

Clinical and Echocardiographic Profile of Patients with Chronic Obstructive Pulmonary Disease

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Abstract

Background: Chronic obstructive pulmonary disease is the fourth leading cause of mortality worldwide. It is defined as a disease formal categorized by airflow limitation that is not fully reversible. Patients with chronic obstructive pulmonary disease (COPD) are at increased risk of cardiovascular disease. Electrocardiography (ECG) carries information about cardiac disease and prognosis in COPD patients. However, Echocardiography provides a rapid, noninvasive, portable, and accurate method to evaluate cardiac functions. **Methods:** 125 patients of COPD fulfilling the inclusion criteria coming to OPD/wards of Medicine, Civil Hospital, Ahmedabad were recruited. They were staged by pulmonary function test (PFT) and evaluated by electrocardiography and echocardiography. Statistical analysis of correlation was done with chi square test and statistical significance was taken $p < 0.05$. **Results:** Mean age was 56.24 ± 9.41 years, with male preponderance, male to female ratio 4.43:1. Mean duration of disease was 6.22 ± 4.28 years. The common symptoms were Breathlessness (100%). Most common ECG and ECHO finding was RAD (51.2%) and PAH (54.4%) respectively. Statistically Right axis deviation and Poor 'r' wave progression were significantly correlated with disease severity by ECG findings while R.A. dilatation, R.V. dilatation and Pulmonary hypertension were significantly correlated with disease severity by ECHO findings ($p < 0.05$). **Conclusions:** COPD is more common in males and in the 5th and 6th decade of life. Most of the patients have fairly advanced disease at presentation. The incidence of abnormalities of ECG and echocardiography increases with COPD severity. ECG and echocardiography are better tools than clinical methods in detecting R.V. dysfunction in COPD.

Keywords: COPD; Electrocardiography; Echocardiography; Pulmonary Arterial Hypertension.

Introduction

Chronic obstructive pulmonary disease (COPD) is characterized by expiratory limitation of airflow that is only partially reversible. The condition is characterized by emphysema and chronic bronchitis. Emphysema is characterized by destruction and elaboration of the lung alveoli while chronic bronchitis is a clinically defined

condition with chronic cough and sputum production and small airway disease, a situation in which small bronchioles are contracted [1].

According to World Health Organization it predicts that COPD will become the 3rd leading cause of death (currently 4th) and the 5th leading cause of disability (currently 12th) worldwide by the year 2020 [2,3].

A clinical diagnosis of COPD should be measured

in any patient who has dyspnea, chronic cough or sputum production and/or a history of exposure to risk factors for the disease. The diagnosis should be confirmed by spirometry. For the diagnosis and assessment of COPD, spirometry is the gold standard because it is the most reproducible, standardized and unbiased way of measuring airflow limitation. Global initiative for chronic obstructive lung disease (GOLD) has described COPD as a disease that is preventable and curable [4]. A post bronchodilator FEV1/FVC <0.70 confirms the presence of airflow limitation that is not fully reversible cor-pulmonale, often denoted to as pulmonary heart disease, is defined as dilatation and hypertrophy of the right ventricle in response to diseases of the pulmonary vasculature and/or lung parenchyma [5]. Several factors contribute to the development of pulmonary arterial hypertension in patients with COPD [5,6]. The common pathophysiologic mechanism in the progress of cor-pulmonale is pulmonary hypertension that is adequate to lead to RV dilatation [5]. COPD affects pulmonary blood vessels, right ventricle, as well as left ventricle leading to development of pulmonary hypertension, cor-pulmonale, right ventricular dysfunction, and left ventricular dysfunction. Echocardiography provides a rapid, noninvasive, portable, and accurate method to evaluate cardiac functions. Early diagnoses and intervention for cardiac comorbidities would reduce mortalities in COPD patients.

The aim of this study is to find echocardiographic changes in COPD patients and to assess RV dysfunction by utilizing RV parameters obtained by echocardiography and correlate with the severity of airflow limitation in COPD patients.

Methods and Materials

A Prospective study is conducted on 125 patients admitted with signs and symptoms suggestive of COPD in the department of internal medicine, Civil Hospital, Ahmedabad from January 2017 to February 2018. Patients were diagnosed clinically as having COPD and were confirmed with spirometry. Patients with Asthma, Bronchiectasis, Tuberculosis, and Pneumoconiosis, restrictive lung disease like kyphoscoliosis, Rheumatic, Congenital, Ischemic heart disease and hypertension were excluded from the study. The study was approved by Ethics committee of our hospital and informed and written consent was obtained from all the patients. Patients who refused were excluded from the study.

Total 125 patients with COPD who presented to emergency department were studied clinically, radiologically, electrocardiographically, echocardiographically and pulmonary function tests after stabilization of their COPD.

History was obtained regarding the symptoms, its severity, and duration and categorized the patients into predominant chronic bronchitis and predominant emphysema. Patients were also inquired about history of pedal edema, facial puffiness, right hypochondriac pain, and distension of abdomen.

A detailed clinical examination was carried out including respiratory examination. Pulmonary function tests were done in all and patients were graded according to the severity of COPD with guidelines given by Global initiative for Obstructive Lung Disease (GOLD). Chest X ray, twelve lead electrocardiogram, and 2-D Echo were done to evaluate the severity of RV dysfunction.

Statistical Analysis

Various observations in the study were analyzed and the severity of COPD was correlated with the ECG and Echocardiographic features of right ventricular dysfunction. The statistical software SPSS 20.0 was used for the analysis of data. Microsoft word and Excel have been used to generate graphs, tables etc.

Results

The maximum numbers of COPD patients (70%) in this study were in the 5th and 6th decades, mean age of presentation was 56.24±9.41 years. Out of 125 patients, 102 were male and 23 were female, with male to female ratio 4.43:1 (Table 1).

Forty four percent patients in our study were symptomatic for 6-10 years at presentation. The mean duration of symptoms was 7.11 years. In the present study, 81.6% patients had history of smoking and 80.3% smokers had history of smoking for >10 pack-years (Table 2).

Table 1: Age and sex wise distribution of the patients

Age in Years	Male	Female	Total
30-39	12	3	15 (12%)
40-49	29	6	35 (28%)
50-59	41	9	50 (40%)
60-69	17	3	20 (16%)
> 70	3	2	5 (04%)
Total	102	23	125

Breathlessness was the commonest symptom found in all 100% patients followed by cough with Expectoration (94.4%). Right hypochondrial pain was the least common symptom found only in 6.4% patient. The most common sign was tachypnea (71.2%) followed by barrel Shaped chest in 57.6% patients, Pedal Edema in 38.4%. Right hypochondrial tenderness was the least common sign present in only 4% patients. 61.6% patients had severe COPD, 33.6% patients had moderate COPD and 4.8% had mild COPD (Table 3).

In chest X-ray, 78.4% of the patients had features of emphysema. 68% patients had increased Broncho-vascular marking suggestive of chronic bronchitis. X-ray evidence of pulmonary hypertension i.e. prominent right descending pulmonary artery (RDPA) was present in 30.4% of the patients. Cardiomegaly on X-ray was present in 24% (Table 4).

Analysis of ECG finding showed 44% patients had ECG evidence of right ventricular hypertrophy (RVH). The most common RVH criteria in these patients were right axis deviation, followed by R/S in V5/6 <1, followed by R/Sin V1>1. Total 48% patients in this study had P pulmonale, 52% had RAD, 32% had PPRW, 8% had Incomplete RBBB and 12% had normal ECG (Table 5).

In patients with severe COPD, all had abnormal ECG. Total 67.5% patients had RAD, 54.5% patients had RVH and p' pulmonale. In patients with moderate COPD, p' pulmonale was present in 40.4% patients, RAD in 28.5% patients, RVH in 28.5% patients and normal ECG in 28.5% patients. In Mild COPD patients, 50% patients had low voltage complex and 50% patients had normal ECG. Table 5 shows that statistical it was found with p' pulmonale, right axis deviation, In complete RBBB, RVH and Normal were significant p< 0.05).

Table 2: Duration of smoking in pack-years

Duration of smoking in pack- years	No of patients	% of patients
<10	22	21.3%
11-20	41	39.8%
21-29	28	27.1%
>30	12	11.6%
Total	103	100%

Table 3: Severity of COPD Disease

Degree	FEV1%	No of Patients	% of patients
Mild	60-79	6	4.8%
Moderate	40-59	42	33.6%
Severe	<40	77	61.6%
Total		125	100%

Table 4: Analysis of Chest X-Ray Findings

X- ray Finding	No of Patients	% of patients
Emphysema	98	78.4%
Increased Broncho-vascular markings	85	68%
Cardiomegaly	30	24%
Prominent right descending pulmonary artery	38	30.4%

Table 5: Correlation of ECG Findings with Severity of the Disease

	Mild (n=6)	Moderate (n=42)	Severe (n=77)	% of patients	P value
'p' pulmonale		17 (40.4%)	42 (54.5%)	59 (47.2%)	0.020
Low voltage complex	3 (50%)	7 (16.6%)	24 (31.1%)	34 (27.2%)	0.103
Right axis deviation		12 (28.5%)	52 (67.5%)	64 (51.2%)	<0.0001
Poor 'r' wave progression		12 (28.5%)	27 (35.1%)	39 (31.2%)	0.183
In complete RBBB			9 (11.6%)	9 (7.2%)	0.048
RVH		12 (28.5%)	42 (54.5%)	54 (43.2%)	0.002
Normal	3 (50%)	12 (28.5%)		15 (12%)	<0.0001

RBBB- Right Bundle Branch Block, RVH- Right Ventricular Hypertrophy

In echocardiography, most common finding was pulmonary arterial hypertension (PAH). PAH which is defined as pulmonary arterial systolic pressure (PASP) > 30 mmHg was observed in 54% cases. 52% had features of RV dilatation, 42% had RA Dilation, 28% had RA Hypertrophy, and 20% had IVS motion abnormality and 14% RV failure. Total 8% patients had normal echocardiography. On further subdivision of echocardiographic findings based on severity of COPD, in patients with severe COPD, 74.02% patients had RV dilatation, 67.5% patients had PAH, and 54.4% patients had RA dilatation. In patients with moderate COPD, PAH was present in 30.9% patients, RV dilatation in 23.8% patients and RVH in 19.04% patients. 21.4% patients had normal Echocardiography. In patients with mild COPD, 50% patients had echocardiography evidence of PAH while rest 50% patients had normal Echocardiography. The echocardiographic signs of right atrium enlargement, RV dilatation R.V. failure, IVS motion abnormality, pulmonary hypertension, and Normal correlated significantly with the severity of the COPD ($p < 0.05$). (Table 6).

Discussion

COPD is one of the leading cause of chronic morbidity and mortality worldwide. Our study included of 125 patients admitted to emergency medicine department. There are various cardiac diseases seen in the patients suffering from COPD. In our study, ECG and echocardiographic changes seen in COPD patients were studied and correlated to severity of the disease.

The maximum numbers of COPD patients in the present study were in 4th, 5th and 6th decades (84%) with the mean age 52.54 ± 9.55 years with male to female ratio 4.55:1, which is younger than previous studies.^{7,8} Patients between 40-70 years form the maximum number of patients admitted, predominant because of the earlier exposure to tobacco and recurrent respiratory tract infections.

All the patients in our study had breathlessness followed by cough with sputum on presentation. Breathlessness is the symptom that commonly cause the patient to pursue medical attention. Patients often date the onset of their illness to an acute exacerbation of cough with sputum production, which leaves them with a degree of chronic breathlessness. In our study, clinical signs of tachypnea was present in 70% patients while right hypochondrial tenderness was present in 4% patients. Similar findings were observed by Krishnan et al. [9] Majority of the patients in our study had an evidence of emphysema on chest X-ray. The incidence of chest X-ray signs in our study are in agreement with study by Krishnan et al. [9] and Suma et al. [10].

In ECG findings, 52% patients had right axis deviation. The incidence of right axis deviation varies widely in different studies depending on the criteria used, and number of patients with 'p' pulmonale of varying etiologies [11,12]. Among the different RVH criteria, poor 'r' wave progression, low voltage complex were the commonest ECG changes, which according to different studies were important criteria for RVH. In our study, 48% patients had p-pulmonale which according to some studies may be taken as indirect evidence of RVH. On correlating the ECG findings with duration of symptoms, prevalence of 'p' pulmonale, right axis deviation, and RVH and incomplete RBBB increased with increase in duration of disease however, statistical significance was found only for right axis deviation. ($p < 0.05$) [10,13].

In the analysis of echocardiographic findings, our study showed 54.4% patients had echocardiographic evidence of pulmonary arterial hypertension and cor-pulmonale as RV dilatation, RV hypertrophy, RA dilatation and RV failure and inter ventricular septum motion abnormality. Similar incidences were found in some previous studies [7,10]. On correlating the echocardiographic signs of right atrium enlargement, right ventricle dilatation and pulmonary artery hypertension correlated significantly with the severity of the COPD ($p < 0.05$). This means that the increase in incidence of the above echocardiographic findings

Table 6: Correlation of ECHO Findings with Severity of the Disease

	Mild (n=6)	Moderate (n=42)	Severe (n=77)	No of patients (%)	P value
R. A. dilatation	-	8 (19.04%)	42 (54.4%)	50 (40%)	<0.0001
R.V. dilatation	-	10 (23.8%)	57 (74.02%)	67(53.6%)	<0.0001
R.V. hypertrophy	-	8 (19.04%)	27 (35.1%)	35 (28%)	0.053
R.V. failure	-	-	17 (22.1%)	17 (13.6%)	0.002
IVS motion abnormality	-	3 (07.1%)	22 (28.5%)	25 (20%)	0.010
Pulmonary hypertension	3 (50%)	13 (30.9%)	52 (67.5%)	68 (54.4%)	<0.0001
Normal	3 (50%)	9 (21.4%)	0	12 (9.6%)	<0.0001

with increasing disease severity (decreasing FEV1) was statistically significant. Other studies correlating the echocardiographic findings with severity of COPD have also made similar observations, and also have given different explanations for their observation [7,10].

Conclusion

Our study shows high occurrence of cardiac comorbidities such as PAH and RV dysfunction in COPD patients. The severity of complications increases with increasing severity of COPD. Echocardiography and ECG are more sensitive than chest radiography and clinical methods in detecting cardiovascular complications like PAH, 'p' pulmonale, RA enlargement and RV dysfunction in COPD patients. ECG changes significantly correlated with disease severity. However, Echocardiography provides a rapid, non-invasive, portable, and accurate method to assess cardiac functions. Early diagnoses and intervention for cardiac comorbidities would reduce mortalities in COPD patients.

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