Original Research Article

Assessment of right ventricular function in patients with chronic obstructive pulmonary disease by echocardiography and its correlation with severity of the disease

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Abstract

Background: Chronic Obstructive Pulmonary Disease (COPD) patients presents with persistent respiratory symptoms and airflow limitation. But the morbidity in such patients is not only because of the pulmonary disease but is also caused by the associated cardiovascular changes. Assessment of the right ventricular changes forms a major part of the cardiac assessment. Transthoracic 2D echocardiography is a simple, effective and non-invasive method to assess the right ventricular function and dynamics. This study was designed to identify those changes in 100 patients with various grades of COPD **Materials and Methods:** The study was carried out as prospective observational study among 100 patients attending a tertiary care hospital in Tamilnadu. Spirometry, ECG and transthoracic 2D echocardiography were done in all patients. **Results:** There were 70 males in the study and the mean age of the patients was 59.73 ± 9.45 years. There were 58 smokers and all of them were males. 43% of patients had moderate disease and 33% had severe or very severe disease. The most common electrocardiographic abnormality was right axis deviation (44%). 46 % of patients had Pulmonary Arterial Hypertension. 38% had RV dilatation and 44% had left ventricular diastolic dysfunction. **Conclusion:** ECHO Doppler evaluation of COPD patients should be used as a risk stratification tool for assessing RV function and pulmonary artery pressure and should constitute part of a periodic screening tool for all COPD patients.
Key Words: COPD, Echocardiography, Pulmonary hypertension, RV function.

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INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) has been defined as a disease state characterized by persistent respiratory symptoms and airflow limitation that is due to airway and/or alveolar abnormalities usually caused by significant exposure to noxious particles or gases.[1] COPD is a leading cause of death and disability worldwide. According to World Bank data it is expected to move from its status in 2000 as the 4th and 12th most frequent cause of mortality and morbidity, respectively, to the 3rd and 5th leading cause of mortality and morbidity, respectively, by 2020.[2,3] Cardiovascular disease accounts for approximately 50% of all hospitalization and nearly one third of all deaths, if forced expiratory volume in one second (FEV1)> 50% of predicted.[4] COPD is associated with significant extra-pulmonary effects among which cardiac complications are most common. The cardiac manifestations of COPD are numerous. Impairment of

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RV function and alteration of pulmonary blood vessels are well known to complicate the clinical course of COPD and correlate inversely with survival.[5] Right ventricular (RV) dysfunction determines prognosis in patients with chronic pulmonary disease.The relative prognostic potential of measures of systolic, diastolic, and global RV function in patients with chronic pulmonary disease was evaluated andunivariate analysis demonstrated that both clinical and echocardiographic variables predicted survival.[6] Echocardiography provides a rapid, noninvasive portable and accurate method to evaluate the right ventricle function, right ventricular filling pressure, tricuspid regurgitation, left ventricularfunction in patients with COPD and to correlate it with the severity of the disease.

MATERIALS AND METHODS

This study was a prospective cross sectional observational study carried over a period of 6 months.After obtaining clearance from the Institutional Ethics Committee, 100 patients with COPD who attended the outpatient and inpatient services of the hospital, were enrolled for the study after obtaining informed written consent. Patients with acute exacerbation of COPD, asthma, cardiac diseases like ischemic heart disease and valvular heart diseases and patients with poor ECHO window were excluded. Detailed history and physical examination was done and all patients were subjected to spirometry. Based on spirometry analysis, subjects were categorized as per GOLD Criteria as mild (FEV_1> 80% predicted),moderate (FEV_1 50 – 80 % predicted),severe (FEV_1 30-50 % predicted) and very severe(FEV_1< 30% predicted). Transthoracic 2D echocardiographic examination was done using Siemens AccusonNX3 Elite machine, with 2 – 4 MHz multifrequency linear probe. Quantitative and qualitative measurements of right ventricle was made using TR jet, Pulmonary artery systolic pressure (PASP) and RV thickness. Left ventricle was also assessed for systolic and diastolic dysfunction and ejection fraction was estimated. All echocardiographic assessments were done by the same person to avoid inter observer variations. The findings were entered in a clinical record form, data were collected in Excel spreadsheet and analyzed using SPSS for Windows version 22.Parametric data were analyzed by student's t test and non-parametric data were analyzed by Chi – square test. Statistical significance was taken for $p < 0.05$

OBSERVATION AND RESULTS

There were 70 males in the study suggesting a male preponderance of the disease. The mean age of the patients was 59.73± 9.45 years. The age sex distribution is shown in Fig 1. Out of the 100 patients, there were 58 smokers and all of them were males. The common clinical presentation was cough with expectoration(96%) followed by breathlessness (92%). The various modes of presentation is represented in Figure 2.The number of patients who had mild, moderate, severe and very severe COPD as per GOLD 2017 guidelines were 24%, 43%, 26% and 7% respectively which is depicted in Fig 3. The most common electrocardiographic abnormality was right axis deviation (44%) followed by P pulmonale (34%). The various ECG manifestations are represented in Figure 3. On echocardiographic evaluation, 38 % of patients had right ventricular dilatation and 28 % of patients had right ventricular hypertrophy. Right atrial enlargement was observed in 28% of patients. Left ventricular diastolic dysfunction was present in 44% of patients whereas only 1% of the patients had left ventricular systolic dysfunction. The various ECHO abnormalities are shown in Fig 5. Pulmonary Artery Systolic Pressure (in mm Hg) was graded as Normal (< 30), Mild (30 – 49), Moderate (50 – 69), Severe (70 and above). In the study, 46 % of patients had Pulmonary Arterial Hypertension. The severity of pulmonary hypertension is shown in Fig 6.

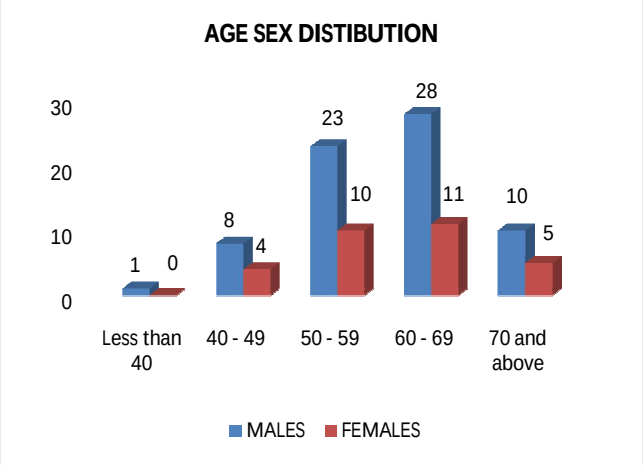

Figure 1: Age sex distribution of the study population

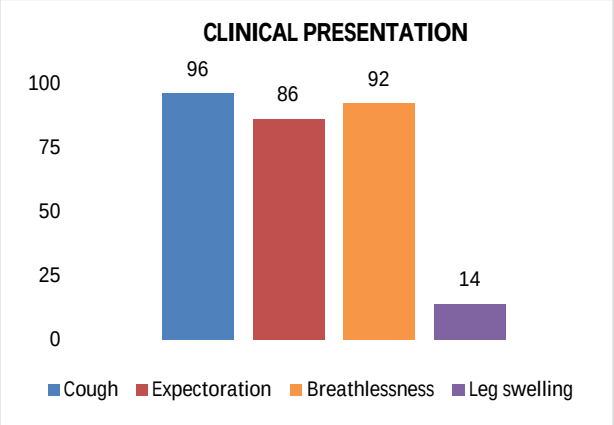

Figure 2: Common symptoms among COPD patients

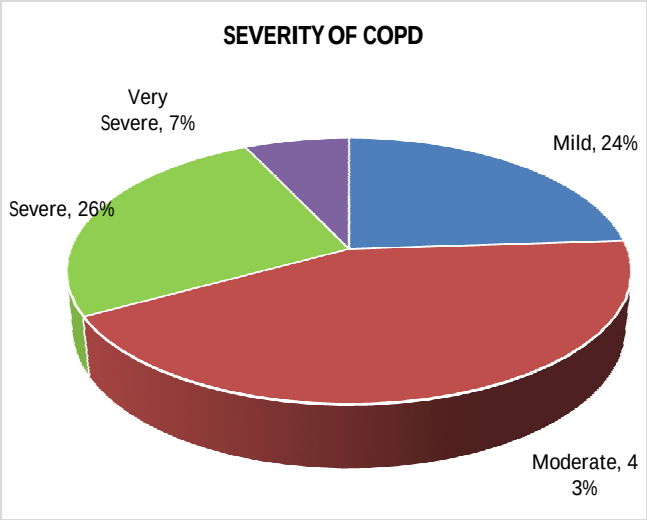

Figure 3: Severity of COPD among study patients

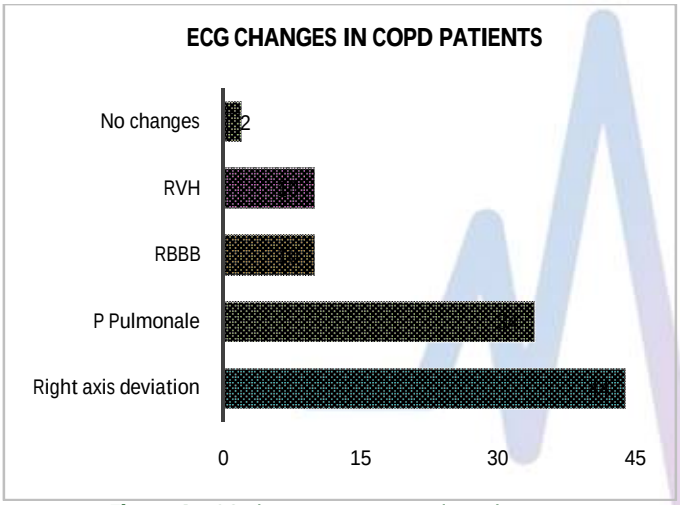

Figure 4: ECG changes among study patients

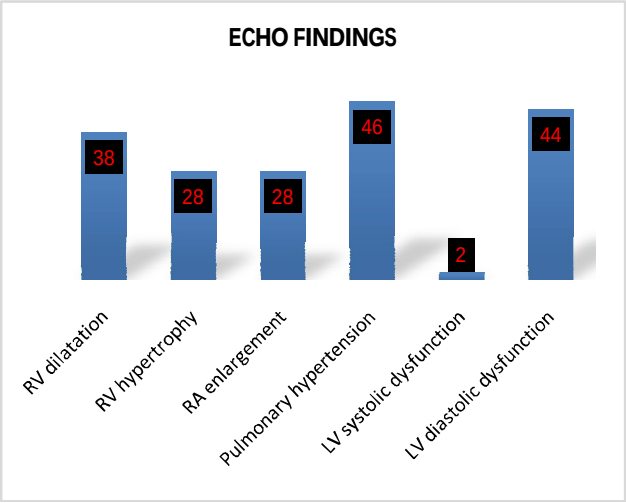

Figure 5: ECHO findings among study patients

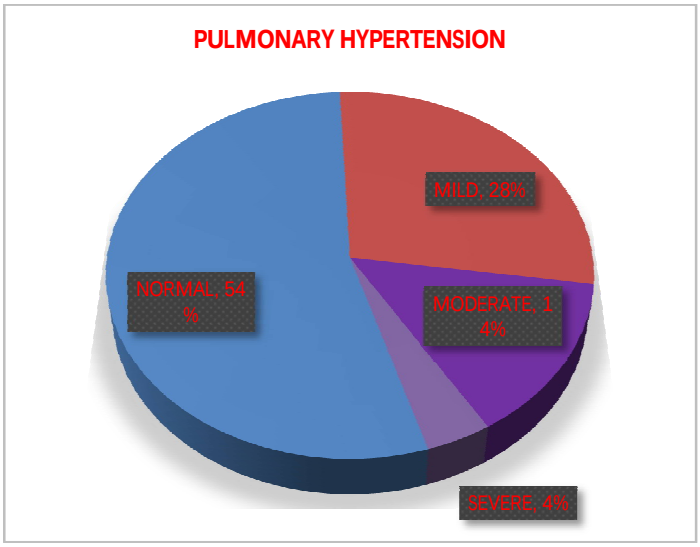

Figure 6: Severity of Pulmonary Hypertension among study patients

DISCUSSION

The mean age of present study population was 59.73 ± 9.45 years which was comparable to the findings of Migueres et al and Mohapatra *et al.*[8,9] In the present study, males account for 70% of population with a male: female ratio of 2.34:1 which was similar to previously reported data. The higher prevalence among males may be attributed to the smoking and exposure to various dusts and allergens at workplace. Nearly 60% of the patients were smokers in our study. In the present study, the prevalence of pulmonary hypertension was estimated to be around 46 % which was comparable with the study done by Rajiv Gupta *et al*[10]. Pulmonary hypertension is a common complication in patients with severe COPD. According to Macnee, elevation of the pulmonary arterial pressure (PAP) is usually mild in patients with COPD but it is a marker for poor prognosis. The small number of patients who have severe pulmonary hypertension usually have a very poor prognosis with the onset of right heart failure.[4] In our study, left ventricular systolic dysfunction was seen in 2% of patients whereas diastolic dysfunction was present in 44 % of patients which was similar to the study done by Gupta *et al.*[5] Various mechanisms could explain the reason for diastolic dysfunction in COPD patients. This may be due to chronic hypoxemia leading to abnormalities of myocardial relaxation, lung hyperinflation, and distension leading to increased stiffness of the parietal pleura and thus of the wall of cardiac fossa leading to added load on ventricle, and also due to ventricular interdependence.[11] Until the right ventricle fails, preoccupation with the underlying pulmonary disease may divert attention from the presence of pulmonary hypertension and the development of right

ventricular enlargement by masking of clinical manifestations. In all patients with COPD invariable of its severity, by detecting, close monitoring and appropriately treating the cardiovascular abnormalities, the morbidity and mortality can be reduced. Echocardiography serves as a main tool in assessing the cardiovascular changes in patients with COPD and should be considered in all the patients irrespective of its severity.[12]

CONCLUSION

The natural history of COPD gets altered with the development of right ventricular dysfunction .Hence it is imminent that ECHO Doppler evaluation of COPD patients should be used as a risk stratification tool for assessing RV function and pulmonary artery pressure and should constitute part of a periodic screening tool for all COPD patients. It helps to identify individuals at risk of increased morbidity and mortality, warranting close monitoring and aggressive treatment to prevent/delay complications of COPD.

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