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# Effect of Copd on Left Ventricular Function And its Correlation With Severity of Disease- A Prospective Study

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***Abstract***
***Background :****Chronic Obstructive Pulmonary Disease (COPD) has considerable effects on cardiac function, including those of the right ventricle, left ventricle and pulmonary blood vessels. Most of the mortality in COPD is related to heart[3].*
***Aim :****To assess the functional changes of left ventricle in patients with COPD with normal Right Ventricular Function and to find out the correlation between the left ventricular changes and the severity of COPD .*
***Materials &Methods:****51 COPDpatients with unknown severity were taken into the study. Patients were categorised into four groups based on GOLD Staging. Echocardiographic assessment of right ventricular and left ventricular function were done using Ejection fraction, diastolic function, Tei index, Global function and Respiratory variation.*
***Results:****A total of 51 patients were recruited in our study, among them 47 patients were Male and 4 patients were Female. Right atrial enlargement and Right Axis Deviation were more common in patients with severe and very severe COPD. Pulmonary hypertension was present in 33.3% (2/6), 28.6% (4/14), 82.3% (14/17) and 71.4% (10/14) cases of mild, moderate, severe and very severe obstruction respectively (P<0.005). Right ventricular Function was normal in all Patients. Left ventricular ejection fraction also was preserved in all patients. When Compared with COPD severity, diastolic dysfunction of Left ventricle was noted in patients with Severe (6/17 patients) and Very Severe COPD (10/14 patients). Left ventricular filling is affected in all group of COPD, it is more when severity increases (Severe COPD - 6/17 patients, Very COPD-9/14 patients).*
***Conclusion :****Left ventricular ejection fraction is preserved in all group of COPD patients those who are having normal RV function. But Left ventricular filling is affected in patients with severe COPD without affecting ejection fraction.*
***Keywords:*** *Copd, Tei Index, Pulmonary Hypertension, Lv Ejection Fraction.*

## I. Introduction

Chronic Obstructive Pulmonary Disease (COPD), a common preventable and treatable disease is characterised by persistent air flow limitation that is usually progressive and associated with an enhanced chronic inflammatory response in the airways and lungs to noxious particles or gases[2]. Exacerbations and comorbidities contribute to the overall severity in the individual patients. The global burden of disease study projected that COPD, which ranked sixth as a cause of death in 1990 will become the third leading cause of death worldwide by 2020[5].

Cardiac manifestations are the most common extra pulmonary effects in COPD patients. It is generally known that dyspnoea and exercise tolerance reduction in COPD patients occur in the advanced stage of the disease as a result of progressive bronchial obstruction, and the development of pulmonary arterial hypertension[4]. In more advanced disease cardiovascular diseases account for 20%–25% of all deaths in COPD[8]. COPD affects pulmonary vessels, right and left ventricle leading to development of pulmonary hypertension, Cor-Pulmunale, RVand LV dysfunction.

We hypothesised that the combination of heart failure and COPD is much more common than generally acknowledged. We reviewed the existing literature to estimate the prevalence of heart failure or left ventricular systolic dysfunction (LVSD) in COPD patients and vice versa. In addition, we discuss diagnostic and therapeutic implications of the co-existence of both syndromes.

## II. Materials &Methods

About 51 COPDpatients with unknown severity who have attendedas out-patients in Institute of thoracic medicine, Chetpet and Department of thoracic medicine,Rajiv Gandhi GovernmentGeneral Hospital, Chennai were subjected to following investigations. The study was done within a time period of ten months.

**Study Population:** 51 patients were taken into the study, among them 47 patients were Male and 4 patients were Female.INCLUSION CRITERIA: 1.known case of COPD patients, 2.newly diagnosed COPD patients 3.age group >30 years. EXCLUSION CRITERIA: 1.PT Sequelae, 2.known diabetics 3.known Hypertensives 4.h/o ischaemic cardiac disease andvalvular heart disease.5. Known case of Bronchial asthma and Interstitial lung disease.6.Patients with echo evidence of Right ventricular dysfunction.

Written consent was obtained from the patients in their regional language, after explaining the details of the study. Complete history regarding the symptoms, past history, smoking history, occupational history and other associated illnesses were taken and noted in a proforma. Clinical examination of the patients had been done. Smoking index were used to categorize in male patients as follows: 150 - mild, 150- 300 - moderate, >300 - severe. In the females, history regarding passive smoking and biomass fuel usage were obtained. Patients were then subjected to routine blood investigations, ECG, Chest X ray PA and CT chest, wherever indicated. The patients who met the inclusion and exclusion criteria are subjected to spirometry. The ECHOCARDIOGRAPHY was done to all the patients finally in the Department of Cardiology, Government General Hospital, Chennai and the reports were obtained in a regular format. Echocardiographic assessment ofpulmonary hypertension, right ventricular and left ventricular function were done using LV Ejection fraction, LV diastolic function,Tei index and Respiratory variation.

Left ventricular internal cavity dimensions, and septal and posterior wall thickness were measured. Similarly RV internal cavity dimensions, RV free wall thickness, right ventricular ejection fraction were also measured. All measurements were obtained on the basis of the standards of the American Society of Echocardiography.

Left ventricular function was also assessed by modified Simpson's method using end diastolic and end systolic volumes. Trans mitral flow velocities were recorded from the apical window, the following variables were measured: peak velocity of early diastolic filling (E), velocity of late filling with atrial contraction (A), E/A ratio, and deceleration time of E. The isovolumetric relaxation time (IVRT) was recorded from the apical 4-chamber view by simultaneous recording of the aortic and mitral flows. Left ventricular diastolic dysfunction (LVDD) is said to be present when E/A is <1.3 (age group 45–49 years), <1.2 (age group 50–59 years), <1.0 (age group 60-69 years), and <0.8 (age group ≥70 years).

**Statistical Analysis:** The data were analyzed for both groups by using Microsoft Excel 2010 software. Mean ± SD was calculated and unpaired student's t-test was applied. P-value of ≤0.05 was considered as statistically significant, a value of ≤0.01 as very significant and a value of ≤0.001 as highly significant.

## III. Results

A total of 51 patients were recruited in our study, among them 47 patients were Male and 4 patients were Female. The patients are categorized according to the severity assessed by spirometry based on GOLD guidelines,as follows, MILD-6, MODERATE-14, SEVERE- 17, VERY SEVERE-14.Sinus rhythm was present in ECG tracing in all patients. Right atrial enlargement and Right Axis Deviation were noted in all group patients, more common in patients with severe and very severe COPD.Pulmonary hypertension was present in 33.3% (2/6), 28.6% (4/14), 82.3% (14/17) and 71.4% (10/14) cases of mild, moderate, severe and very severe obstruction respectively. Right ventricular Function was normal in all Patients. Left ventricular ejection fraction also was preserved in all patients. Although the mean value of the Ejection fraction decreases as the COPD severity increases, all the values comes within the normal range. Mean EF in all groups as follows: Mild-72 %, Moderate -70.1%, Severe -67.2%, Very Severe – 67.6%. Left Ventricular Diastolic Function was Measured By E/A & E/E' Ratio. When Compared with COPD severity, diastolic dysfunction of Left ventricle was noted in patients with Severe (6/17 patients) and Very Severe COPD (10/14 patients). Left ventricular filling is affected in all group of COPD, it is more when severity increases (Severe COPD - 6/17 patients, Very COPD-9/14 patients). Abnormal global dysfunction of LV was noted in all group patients, but it was not correlated with severity of Disease. LV global dysfunction was noted in 66.7% of Mild, 28.6% of moderate, 17.6% of Severe, and 21.4% of very severe group Patients.

## IV. Discussion

Chronic Obstructive Pulmonary Disease have been proved to be a systemic disease rather than a pulmonary disease as it was identified in the past.

Cardiovascular system is mainly affected among systems other than lung itself. Cardiac dysfunction has been well known to complicate COPD of any severity and also remain to be the main cause of mortality in these patients[8]. Changes in cardiovascular system both in mild and moderate COPD has been demonstrated in many studies and also well documented in literature.

Right ventricle and the pulmonary blood vessels are the major parts affected in patients with COPD during its clinical course. The structure of pulmonary blood vessels would be affected, leading to intimal thickening and medial hypertrophy which further increases the pulmonary arterial pressure and so pulmonary

hypertension[4]. The raise in pulmonary arterial pressure has been reported in 30-80% of COPD patients, using pulmonary arterial catheterisation.

Pulmonary hypertension, in turn augments the right ventricular afterload leading to the dilatation and hypertrophy of right ventricle. In addition to these, left ventricle also have been known to be affected, either alone or along with right ventricle.This study mainly focuses on the assessment of cardiovascular changes in COPD patients and its correlation with the disease severity. In south India, studies related to this are not found easily,Based on GOLD guidelines, the no. of Mild, Moderate, Severe and Very severe COPD patients are 6, 14,17 and 14 respectively using spirometry.Pulmonary hypertension is present in 33.3% (2/6), 28.6% (4/14), 82.3% (14/17) and 71.4% (10/14) cases of mild, moderate, severe and very severe obstruction respectively. This reveals that pulmonary hypertension is present more commonly in the severe cases than in the milder cases.Although normal values of TAPSE and ejection fraction are observed indicating normal ventricular systolic function, the ejection fraction diminishes with the disease severity.

Right ventricular global dysfunction (using Tei index[2] ) are 33.3%,42.9%,76.5% and 85.7% in mild, moderate, severe, and very severe obstruction respectively, which shows that right ventricular dysfunction increases with COPD disease severity.

Left ventricular ejection fraction was preserved in all patients. Although the mean value of the Ejection fraction decreases as the COPD severity increases, all the values comes within the normal range. Mean EF in Severe and very severe COPD is 67.2% and 67.6% respectively.When Compared with COPD severity, diastolic function of Left ventricle was noted in patients with Severe (6/17 patients) and Very Severe COPD (10/14 patients). Left ventricular filling is affected in all group of COPD, it is more when severity increases (Severe COPD - 6/17 (35%) patients, Very Severe COPD-9/14 (64%) patients). Abnormal global dysfunction of LV was noted in all group patients, but it was not correlated with severity of Disease.N.K.Gupta et al did one study and concluded that 7.5% of COPD patients had systolic dysfunction and 47.5 % had diastolic dysfunction[6].The haemoglobin values in all the cases in are in the low normal range and no value showed polycythaemia. 3.2% of COPD patients developed LV Dysfunction – Amresh Kumar et al[7].

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].

## V. Conclusion

**1.** There is increase in Pulmonary hypertension in COPD patients as the severity increases but is not having much influence on Left Ventricular Function.

**2.** Left ventricular ejection fraction is preserved in all group of COPD patients those who are having normal RV function. But Left ventricular filling is affected in patients with severe COPD without affecting ejection fraction

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**Table 1.** Severity of copd with right and left ventricular function

| COPD severity | PHT | | | | RV Function | Mean LV EF |
|---|---|---|---|---|---|---|
| | Normal | Mild PHT | Moderate PHT | Severe PHT | | |
| Mild - 6 | 66.7% | 16.7% | 16.7% | 0% | Normal | 72.0% |
| Moderate - 14 | 71.4% | 28.6% | | 0% | Normal | 70.1% |
| Severe - 17 | 17.6% | 47.1% | 35.3% | 0% | Normal | 67.2% |
| Very Severe - 14 | 28.6% | 42.9% | 28.6% | 0% | Normal | 67.6% |

**Table 2.** left ventricular respiratory variation correlated with severity of copd

| COPD severity | Left Ventricular Respiratory variation | | Total |
|---|---|---|---|
| | Normal | Abnormal | |
| Mild | 5 | 1 | 6 |
| Moderate | 12 | 2 | 14 |
| Severe | 13 | 4 | 17 |
| Very Severe | 7 | 7 | 14 |
| Total | 37 | 14 | 51 |