defined as the process affecting part of one or two of lungs in which the area does not exceed the second anterior intercostal space (lung volume that is located above the chondrosternal junction of the second rib of the front and the spinous process of the thoracic 4 or 5 vertebrae), and no cavity is found whereas a large lesion is a wider process than the minimal one. Ethical clearence was obtained from the Bioethics Commission of Medical/Health Research, Faculty of Medicine, Universitas Sultan Agung, Semarang. The correlation analysis was done by using the gamma test with SPSS version 17.

3. Results

There were 32 subjects who met our inclusion criteria (Table 1 and Table 2). They were dominated by male patients (75%). Most of them had an elementary school education (37.5%). They were mostly laborers (34.4%). The mean age of the subjects was 53.7 years old, ranging from 33 to 69 year old. The duration of being DM varied between 0 years (newly diagnosed) and 10 years. The lowest HbA1C level was 6.7, and the highest was 14.6%. The random blood glucose level ranged from 112 to 652 mg/dl. Hemoglobin (Hb) level obtained a minimum of 10.2 and a maximum of 17.1%.

The clinical description of the respondent's condition (Table 3) showed that the new cases of pulmonary TB were found in 28 patients (87.5%). Pulmonary TB lesions with a broad category reached 90.6% of all respondents. Types of lung lesions in the form of consolidation/infiltrates were found in 32 respondents; cavities were obtained in 15 respondents and lesions of pleural effusion were obtained in 5 respondents. Half of the total respondents had HbA1C values in the range of 7-9%. There were 24 (75%) active smokers. All smokers were male with the duration of smoking ranged from 10 to 30 years, and they generally smoked 1 to 2 packs of cigarettes daily. The correlation analysis was done by using gamma test (Table 4) and we obtained a significant relation between HbA1C and pulmonary TB lesion ($p = 0.042$) with a positive and robust correlation ($r= 1$).

Table 1: Demographic characteristics of the study subjects.

Variables	n	Percentage (%)
Gender		
• Male	24	75.0
• Female	8	25.0
Education		
• Elementary school	12	37.5
• Junior high school	18	25.0
• Senior high school	9	28.1
• Diploma	1	3.1
• Graduates	1	3.1
• Post Graduates	1	3.1
Job		
• Unemployed	4	12.5
• Laborers	11	34.4
• Entrepreneur	8	25.0
• Civil Workers	3	9.4
• Retiree	1	3.1
• Housewife	5	15.6

Table 2: Numerical data description.

Variables (n=32)	Minimum	Maximum	Mean (SD)
Age (years)	33	69	53.7 (9.44)
Duration diagnosed as DM	0	10	2.31 (2.47)
HbA1C level (%)	6.7	14.6	9.2 (11.28)
Glucose levels (mg/dl)	112	652	314 (135.5)
Hb levels (gr/dl)	10.2	17.1	12.7 (1.56)

4. Discussion

The variables used for demographic data in our study were gender, age, education, and occupation. The chest radiographic features in our study were based on the extent of the lesions found which was categorized into minimal and extensive lesions. The severity of DM was based on HbA1C levels which were categorized into three levels:<7%, 7-9%, and > 9%.

The correlation between chest radiographic images of TB patients and HbA1C levels were analyzed with gamma test. It showed a positive correlation with very strong correlation coefficient. The results of our study support the previous research conducted by Chen Yuang Chiang which reported that glycemic control significantly affected the manifestation of radiographic images of pulmonary TB in DM patients [13].

Table 3: The study subject distribution based on the condition of the disease.

Variables	Frequency	Percentage (%)
Type of TB cases		
• New cases	28	87.5
• Old cases	4	12.5
BTA test of the sputum		
• Positive	22	65.6
• Negative	10	34.4
The area of TB lung lesions		
• Minimal	3	9.4
• Extensive	29	90.6
The type of lung lesion		
• Consolidates/infiltrates	32	100
• Cavity	15	46.9
• Pleural effusion	5	15.6
The site of the lung lesion		
• Upper right	18	56.3
• Middle right	14	43.8
• Lower right	12	37.5
• Upper left	12	37.5
• Middle left	17	53.1
• Lower left	16	50
HbA1C levels		
• < 7%	3	6.3
• 7 – 9 %	15	50.0
• > 9%	14	43.7
Smoker		
• Yes	8	25
• No	24	75

Table 4: Correlation of HbA1C levels with the extent of lung TB lesions.

		TB lung lesion extent		[a]	p
		Minimal	Extensive		
HbA1C levels	< 7%	3	0	1	0.042*
	7-9%	0	14		
	>9%	0	15		
	Total	3	29		

*p-value < 0,05 considered as significant

Cavity lesion type was observed in 46.9% of the total subjects in our study. This finding is in accordance with an earlier study which described that the frequency of cavitation remained high in diabetics of all ages. An increased frequency of cavitation

in DM patients is not due to longer disease duration. The mechanisms altering the frequency of cavitation in DM patients are unclear and require further study [13, 14].

The site of pulmonary TB lesions is generally present in the upper lobes. However, in our study, it was mostly found to be evenly distributed in all lung fields. This is consistent with previous study which reported that in diabetics, lung lesions might occur at lower sites. It was mentioned that diabetes and aging were the same predisposing factors for the pulmonary radiographic feature of TB patients [13].

We obtained a positive correlation with very strong correlation coefficient in our study. This finding is in line with previous studies assessing the effect of type 2 DM on clinical severity and treatment outcomes in patients with pulmonary TB. In the study, it was reported that in patients with pulmonary tuberculosis with type-2 diabetes had more severe clinical appearance than those ones without type-2 DM. Cavitation was found in 75% of pulmonary TB patients with type-2 diabetes. Type-2 DM may potentially cause multi-drug resistance in pulmonary TB patients. Diabetes mellitus and the severity of pulmonary radiographic features are a major contributing factor to TB treatment failure [15]. Several limitations were present in our study. There were many confounding factors such as gender age, and smoking habits were not included in the analysis.

5. Conclusion

Chest radiograph image of pulmonary TB is strongly and positively correlated with the HbA1C level in type-2 DM patients. In this study, it was reported that patients with pulmonary TB and type-2 DM had a more severe clinical picture than pulmonary TB patients without type-2 DM. The results of this study support previous research which states that glycemic control significantly affects the manifestation of radiographic pulmonary TB in DM patients.

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