

RESEARCH ARTICLE

Electrocardiogram Characteristics of Chronic Obstructive Pulmonary Disease Patients are Associated with Severity and Disease Duration

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Abstract

Chronic obstructive pulmonary disease (COPD) is characterized by persistent airflow limitations associated with an increase in chronic inflammatory responses to the airways and lungs. COPD patients are more likely to be hospitalized and die from cardiovascular disease. This study aims to determine the factors associated with the incidence of electrocardiogram (ECG) abnormalities in COPD patients. This a cross-sectional study with an analytical observational design. From October 30 to December 5, 2019, data was collected on 42 COPD patients, inpatients, and outpatients at Muhammadiyah Palembang Hospital who met the inclusion and exclusion criteria. A questionnaire was used to collect data, and spirometry and an electrocardiogram test were used to measure pulmonary function and detect ECG abnormalities. Research variables included age, sex, smoking habits, severity, and duration of COPD. Data analysis using the chi-square test and followed by a logistic regression test found a significant relationship between severe to very severe COPD and ≥ 5 years of suffering from COPD with the incidence of ECG abnormality ($p < 0.05$). The severity and the length of time of suffering from COPD are significantly related to the incidence of ECG abnormalities in outpatients and inpatients.

Keywords: COPD, electrocardiogram (ECG), smoking

Introduction

Chronic obstructive pulmonary disease (COPD) is characterized by persistent airflow limitations, generally progressive and associated with an increased chronic inflammatory response to the airways and lungs due to harmful particles or gases.¹ Heart disease is one of the comorbid factors of COPD; patients with COPD have a high chance of developing heart disease.² The coexistence of two conditions can not be separated from the linkage of the function of the lungs and heart. It most likely can be caused by having the same risk factors: smoking, age, unhealthy lifestyle, and low socioeconomic factors.^{3,4} COPD patients are more likely to be hospitalized and die from cardiovascular disease,⁵ which impacts the management of patients.⁶ Changes in the electrocardiogram (ECG) image are associated with the risk of acute exacerbation and an increased risk of death in patients who do not have a previous heart history.⁷⁻⁹

ECG images are often found in COPD patients, such as right axis deviation (RAD), right bundle branch block (RBBB), P-pulmonary/right atrial hypertrophy (RAH), and right ventricle

hypertrophy (RVH). This ECG change in COPD patients is highly related to the severity of the disease.⁹⁻¹¹

Changes in ECG characteristics in COPD patients are related to the severity of the disease and affect the patient's prognosis. We know the aspects related to the incidence of ECG abnormalities in COPD patients and expect to raise awareness of the onset of cardiovascular impact in patients who do not have a comorbid history of cardiovascular disease, both inpatients and outpatients. This study aims to determine the factors associated with the incidence of ECG abnormalities in COPD patients.

Methods

This type of research is observational analytical research with a cross-sectional approach. The population and sample in the study were patients who had been diagnosed with COPD. This study used purposive sampling strategies to collect samples from inpatients and outpatients at Muhammadiyah Palembang Hospital from October 30 to December 5, 2019.

The inclusion criteria in this study were

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patients with age ≥ 21 years, patients diagnosed with COPD in the internal ward and polyclinic, and were willing to sign informed consent. In contrast, the exclusion criteria in this study were patients with tuberculosis, patients with non-pulmonary disorders causing cardiac abnormalities, and patients who could not be performed the ECG installation (injury to thoracic region, mammae carcinoma). In addition, these COPD patients were experiencing symptoms of exacerbation.

A questionnaire was used to collect data, and a spirometry examination was used to assess lung function. The patient was asked to blow into the spirometer, and then the FEV₁ was measured. Degrees of lung function are divided into mild to moderate degrees (FEV₁ $\geq 50\%$ of the predicted value) and severe to very severe degrees (FEV₁ $< 50\%$ of the expected value). An electrocardiogram is performed to detect ECG abnormalities. Data collected were processed using SPSS version 24. The data were analyzed using chi-square tests in bivariate analysis and, afterward, logistic regression in multivariate analysis.

This study has received ethical clearance from the Bioethics, Humanities, and Islamic Medicine Committee of the Faculty of Medicine, Universitas Muhammadiyah Palembang (Approval No. 17/EC/KBHKI/FK-UMP/X/2019).

Results

This research was conducted at Muhammadiyah Palembang Hospital with 42 respondents who had met the criteria for inclusion and exclusion. The most commonly observed ECG abnormalities are cardiac conduction problems in the form of RBBB (54%) followed by ischemic images (T inversion, ST depression, pathological Q) by 28%, rhythm abnormalities in the form of tachycardia and atrial fibrillation (2.1%), P-pulmonary/RAH (1.9%), RVH (1%), and RAD (1%).

Table 1 shows the picture of the most ECG in COPD patients is an abnormal ECG of 31/42 patients. Most COPD patients were aged ≥ 60 years (27/42 patients), male (27/42 patients), had a history of smoking (27/42 patients), had a very severe degree (29.1%), and had COPD for < 5 years (27/42 patients).

Table 2 reveals a significant association between the severity of COPD and the length of time COPD patients have been suffering from it,

Table 1 Baseline Characteristics of Respondents

Characteristics	n=42
Age (years)	
<60	15
≥ 60	27
Sex	
Male	27
Female	15
Smoking habits	
Yes	27
No	15
COPD severity stage	
Mild to moderate	13
Severe to very severe	29
Diseases duration	
<5 Years	27
≥ 5 Years	15
ECG	
Normal	11
Abnormal	31

along with the abnormalities of the ECG image in COPD patients, with $p < 0.05$.

Discussion

This study showed a significant association between the severity of COPD ($p = 0.001$) and the length of suffering from COPD ($p = 0.014$) with abnormalities of ECG in COPD patients. Furthermore, they remained significant following a logistic regression test, even though the patient's age, male sex, and smoking history had no significant correlation ($p > 0.05$).

In this study, the results found that most degrees in people with COPD are severe to very severe, which is 29/42 patients. In addition, the ECG picture found in this study showed most patients had an abnormal ECG (31/42 patients). This study's results align with previous studies' results that the more severe the degree of COPD suffered by patients, the greater the risk of ECG abnormalities and arrhythmias.¹²⁻¹⁴

Another study said ECG abnormalities in patients with COPD are related to the severity and duration of the disease. Hence, ECG becomes one of the examinations that can be used to assess the severity of COPD.^{16,17} The severity and duration of the disease are significantly related to the incidence of ECG abnormalities.

Table 2 Statistical Analysis Factors Associated with ECG Abnormality

Variable Independent	ECG Abnormality		p Value ¹	Adjusted p Value ²
	Yes	No		
Age (≥60 years old)	16	11	0.636	0.77
Sex (male)	16	11	0.636	0.99
Smoking (yes)	17	10	0.850	0.98
COPD severity stage (severe to very severe)	23	6	0.001*	0.004*
Diseases duration (≥5 years)	13	2	0.014*	0.03*

Note: ¹Chi-square analysis; ²Logistic regression analysis; *p<0.05, significant

In addition, in another study, ECG examination of COPD patients showed a relationship between the severity of COPD and changes in P waves and QRS complexes. The higher the severity of COPD, the more visible changes in P waves and QRS complexes.¹⁴

ECG abnormalities arise both due to the comorbidities of cardiovascular disease and the impact of COPD disease on the cardiovascular system. The mechanism of arrhythmia in COPD is thought to be related to hypercapnia. Hypercapnia is a condition of higher CO₂ levels in the blood than average. Known CO₂ is a substance with proarrhythmic properties¹⁸ that increases the risk of arrhythmias in the heart.¹⁵

The presence of several related mechanisms, such as tachycardia, arterial stiffness, increased occurrence of thrombus, hypoxemia, infection, and the use of short-acting b2 agonists,^{17,19} causes ischemic abnormalities in COPD, as also seen in this study. Increased pulmonary artery resistance in patients with higher degrees of COPD leads to increased water trapping and lung hyperinflation. In addition, the right ventricle is enlarged, and the movement of the heart's vertical axis is due to COPD. Then the heart will rotate clockwise, so that right ventricle hypertrophy is closely related to the onset of right axis deviation.²⁰

The mechanism of conduction disorders in COPD patients is through an increase in afterload followed by changes in heart structure. These changes also cause the heart's electrical conduction system to undergo remodeling, so conduction disorders can occur, resulting in abnormalities of the ECG image. The most conduction is in the form of the RBBB, as revealed by this research. The increased risk of cardiovascular disorders, among others, is also due to systemic inflammation in COPD patients associated with an increased risk of trauma to the heart that

increases cardiovascular complications.^{21,22} The importance of conducting an ECG examination in performing cardiovascular disease management in COPD patients for a better patient prognosis.²³

In this study, the age of most COPD sufferers was ≥60 years old. As we age, the body's ability to regenerate will decrease, so damaged body cells will be replaced by fibrosis tissue.²⁰ COPD patients tended to have abnormalities in ECGs compared to non-COPD patients in the patient population over the age of 65 years of age.²⁴ However, in this study, there was no significant association between age over 60 years and the incidence of ECG abnormalities. This is likely because 53% of the under-60 age group has a severe degree of disease severity that has an impact on ECG characteristics in that group of patient.

Increased age and gender are risk factors associated with increased severity of COPD²⁵ and are a risk factor for increased cardiovascular comorbid.²⁶ This study found that sex and smoking were not directly related to ECG abnormalities in COPD patients. Most subjects are male, which is in line with research conducted by Jatav et al.¹⁶ that COPD patients are more men than women. The higher prevalence of men in COPD patients was also associated with smoking habits. Longer duration of exposure to cigarette smoke and recurrent respiratory infections will lead to a decrease in the quality of life of COPD patients. Factors related to specific ECG abnormality categories, such as ischemia images, arrhythmias, or structural abnormalities of the heart, need to be investigated further.

Conclusion

The severity and the length of time of suffering from COPD are significantly related to the incidence of ECG abnormalities in outpatients

and inpatients.

Conflict of Interest

There is no conflict of interest at all authors.

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