

**A study on echo changes in chronic obstructive pulmonary disease and its relation with the disease severity**

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**Abstract**

**Introduction:** Chronic Obstructive Pulmonary Disease (COPD), a common preventable and treatable disease is characterised by persistent air flow limitation that is usually progressive and is associated with enhanced chronic inflammatory response in the airways and lungs to noxious particles or gases. Chronic Obstructive Pulmonary Disease (COPD)<sup>1</sup> has significant impacts on cardiac function, such as those of the right ventricle, left

ventricle and the blood vessels of pulmonary circulation. The involvement of the heart is primarily responsible for the higher mortality linked to COPD. A quick, non-invasive, portable, and accurate approach to assess the heart is provided by echocardiography to rule out the underlying cardiac changes<sup>2</sup>.

**Aims of the study:** 1. To assess the cardiovascular changes secondary to COPD by echocardiography. 2. To

determine the relation between the cardiovascular changes and the severity of COPD

**Materials and methods:** A cross-sectional study was conducted among 50 COPD patients attended to the Pulmonology OPD at Tertiary care Hospital were screened for cardiovascular risk factors by using ECHO for a period of 1 year.

**Observation and results:** Out of 50 COPD patients 40 patients had abnormal ECHO findings. Right Ventricle and Pulmonary Blood vessels are majorly affected in COPD patients which results in Pulmonary Hypertension, Dilatation and Hypertrophy of Right ventricle seen among 48% of patients. In addition to this, left ventricle also got affected among 38%.

**Conclusion:** 1. There is an increase in right ventricular global dysfunction and also pulmonary hypertension in COPD patients as the severity increases and is not statistically significant.

2. All COPD patients should undergo cardiac evaluation using echocardiogram to detect early cardiac abnormalities so as to prevent cardiac mortality and morbidity

**Keywords:** COPD, Pulmonary Hypertension, right ventricular Hypertrophy, Echocardiography.

### **Introduction**

Chronic Obstructive Pulmonary Disease (COPD) has significant impacts on cardiac function, such as those of the right ventricle, left ventricle and the blood vessels of pulmonary circulation.

Chronic Obstructive Pulmonary Disease (COPD), a common preventable and treatable disease is characterised by persistent air flow limitation that is usually progressive and is associated with enhanced chronic inflammatory response in the airways and lungs to noxious particles or gases.

Cardiovascular disease is a frequent comorbidity and death due to chronic obstructive pulmonary disease (COPD).<sup>1</sup> 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. Many patients with COPD have comorbidities that have a major impact on quality of life and survival.

Gas exchange and heart function are affected by airflow restriction and particularly hyperinflation. The main cause of pulmonary hypertension, which can occur late in the course of COPD, is hypoxic vasoconstriction of the small pulmonary arteries. Progressive pulmonary hypertension may lead to right ventricular enlargement and leading to right sided cardiac failure and also left heart failure.

Progressive impairment of left ventricular diastolic function corresponds to the severity of pulmonary Hypertension. It is likely that this results in large part from expansion of the inter ventricular septum from the hypertrophied and dilated right ventricle into the cavity of the left ventricle.

The involvement of the heart is primarily responsible for the higher mortality linked to COPD. A quick, non-invasive, portable, and accurate approach to assess the heart is provided by echocardiography to rule out the underlying cardiac changes<sup>2</sup>

### **Aims of the study**

1. To assess the cardiovascular changes secondary to COPD by echocardiography. 2. To determine the relation between the cardiovascular changes and the severity of COPD

### **Materials and methodology**

#### **Study design**

Cross-sectional study

### Study population

COPD patients attending pulmonology Out patient department (OPD) of a tertiary care hospital.

### Study period

### Sampling technique

Simple random sampling

### Sample size

50 COPD patients.

### Study tools

Semi structured questionnaire, Severity of COPD was determined using GOLD criteria and right ventricular and left ventricular function was assessed using Echo.

### Inclusion criteria

1. Known case of COPD patients
2. Newly diagnosed COPD patients
3. Age group > 30 years

### Exclusion criteria

1. Unwilling patients.
2. Pulmonary Tuberculosis sequelae
3. H/o ischemic cardiac disease and valvular heart disease
4. Known case of bronchial asthma and interstitial lung disease

### Study method

The patients who met the inclusion and exclusion criteria are subjected to spirometry.

Classification of Severity of Airflow Limitation in COPD (Based on Post-Bronchodilator FEV1)		
In patients with FEV1/FVC < 0.70		
GOLD 1	Mild	FEV1 ≥ 80% predicted
GOLD 2	Moderate	50% ≤ FEV1 < 80% predicted
GOLD 3	Severe	30% ≤ FEV1 < 50% predicted
GOLD 4	Very Severe	FEV1 < 30 % predicted

### Echocardiography

Echocardiographic assessment of LV and RV function were done using

- The pulmonary arterial systolic pressure
- Systolic excursion of the tricuspid annular plane (TAPSE)
- LV Ejection fraction
- RV & LV diastolic function
- TEI index
- Respiratory variation

The Echocardiography done to all the patients in the Department of Cardiology

### Ethical clearance

Ethical clearance was taken from Institutional Ethics Committee (IEC).

### Data analysis

SPSS V 16 was used for analysis after data entry was completed using Microsoft Excel 2013. Qualitative data was expressed in frequencies and percentages and Quantitative data in mean and standard deviation. Non-Parametric tests include Chi square test was used for intergroup comparison.

p value of <0.05 was considered statistically significant.

### Observation and results

In this study, 44 (88%) were males and 6 (12%) were females between 31 – 70 years of age. Out of 50 COPD patients, 40 patients had abnormal ECHO findings. Right Ventricle and Pulmonary Blood vessels are majorly affected in COPD patients which results in Pulmonary Hypertension, Dilatation and Hypertrophy of Right ventricle. In addition to this, left ventricle also gets affected either alone or along with Right Ventricle.

Table 1: Pulmonary Hypertension by SPAP

	Frequency	Percentage
Normal	0	0%
Mild	13	26%
Moderate	18	36%
Severe	19	38%
Total	50	100%

Table 2: Relation between Right ventricular Diastolic function by E/A and E/E' and COPD severity

COPD Severity	Right ventricular Diastolic function		Total
	Normal	Abnormal	
Mild	1(33.3%)	2(66.7%)	3(100%)
Moderate	5(41.6%)	7(58.4%)	12(100%)
Severe	11(57.8%)	8(42.2%)	19(100%)
Very Severe	8(50%)	8(50%)	16(100%)
Chi square test= 1.14, p=0.76, Not Statistically significant			

Table 3: Right ventricular global function by TEI index and COPD severity

	Right ventricular global function by TEI index		Total
	Normal	Abnormal	
Mild	2(66.7%)	1(33.3%)	3(100%)
Moderate	8(66.7%)	4(33.3%)	12(100%)
Severe	9(47.3%)	10(52.7%)	19(100%)
Very Severe	7(43.7%)	9(56.3%)	16(100%)
Chi square test= 1.89, p=0.59, Not Statistically significant			

Table 4: Left Ventricular systolic function and COPD severity

	Left systolic Ejection fraction
Mild	71%
Moderate	70.4%
Severe	66.2%
Very Severe	64.8%

Graph 1:

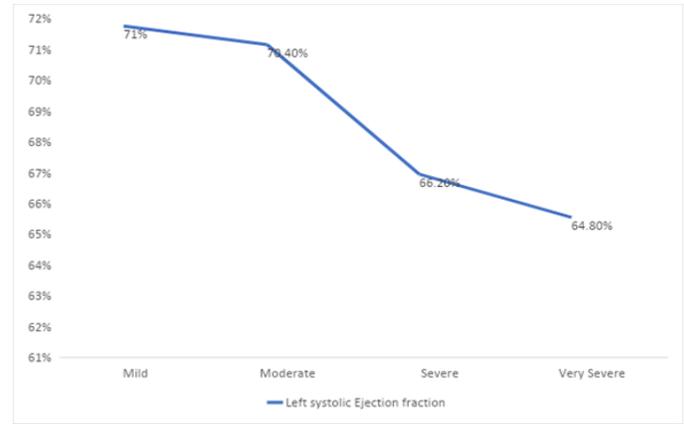


Table 5: Left Ventricular Diastolic function and COPD severity

COPD Severity	Left Ventricular Diastolic function		Total
	Normal	Abnormal	
Mild	2(66.67%)	1(33.33%)	3(100%)
Moderate	11(91.6%)	1(8.4%)	12(100%)
Severe	10(52.6%)	9(47.4%)	19(100%)
Very Severe	8(50%)	8(50%)	16(100%)
Chi square test= 6.19, p=0.10, Not Statistically significant			

Table 6: Left ventricular filling and COPD severity

	Left Ventricular Filling		Total
	Normal	Abnormal	
Mild	2 (66.67%)	1(33.33%)	3(100%)
Moderate	10(83.3%)	2(16.6%)	12(100%)
Severe	15(78.9%)	4(21%)	19(100%)
Very Severe	8(50%)	8(50%)	16(100%)
Chi square test= 4.80, p=0.18, Not Statistically significant			

**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.

COPD is a global health issue associated with cigarette smoking which is important risk factor. COPD affecting mainly pulmonary blood vessels left ventricle and also right ventricle resulting in development of pulmonary hypertension, right and left ventricular dysfunction and CorPulmonale.

Echocardiography provides a rapid, non-invasive and accurate method to evaluate cardiac function. Early diagnosis and intervention for cardiac comorbidities would reduce mortalities. So all patients should undergo investigations such as chest X-Ray, ECG and Spirometry followed by 2D Echo.

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 COPD individuals. Changes in cardiovascular system both in mild and moderate COPD has been demonstrated in many studies and also well documented in literature.

Both COPD and Heart Failure are common in people with both conditions. 20% of primary care patients with COPD had previously undiagnosed Heart Failure<sup>3</sup>, which is linked to a worse prognosis for COPD patients.<sup>4</sup> Patients with COPD who smoke regularly run an independent risk of developing cardiovascular problems<sup>5</sup>. Increased systemic oxidative stress, altered nitric oxide (NO) bioavailability, endothelial dysfunction, and an impact on the levels of other significant risk factors, like blood pressure, are potential mechanisms.<sup>6-8</sup>

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

pulmonary arterial pressure and so, pulmonary hypertension. 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.

Early cardiac screening of all COPD patients which help in assessment of

Prognosis and it further assess in identifying the individuals likely to suffer Increase mortality and morbidity.

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. The salient features of this study are

- Pulmonary hypertension is present in 0% (0/50), 26%(13/50), 36%(18/50) and 38%(19/50) in cases of normal, mild, moderate and severe obstruction respectively. This reveals that pulmonary hypertension is present more commonly in the severe cases than in 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) are 33.3%, 33.3%, 52.6% and 56.2% in mild, moderate, severe, and very severe obstruction respectively, which shows that right ventricular dysfunction increases with COPD disease severity.
- The left ventricular global dysfunction does not

correlate with the disease severity.

In contradiction to these results, A study published in the Respiratory Medicine in the year 2010 revealed that COPD patients have right ventricular dysfunction related to airways obstruction and sub-clinical left ventricular dysfunction related to arterial stiffness. This study also explains that cardiovascular changes are seen in COPD even during mild airways obstruction. (2)

Another study published in EUR J Echocardiography in 2006 implied TEI index as a main parameter in Echocardiography for measuring right ventricular dysfunction in COPD. This showed the presence of both right and left ventricular dysfunctions in patients with COPD.

A study published in the journal LUNG INDIA in the year 2011 observed that the pulmonary hypertension, right ventricular and left ventricular dysfunction are more prevalent and their occurrence correlated well with the severity of COPD. This study is based mainly on Echocardiographic findings.

### Conclusion

1. There is an increase in right ventricular global dysfunction and also pulmonary hypertension in COPD patients as the severity increases.

2. All COPD patients should undergo cardiac evaluation using echocardiogram to detect early cardiac abnormalities so as to prevent cardiac mortality and morbidity.

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