Incidence of Left Ventricular Diastolic Dysfunction in Chronic Obstructive Pulmonary Disease

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ABSTRACT

BACKGROUND
Chronic obstructive pulmonary disease is a leading cause of mortality and morbidity. Its effects extend beyond the respiratory system, to involve other organs like the heart and the brain. This study aimed to find out the relation between the severity of COPD as assessed by the CAT score and the echocardiographic abnormalities in subjects who did not have other comorbid conditions to influence the echocardiographic findings.

METHODS
The study population included 33 patients with a confirmed diagnosis of COPD based on pulmonary function tests. The study was done in Government Medical College, Thrissur, which is a tertiary care centre.

RESULTS
The study established that left ventricular diastolic dysfunction is a close accompaniment of COPD, more so as the severity of COPD increases. Another interesting observation is that it is the left ventricle which is more commonly affected in subjects with COPD, than the right ventricle even in subjects with pulmonary artery hypertension.

CONCLUSIONS
Left ventricular diastolic dysfunction is a well-established accompaniment of COPD, the severity of which has a linear relationship with the severity of COPD. Thus it becomes important to rule out decompensated heart failure during exacerbations of COPD.

KEYWORDS
COPD, Diastolic Dysfunction, CAT Score, Heart Failure

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BACKGROUND

COPD is a disease characterised by airflow limitation, which is not fully reversible.[1] COPD is a leading cause of death worldwide. One of the major reasons for the mortality in COPD is the associated cardiovascular conditions.[2] Studies have shown association of COPD with ischemic heart disease and stroke.[3] COPD is an important risk factor for the development of heart failure especially heart failure with preserved ejection fraction.[4] Previous studies have been done which showed the presence of left ventricular diastolic dysfunction in COPD. The prevalence of left ventricular dysfunction was found to vary from as low as 12%[5] to as high as 88%.[6] This study was done to find the prevalence of echocardiographic abnormalities in patients with COPD. In the previous studies the severity of COPD was assessed as per the GOLD criteria. COPD assessment test (CAT) score is a validated score in the assessment of severity of COPD.[7] In this study the severity of COPD was assessed using CAT score and the relation between CAT score and echocardiographic abnormalities was studied.

METHODS

The study population included 33 patients with a confirmed diagnosis of COPD based on pulmonary function tests. The study was done in Government Medical College, Thrissur, which is a tertiary care centre. Study included only patients whose diagnosis had been already established with pulmonary function tests. Only those patients who gave written informed consent were taken up for the study purpose. All procedures were approved by the Institutional Research Committee. The patients were assessed on three different days of the same week by clinical evaluations, and echocardiography.

Exclusion Criteria

1. Primary diagnosis of other respiratory diseases
2. Primary diagnosis of cardiac diseases like coronary artery disease, heart failure
3. Other diseases which could contribute to heart failure like Systemic HTN, DM, Renal disease, CLD.

Assessment of Severity of COPD

CAT (COPD Assessment Test) score is a method for assessing the impact of COPD on the health status of the patient. The diagnostic test for COPD is the PFT (Pulmonary function test). The utility of the PFT in assessing the health status of the patient is poor. CAT score is considered equivalent to FEV1 in the assessment of severity of COPD. CAT score ranges from 0 to 40. CAT score of less than 10 was taken as mild COPD; score of 11 to 20 was taken as moderate COPD and score more than 21 as severe COPD.

Echocardiographic Analysis

Echocardiography was done by cardiologist. The Systolic function, diastolic function of the Left Ventricle was assessed with the standard measures; the RV function assessment was done by TAPSE (Tricuspid Annular Plane Systolic Excursion) measurement and PSV (Peak systolic Velocity of the tricuspid annular motion) measurement.[8] The assessment of presence and severity of PAH was done. Other structural heart disease of the myocardium, valves and pericardium excluded.

Statistical Analysis

Statistical analysis was done using SPSS software, all continuous values and categorical variables are expressed as mean ± standard deviation and the number and percentage of patients, respectively. Categorical variable were compared using cross tabs. A two-sided probability value of $p<.05$ was considered statistically significant.

RESULTS

Total of 33 patients were included in the study. 30 were males (90.9%) and 3 were females (9.1%). The youngest patient was aged 31 years and the oldest was 81 years. 14 patients were in the age group less than 65 years and 19 patients were in the age group >65 years.

Characteristics	Frequency	%
CAT score 1	11	33.3
CAT score 2	3	9.1
CAT score 3	19	57.6
LV diastolic dysfunction	9	27.3%
Left ventricular hypertrophy	3	9.1%
Regional wall motion abnormality	2	6.1%
Left ventricular systolic dysfunction	0	0
Pulmonary artery hypertension	19	57.5%
Right ventricular dysfunction	3	9.1%

Table 1. Frequency of Clinical Characteristics of Patients

11(33%) had CAT score less than 10. 3 patients (9.1%) had CAT score 11-20. 19 patients (57.6%) had CAT score more than 20. Among the 33 patients 3 (9.1%) had left ventricular hypertrophy, 2 (6.1%) had regional wall motion abnormality. None of the patients had left ventricular systolic dysfunction. 9(27.3%) patients had left ventricular diastolic dysfunction. 19(57.5%) patients had pulmonary artery hypertension, of which 18 (54.5%) had mild to moderate pulmonary artery hypertension. 3(9.1%) had right ventricular dysfunction. Of the 22 patients with moderate to severe COPD, 7(31.8%) had left ventricular diastolic dysfunction. Among the 9 patients with left ventricular diastolic dysfunction, 7(77.8%) had moderate to severe COPD (CAT score of more than 1), even though it did not reach statistical significance. Of the 11 patients with CAT score of 1, 9 (81.8%) did not have left ventricular diastolic dysfunction. 8 of the 9 patients with left ventricular diastolic dysfunction (88.8%) had pulmonary artery hypertension.

Of the 19 patients with pulmonary artery hypertension, 8 (42.1%) had left ventricular diastolic dysfunction (p value .05), while only 3 (15.8%) had right ventricular dysfunction. There was statistically significant correlation between presence of pulmonary artery hypertension and CAT score of more than 10 p value .01)

DISCUSSION

Patients with COPD often have co morbidities like hypertension, diabetes, and osteoporosis. These co morbidities predispose them to the development of cardiovascular complications. They also have a role in deciding the duration of hospitalisation during the exacerbations. Pharmacotherapy is also hampered by the presence of multiple associated illnesses. Betablocker therapy in COPD is always a question of debate. Use of bronchodilators is closely linked with development of tachycardia and worsening the workload of the heart. Corticosteroids worsen the systemic hypertension, diabetes and osteoporosis. Besides the traditional risk factors, airflow obstruction and low vital capacity are also risk factors for the development of cardiovascular disease. It is a common scenario to find patients brought to the emergency department in the middle of the night with exacerbation of breathlessness. It is very difficult to distinguish between worsening of cardiac failure and exacerbation of COPD. To confound matters further, exacerbations of COPD are also associated with chest pain which is very similar to angina pain and there are changes in the ECG in COPD in the absence of cardiac injury. Besides the similarity in clinical features, raised troponin levels have also been observed in patients with exacerbations of COPD. In addition to troponin BNP and NT pro BNP are also elevated during acute exacerbations of COPD. The 30 day mortality of patients admitted with acute exacerbation of COPD is higher in those with elevated troponin and BNP than in those without elevated biomarkers. The inclusion of these biomarkers would thus help in the prognostication of patients with COPD.

The most common precipitating factor for exacerbation of COPD is respiratory infection. Respiratory infections are also associated with increased risk of vascular events and increase in left ventricular after load .Cardiac troponins and BNP are also elevated in community acquired pneumonia. COPD is a systemic inflammatory disease. The proinflammatory state exerts oxidative stress on the endothelium of the vessels and thereby leads to alterations in the myocardium precipitate atherosclerotic plaque rupture and thrombosis.[9,10,11] COPD has been shown to adversely affect left ventricular filling and leading to decrease in cardiac output, without decreasing the ejection fraction.[9] In this study also none of the patients had left ventricular systolic dysfunction. Heart failure is classified based on the ejection fraction into those with reduced ejection fraction, with preserved ejection fraction and mid-range ejection fraction. The clinical features are similar across the various groups, but there are differences in the pathophysiology and treatment. In those cases with contractile dysfunction can only be made out with advanced imaging techniques. Like in heart failure with reduced ejection fraction, there is elevated left ventricular end diastolic pressure in heart failure with preserved ejection fraction. The reasons for elevated end diastolic pressure include among many factors, myocardial wall thickness and arterial compliance. Similar to heart failure with reduced ejection fraction, the prognosis is very poor. The prognosis in heart failure is worse than in patients with cancer. Unlike in heart failure with reduced ejection fraction, not much advances have been made in the treatment of heart failure with preserved ejection fraction. The main stay of treatment is diuretics. It is also important to control the risk factors which contribute to the occurrence.

This in turn leads to the fact that the patients attending the emergency department with exacerbation of COPD will need treatment with diuretics, in addition to the use of bronchodilators. This needs to be emphasised in order to make the management more effective. Another important aspect in the treatment of heart failure with preserved ejection fraction is the role of regular exercise. Exercise is also the mainstay in pulmonary rehabilitation. Regular exercise helps to improve the exercise tolerance and muscle mass. Thus the role of exercise in the management of COPD is all the more relevant, not only as part of pulmonary rehabilitation but also for the cardiac complication.

Some studies have found the prevalence of left ventricular diastolic dysfunction to be more than 50%.[10,12,13] There are also studies where the prevalence is much lower.[14] In the study by Freixa et al only 12% had echocardiographic evidence of left ventricular diastolic dysfunction.[5] In this study 27.3% of the study subjects had left ventricular diastolic dysfunction. The common causes of diastolic dysfunction are advanced age, female sex, diabetes, hypertension and cardiac ischemia. In this study we had excluded patients with other risk factors likely to have contributed to diastolic dysfunction. In many of the other studies which had shown a higher prevalence of diastolic dysfunction, many of the subjects had co morbidities like myocardial ischemia, hypertension and diabetes. This might be the reason why the figures are much lower in this study.

Diastolic heart failure is associated with shortened life span.[15] In relation to COPD, diastolic dysfunction has been found to have association with exacerbations of COPD and hospitalisation for exacerbations.[16] These data highlight the importance of detecting left ventricular dysfunction in COPD. Another interesting observation in this study is the occurrence of left ventricular dysfunction to a greater extent (42%) than right ventricular dysfunction even among those with pulmonary artery hypertension (16%). Pulmonary hypertension is another proposed mechanism for left ventricular diastolic dysfunction in COPD.[17] In this study nearly 90% of the subjects with diastolic dysfunction had pulmonary artery hypertension. Hyperinflation of the lungs leads to increase in intrathoracic pressure and decrease in venous return to the cardiac chambers leading to diastolic dysfunction.[18]

Limitations

The small size of the study population is a major drawback of this study. Simultaneous evaluation of FEV1 would have added strength to this study.

CONCLUSIONS

Left ventricular diastolic dysfunction is a well-established accompaniment of COPD, the severity of which has a linear relationship with the severity of COPD. Thus it becomes important to rule out decompensated heart failure during exacerbations of COPD.

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