Original Research Article

Study of clinical, electrocardiographic and echocardiographic profile in 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: A 100 patients of COPD fulfilling the inclusion criteria coming to OPD/wards of Medicine, Gitanjali medical college and Hospital, Udaipur 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 52.54 ± 9.55 years, with male preponderance, male to female ratio 4.55:1. Mean duration of disease was 6.36 ± 4.14 years. The common symptoms were Breathlessness (100%). Most common ECG and ECHO finding was RAD (52%) and PAH (54%) respectively. Statistically Right axis deviation and Poor 'r' wave progression was 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: Chronic obstructive pulmonary disease, ECG, 2D-Echo

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is characterized by airflow limitation that is not entirely reversible. Chronic obstructive pulmonary disease (COPD) includes emphysema, an anatomically defined condition characterized by destruction and elaboration of the lung alveoli; chronic bronchitis, a clinically defined condition with chronic cough and phlegm; 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 too. 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

A Prospective study is conducted on 100 patients admitted with signs and symptoms suggestive of COPD in Gitanjali medical college and Hospital, Udaipur, Rajasthan from January 2017 to December 2017. Patients were diagnosed clinically as having COPD with following confirmation by spirometry.

The patients with asthma, bronchiectasis, tuberculosis, and pneumoconiosis, restrictive lung disease like kyphoscoliosis, rheumatic, congenital, ischemic heart disease and hypertension were excluded from the present study. All enrolled patients were informed about nature of the study and their rights to refuse. The informed written consent was taken from patients before including in the study. All the 100 randomly selected COPD patients were studied clinically radiologically, electrocardiographically, echocardiogaphically and also with pulmonary function tests. Patients were investigated when their disorder stabilized.

Patients were asked about the duration of symptoms like breathlessness, cough, nature and diurnal variation of expectoration and severity of breathlessness to clinically categorize them into predominant chronic bronchitis and predominant emphysema. Patients were also inquired about history of pedal edema, puffiness of face, right

hypochondriac pain, and distension of abdomen, to know whether the patient had developed R.V. dysfunction.

A detailed clinical examination was carried out in the proforma. 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.

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 6th and 7th decades, mean age of presentation was 52.54±9.55 years. Total number of patients in study was 100, out of which 82 were male and 18 were female, with male to female ratio 4.55:1 (Table 1).

Table 1: Age and sex wise distribution.

Age in years	Male	Female	Total
30-39	9	3	12 (12%)
40-49	26	4	30 (30%)
50-59	30	6	36 (36%)
60-69	15	3	18 (18%)
> 70	2	2	4 (04%)
Total	82	18	100

Majority of patients (48%) in the study had symptoms for 6-10 years at presentation. The mean duration of symptoms was 7.58 years. In the present study, majority of the patients (86%) had history of smoking. Majority of smokers (80.3%) had history of smoking more than 10 pack years (Table 2).

Table 2: Duration of smoking in pack years.

Duration of smoking in pack years	No. of patients	% of patients
<10	16	19.5%
11-20	34	41.4%
21-29	24	29.2%
>30	8	9.7%
Total	82	100%

Breathlessness was the commonest symptom found in all 100% patients followed by cough with expectoration (94%). while RHC pain was the least common symptom found in 8% patient. The most common sign was tachypnoea present in 70% patients (70%), Barrel Shaped

chest in 58% patients, pedal edema was 36%; while right hypochondrial (RHC) tenderness was present in 4% patients. Majority of patients had severe COPD (62%), 4% patients had mild COPD and 3(4%) had moderate COPD (Table 3).

Table 3: Severity of COPD disease.

Degree	FEV1%	No. of Patients	% of patients
Mild	60-79	4	4%
Moderate	40-59	34	34%
Severe	<40	62	62%
Total		100	100%

In chest X-ray, 80% of the patients had features of emphysema. 68% of the patients had increased brochovascular marking suggestive of chronic bronchitis. X-ray evidence of pulmonary hypertension i.e. prominent right descending pulmonary artery (RDPA) was present in 30% of the patients. Cardiomegaly on X-ray was present in 24% (Table 4).

Table 4: Analysis of chest X-ray findings.

X- ray Finding	No. of Patients	% of patients
Emphysema	80	80%
Increased bronchovascular markings	68	68%
Cardiomegaly	24	24%
Prominent right descending pulmonary artery	30	30%

Analysis of ECG finding showed that 44% of the patients had ECG evidence of right ventricular hypertrophy (RVH) in the study.

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. 48% of the patients in this study had P pulmonale, 52% had RAD, 32% had PPRW, 8% had Incomplete RBBB and 12% had normal ECG (Table 5).

Table 5: Correlation of ECG findings with severity of the disease.

	Mild (n=8)	Moderate (n=34)	Severe (n=62)	% of patients	P value
'p' pulmonale		14 (41.1%)	34 (54.8%)	48%	0.2538
Low voltage complex	2 (50%)	6 (17.6%)	20 (32.2%)	28%	0.4354
Right axis deviation		10 (29.4%)	42 (67.7%)	52%	0.0247
Poor 'r' wave progression		10 (29.4%)	22 (35.4%)	32%	0.0084
In complete RBBB			8 (12.9%)	8%	0.2638
RVH		10 (29.4%)	34 (54.8%)	44%	0.1651
Normal	2 (50%)	10 (29.4%)		12%	0.1797

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

	Mild (n=4)	Moderate (n=34)	Severe (n=62)	No. of patients (%)	P value
R. A. dilatation		6 (17.6%)	34 (54.8%)	42%	0.0431
R.V. dilatation		8 (23.5%)	46 (74.1%)	52%	0.0001
R.V. hypertrophy		6 (17.6%)	22 (35.4%)	28%	0.3329
R.V. failure			14 (22.5%)	14%	0.1594
IVS motion abnormality		2 (05.8%)	18 (29.1%)	20%	0.1226
Pulmonary hypertension	2 (50%)	10 (29.4%)	42 (67.7%)	54%	0.0386
Normal	2 (50%)	6 (17.6%)	0	8%	0.2102

Severe category of COPD had abnormal ECG that RAD (67.7%), RVH (54.8%), p' pulmonale (54.8%), were common finding and Moderate COPD patient had 'p' pulmonale (41.1%), RAD (29.4%), RVH (29.4%) were common with normal ECG (29.4%). While Mild COPD (50%) low voltage complex and (50%) had normal ECG. Table 5 shows that statistical it was found with right axis deviation and Poor 'r' wave progression which was also significant (i.e. p< 0.05).

Analysis of echocardiographic findings showed that most common echocardiographic finding Pulmonary arterial hypertension (PAH). PAH which is defined as pulmonary arterial systolic pressure (PASP)> 30mmHg was

observed in 54% cases. 52% had features of R.V. dilatation, 42% had RA Dilation, 28% had RA Hypertrophy, 20% had IVS motion abnormality and 14% RV Failure had 8% Normal (Table 6).

Severe category of COPD has abnormal echocardiographic finding were RVD (74.1%), PAH (67.7%), RAD (54.8%) Moderate COPD had PAH (29.4%), RVD (23.5%), RVH (17.6%) were common and normal Echo (17.6%) while Mild COPD had (50%) Pulmonary hypertension and (50%) normal Echo. The echo signs of right atrium enlargement, right ventricle dilatation and pulmonary hypertension correlated significantly with the severity of the COPD (p<0.05) (Table 6).

DISCUSSION

Chronic obstructive pulmonary disease is one of the leading cause of chronic morbidity and mortality worldwide. This study consisted of 100 patients admitted to Civil Hospital, Ahmedabad, Gujarat, India.

There are various cardiac deviations seen in the patients suffering from COPD. In this study ECG and echocardiographic changes seen in COPD patients were studied and correlated to severity of the disease. Approximations suggest that COPD will increase from sixth to third most common cause of death universal by 2020.

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 male patients admitted, mainly because of the longer interval of tobacco exposure and continual respiratory tract infections, which would have negotiated their quality of life.

Almost all the patients had breathlessness followed by cough with sputum on presentation. Breathlessness is the symptom that commonly cause the patient to pursue medical attention and is usually put out of action of the symptom. 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. Moreover, clinical signs of tachypnoea were present in (70%) of the patients while right hypochondrial (RHC) tenderness was present in 4% patients. Similar findings were observed with study of Krishnan DR et al.[9]

Majority of the patients had evidence of emphysema i.e. signs of hyperinflation like low flat diaphragm, hypertranslucency etc. The incidence of chest X-ray signs correlated with the study of Krishnan DR et al and Suma KR et al.[9,10]

Among ECG findings, 52% of the patients in this study had right axis deviation, which 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 or RVH. 48% of the patients had p-pulmonale which according to some can be taken as indirect evidence of RVH. On correlating the ECG findings with duration of symptoms, 'p' pulmonale, right axis deviation, and RVH and incomplete RBBB, increased with the duration of the disease, statistical significance was found only with right axis deviation (p<0.05).[10,13]

In the analysis of ECHO findings, our study showed 54% of the patients had echocardiographic evidence of Pulmonary arterial hypertension, comprising of R.V. dilatation, R.V. hypertrophy, R. A. dilatation, or evidence of R.V. failure, or inter ventricular septum motion abnormality. Similar incidences were found in some previous studies.[8,10]

On correlating the echocardiographic signs of right atrium enlargement, right ventricle dilatation and pulmonary hypertension correlated significantly with the severity of the COPD (p<0.05). This means that the increase in incidence of the above ECHO findings, with increasing disease severity (decreasing FEV1) was statistically significant. Other studies correlating the ECHO findings with severity of the disease have also made similar observations, and also have given different explanations for their observation.

CONCLUSION

The study shows high occurrence of cardiac co-morbidities such as PAH, RV dysfunction and LV dysfunction in COPD patients. The severity of complications increases with severity of COPD which makes a linear relation. The 2D echocardiography and ECG are more sensitive than radiography and clinical methods in detecting cardiovascular complications like PAH, 'p' pulmonale and RV dysfunction in COPD patients. ECG changes significantly correlated with disease severity. It can be incidental that ECG is a useful bedside test to assess the severity of COPD when spirometry is not available. 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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