

A Prospective Study to Evaluate the Association between Electrocardiographic Findings and Severity of Chronic Obstructive Pulmonary Disease Severity

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Abstract

Background: Electrocardiographic evaluation is crucial for assessing cardiac abnormalities in chronic obstructive pulmonary disease (COPD) patients.

Aims and Objectives: To evaluate the electrocardiographic findings in patients with COPD and distribute them based on COPD severity.

Material and Methods: Hundred COPD patients confirmed using clinical radiology of chest and pulmonary function tests were studied in the Department of Medicine, BRD Medical College, Gorakhpur, from February 2020 to July 2021. Patients were divided based on the severity of COPD based on forced expiratory volume in one second (FEV1) values into mild (60-79), moderate (40-59), and severe (<40). Two-dimension trans-thoracic Doppler and M-mode echocardiography were performed, and findings were compared with COPD severity.

Result: The majority were males (87%). The mean age of the study cohort was 61.45±11.27 years. COPD was more prevalent in patients in the fifth to the seventh decade of their age. Mean FEV1 was 36.78 ± 11.56 %, as predicted. The majority of the patients had severe COPD (65%). The most common symptoms of COPD were breathlessness (100%) followed by cough with sputum (96%). In echocardiographic evaluation majority had pulmonary hypertension (62%), 58% had cor pulmonale, 52% had right ventricular dilatation, and 34% had right ventricular hypertrophy. Among the patients with mild COPD, only 2 patients had evidence of pulmonary hypertension. Among the patients with moderate COPD, 31% had echocardiography evidence of pulmonary hypertension, and 28% had evidence of cor pulmonale. In contrast, in the severe COPD, group 75% had pulmonary hypertension, and 82% had echocardiographic evidence of cor pulmonale.

Conclusion: We found a high prevalence of pulmonary hypertension, cor pulmonale, and left ventricular dysfunction complicating COPD, more so with more severe COPD. We recommend screening all COPD patients for cardiac complications.

Keywords: breathlessness, pulmonary hypertension, electrocardiography, cardiac complications

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Introduction

Chronic obstructive pulmonary disease (COPD) is a disorder with the reduced maximum expiratory flow and delayed emptying of the lungs. The majority of the airflow limitation are progressive and irreversible¹. Previous reports have suggested that even a minor reduction in expiratory flow volumes modifies the risk of ischemic heart diseases, strokes, and sudden cardiac deaths 2- to 3-fold. [1,2]

Reports have shown that patients with forced expiratory volume in one second (FEV₁) > 50% of predicted cardiovascular diseases (CVDs) are responsible for approximately 50% of all hospitalization and nearly one-third of all deaths². In more severe diseases, CVD accounts for 20%–25% of all deaths in COPD. [3]

Cardiac abnormalities like pulmonary hypertension, cor pulmonale, right ventricular dysfunction, and left ventricular dysfunction are also developed in patients with COPD. Patients with COPD also get acute exacerbations. [4,5] World Bank data has projected COPD as the 3rd and 5th leading cause of mortality and morbidity in 2020. [6]

Echocardiography is a rapid and noninvasive, portable, and accurate method for evaluating right ventricle function, right ventricular filling pressure, tricuspid regurgitation, left ventricular function, and valvular function. [7] Previous studies have proven that echocardiographically derived estimates of pulmonary arterial pressure co-relate closely with pressures measured by a right heart catheter. [8,9] In the present study, we tried to evaluate the echocardiographic abnormalities in COPD patients and correlate them with different grades of severity.

Material and Methods

Present prospective study was performed on 100 COPD patients in the Department of Medicine, BRD Medical College,

Gorakhpur, from February 2020 to July 2021.

Confirmation of COPD was done using clinical history (cough with expectoration of at least 3 months duration in 2 consecutive years), radiology of chest, and pulmonary function test.

Institutional Ethics Committee approval and written informed consent were secured before starting the study. We excluded the patients with a H/O of chronic lung disease other than COPD, hypertension, primary cardiac disease, or any systemic disease that can cause pulmonary hypertension. Patients with poor echo windows and who could not perform spirometry were excluded from the present study. The study cohort also underwent respiratory, cardiovascular, and abdominal examinations to determine the physical signs of COPD, right ventricular hypertrophy or dilatation, right ventricular failure, and pulmonary hypertension.

In spirometry, the study cohort was investigated for forced expiratory volume in one second (FEV₁), Forced vital capacity (F.V.C.), and FEV₁ / FVC ratio. The severity of COPD was assessed according to British Thoracic Society guidelines as Mild: FEV₁ 60-79% of predicted, Moderate: FEV₁ 40-59% of predicted, Severe: FEV₁ < 40% of predicted. All patients were subjected to a chest X-ray P.A. view to observe the evidence of emphysema, chronic bronchitis, cardiomegaly, and pulmonary hypertension.

Two-dimension trans-thoracic Doppler and M-mode echocardiography were also performed on all hundred patients to observe the presence of pulmonary hypertension, right ventricular hypertrophy, right ventricular dilatation, right ventricular failure, and left ventricular failure systolic or diastolic dysfunction.

All the data analysis was performed using IBM SPSS ver. 20 software. Frequency distribution was used to prepare the tables. Quantitative data were expressed as mean \pm S.D., whereas categorical data were expressed as percentages. Microsoft excel 2010 was used to prepare the graphs.

Results

Out of 100 patients, most were males (87%). The mean age of the study cohort was 61.45 ± 11.27 years. COPD was more prevalent in the age group of 50-70 years. In the study, the cohort mean duration of symptoms of COPD was 6.35 ± 5.68 years. The majority of the patients (72%) had symptoms 1-5 years of duration. Mean FEV1 was 36.78 ± 11.56 %, as predicted.

Table 1: Distribution of Patients According To Severity of COPD

COPD Severity	FEV1	Percentage*
Mild	60-79	10
Moderate	40-59	25
Severe	<40	65

*Data is expressed as a percentage, FEV1; forced expiratory volume in one second, COPD; Chronic obstructive pulmonary disease.

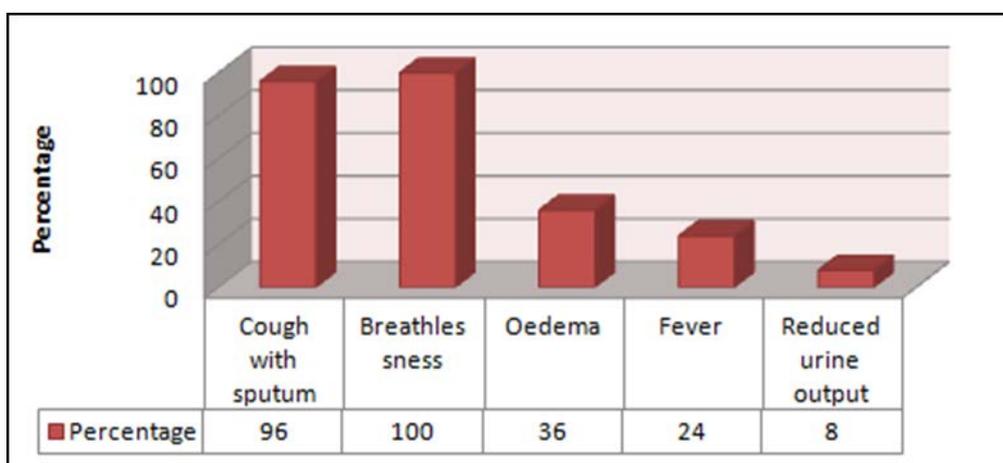


Figure 1: Distribution of Patients According To Symptoms of COPD

COPD: Chronic obstructive pulmonary disease.

In the present study, we found that the mean duration of tobacco use was 24.6 packs per year. The majority of the patients had a history of tobacco exposure of at least 20-29 pack years. The majority of the patients with severe disease (70%) had a history of greater than 20 pack-years of tobacco exposure. The most common physical sign was tachypnea in 75% of patients, followed by epigastric pulsation (62%). The most common E.C.G. finding was right ventricular hypertrophy (56%), followed by P Pulmonale (42%). Only 2% of patients with COPD had been found to

have an arrhythmia, which is multifocal atrial tachycardia. Echocardiographic evaluation in the present study revealed 62% pulmonary hypertension, 58% had cor pulmonale, 52% had right ventricular dilatation, and 34% had right ventricular hypertrophy. In the present study, we also found that 17% had features of R.V. failure, and 21% had evidence of inter-ventricular septal motion abnormalities. Right atrial dilatation was present in 38% of patients, left ventricular dysfunction (32%), and 8% of patients had left ventricular systolic dysfunction.

Comparing the echocardiographic findings with the severity of the disease, we found

that among the patients in the mild group, only 2 patients had evidence of pulmonary hypertension, and none of the patients had cor pulmonale.

Among the patients with moderate COPD, 31% had echocardiography evidence of pulmonary hypertension, and 28% had evidence of cor pulmonale. In contrast, in the severe COPD, group 75% had pulmonary hypertension, and 82% had echocardiographic evidence of cor pulmonale.

Discussion

COPD is the leading cause of chronic morbidity and mortality worldwide. [10,11] In the present study, COPD was more prevalent in male patients. The possible reason for this high prevalence may be due to the higher frequency of smoking among males. In the present study, no female COPD patients were smokers. However, all of them had a history of cooking with dried cow dung or dried wood fuel, which might lead them to COPD. The majority of the COPD patients were in the age groups of 50-70 years; it may be because of the longer duration of tobacco exposure and repeated respiratory tract infections, which would have compromised their quality of life.

In the present study majority of the patients had severe COPD (65%), which means $FEV1 < 40\%$. It is evident from the previous studies that patients start experiencing breathlessness on any exertion when the $FEV1$ falls to $< 40\%$ as per British Thoracic Society (B.T.S.) [10] and as per the GOLD criteria [11] patients start experiencing worsening dyspnoea when the patient has $FEV1 < 50\%$ of predicted. Such patients require medical attention among the patients who have severe obstructive defects.

The present study's mean duration of tobacco use was 24.6 packs per year. The majority of the patients had a history of tobacco exposure of at least 20-29 pack years. The majority of the patients with

severe disease (70%) had a history of greater than 20 pack-years of tobacco exposure. According to B.T.S. guidelines, most patients with COPD have at least 20 pack-years of smoking history [10]. Our finding correlates well with this.

The most common clinical sign in the present study was right ventricular hypertrophy and pulmonary hypertension. This can be explained by the fact that clinical signs of pulmonary hypertension and cor pulmonale are usually found in advanced cases and are masked due to the hyperinflation of the lungs. The findings of p-pulmonale in this study are similar to Gupta and Khastgir [12] (43.3%) and Calatayud et al. (46.2%) [13].

Previous authors have used p-pulmonale as evidence of right ventricular hypertrophy. However, other authors considered it the positional change due to hyperinflation, lowering of the diaphragm, and vertical position of the heart. [14]

In the present study, we found that the incidence of all the echocardiographic findings increased as the severity of the disease increased. All abnormal echocardiographic findings showed a significant correlation with COPD severity except right ventricular hypertrophy, interventricular wall motion abnormality, and left ventricular systolic dysfunction. The possible reasons for this difference may be due to the lesser number of patients in the moderate severity group; relative difficulty in getting the exact measurement of the thickness of the right ventricular free wall, as it is difficult to differentiate from the surrounding structures, and lastly because of local variations in the right ventricular wall thickness concerning the presence of trabeculae the right ventricle. [15]

The cross-sectional nature and small size were the main limitations of the present study; a large randomized clinical trial is required to strengthen the current study findings.

Conclusion

Based on the present study findings, we conclude that the prevalence of pulmonary hypertension, cor pulmonale, and left ventricular dysfunction is high among COPD patients. These abnormalities have complicated COPD, mainly in patients with severe COPD. We recommend screening all COPD patients for cardiac complications; this will add an advantage in assessing prognosis in these patients and assist in identifying individuals likely to suffer increased mortality and morbidity, warranting close monitoring and intense treatment.

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