

## Original Research Article

# Study on prevalence of left ventricular diastolic dysfunction in chronic obstructive pulmonary disease

Mohamed Rafi, Monna Mohamed Jaber\*

Department of Medicine, Tirunelveli Medical College, Tirunelveli, Tamilnadu, India

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### \*Correspondence:

Dr. Monna Mohamed Jaber,

E-mail: [drjabertvmc@gmail.com](mailto:drjabertvmc@gmail.com)

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### ABSTRACT

**Background:** Left ventricular diastolic dysfunction (LVD) is very common in chronic obstructive pulmonary disease (COPD) patients. The aim of the present study was to LVD function in COPD patients using echocardiogram and to detect the presence of LVD dysfunction in all stages of COPD.

**Methods:** This was an observational study done at Institute of Internal Medicine, Madras Medical College and Rajiv Gandhi Government General Hospital, Chennai, during the period from March 2015 to August 2015. The study included 100 patients with COPD. All patients were subjected to chest X-ray, electrocardiogram, pulmonary function test (PFT) and echocardiogram.

**Results:** The results showed the prevalence rate of LVD dysfunction in 80% patients with COPD. There was a good significant correlation between age ( $p < 0.001$ ), status of smoking ( $p < 0.05$ ), chest X-ray findings ( $p < 0.001$ ) and stages of COPD ( $p < 0.001$ ) with incidence of LVD in study population.

**Conclusions:** High prevalence of LVD dysfunction was noticed in patients with COPD. Hence patients with COPD should undergo routine examinations timely to prevent the incidence of associated cardiovascular complications.

**Keywords:** Chronic obstructive pulmonary disease, Left ventricular diastolic dysfunction, Risk factors

## INTRODUCTION

Chronic obstructive pulmonary disease (COPD), a very common disease, and is the 4<sup>th</sup> leading cause of death in worldwide. In India, it is the 2<sup>nd</sup> most common lung disorder after pulmonary tuberculosis. It is one of the preventable and treatable diseases. Smoking and air pollution are the main risk factors.<sup>1</sup>

COPD is a systemic disease, because inflammation is not only involved in lung airways, but also seen in systemically.<sup>2</sup> So COPD is associated with variety of extra pulmonary manifestations. Most important systemic manifestation is cardiovascular diseases, which are more frequently common in patients with COPD, and it is

responsible for high mortality and morbidity. Among COPD patients, cardiovascular disease is responsible for 50% of hospitalization and 20% of all deaths.<sup>3,4</sup> Inflammation is one of the systemic manifestations of COPD and provides a hypothesis to explain the relationship between cardiovascular risk and airflow limitation.<sup>4,5</sup> COPD increases the risk of cardiovascular disease regardless of age, sex, and smoking status. Cardiovascular manifestations associated with COPD presence are ischemic heart disease, congestive heart failure, arrhythmias, most commonly atrial fibrillation (AF), etc.<sup>6</sup>

Recent studies show that there is high prevalence left ventricular diastolic dysfunction (LVD) dysfunction in

COPD patients even in the absence of ischemic heart disease.<sup>2</sup> Hence the present study was done to assess the LVD function in COPD patients using echocardiogram and to detect the presence of LVD dysfunction in all stages of COPD (Global initiative for chronic obstructive lung disease-GLOBAL stages).

## METHODS

This was a hospital based observational study conducted on 100 Patients admitted in Institute of Internal Medicine, Madras Medical College and Rajiv Gandhi Government General Hospital, Chennai, diagnosed to have COPD during the period from March 2015 to August 2015. Proven cases of COPD by clinical, imaging, and pulmonary function test were included in the study. Patients with co morbid illness diabetes mellitus, hypertension, chronic kidney disease, coexisting intrinsic heart disease like coronary artery disease, valvular heart diseases and with coexisting other lung pathologies.

Data was collected in a pretested proforma from eligible patients. Study participants were selected on the basis of simple random sampling. They were subjected to detailed history taking and clinical examination. All patients were subjected to chest X-ray, electrocardiogram, pulmonary function test (PFT) and echocardiogram. PFT was done using spirometer in the standing position according to standard procedures.

A 2-D transthoracic echocardiography was done for all patients to assess chambers size, systolic and diastolic functions of left ventricle (LV), presence of pulmonary hypertension and RV function. LVD function was assessed and graded by Doppler echocardiography by assessing mitral inflow signal, E/A ratio, deceleration time of E wave (DT), isovolumetric relaxation time (IVRT).

Data were analysed using the SPSS software. Statistical significance was indicated by the Chi square test. Variables were considered to be significant if  $p < 0.05$ .

## RESULTS

Table 1 shows the demographic of the study participants. Most cases of COPD occur in the age group 51-60 years and above 60 years. 78% of cases are above 50 years. Males (81%) outnumbered females (19%). Majority of COPD patients in this study are smokers (77%).

Clinical observations were presented in Table 2. Patients with symptoms less than 5 years were 54% and more than 10 years are least common. In this study among 100 patients, 16 patients were in stage I, 40 were in Stage II, 30 were in Stage III, 14 were in Stage IV. Hyper inflated lung field is the common chest x-ray findings. Hyper inflated lungs were noticed in 66% of patients. 44% had finding of prominent bronchovascular markings. Most common ECG finding in this study population is right

axis deviation (32%). P-pulmonale was found in 30% of patients. Most common echo finding is LVD dysfunction, seen in 80% of patients. 50% patients had pulmonary hypertension. Dilated right atrium and ventricle seen in 30% of patients. Right ventricular dysfunction seen in 14% of patients. Left ventricular systolic dysfunction seen in 6% of patients.

**Table 1: Demographic characteristics (n=100).**

Characteristics	Frequency (N)
<b>Age group in (years)</b>	
<40	2
41-50	20
51-60	39
>60	39
<b>Sex</b>	
Male	81
Female	19
<b>Status of smoking</b>	
Smokers	23
Non smokers	77

**Table 2: Clinical characteristics of study participants (n=100).**

Clinical characteristics	Frequency (N)
<b>Duration of symptoms (in years)</b>	
<5	54
5-10	32
>10	14
<b>Stages of COPD (GOLD stages)</b>	
I	16
II	40
III	30
IV	14
<b>Chest X-ray findings</b>	
Prominent bronchovascular markings	34
Hyper inflated lungs	66
<b>ECG findings*</b>	
P - pulmonale	30
RVH	10
RAD	32
RBBB	12
PPRW	26
Low voltage complexes	18
<b>ECHO findings*</b>	
LV systolic dysfunction	6
LV diastolic dysfunction	80
Pulmonary hypertension	50
Dilated RA/RV	30
RV dysfunction	14

\*Multiple findings.

Correlation of risk factors with LVD dysfunction was shown in Table 3. In this study, there is high prevalence

of LVD dysfunction seen in patients above 60 years of age (92%). As age advances, prevalence of LVD dysfunction increases. Prevalence of LVD dysfunction increases when duration of symptoms increases. Smokers had high prevalence of LVD dysfunction compared to non-smokers. All patients with hyper inflated lungs on imaging had LVD dysfunction (100%) and 41% of

patients with prominent bronchovascular markings on chest X ray were found to have LVD dysfunction. Patients with abnormal ECG had high prevalence of LVD dysfunction (92%) compared to normal ECG (68%). A significant correlation between stages of COPD and LVD dysfunction were seen.

**Table 3: Correlation of risk factors with incidence of LVD dysfunction.**

Risk factors		No. patients	LVD dysfunction	Chi square	P value	Correlation coefficient (r)
Age (in years)	Upto 40	2	0	16.795	P<0.001	r=0.373
	41-50	20	12			
	51-60	39	32			
	Above 60	39	36			
Duration of symptoms (in years)	Upto 5	54	40	4.238	P=0.038	r=0.208
	5-10	32	26			
	Above 10	14	14			
Status of smoking	Non smokers	23	15	4.080	P<0.05	r=0.202
	Smokers	77	65			
Chest X ray signs	Hyper inflation	66	66	48.529	P<0.001	r=0.042
	Prominent bronchovascular markings	34	14			
ECG findings	Normal ECG	50	34	9.00	P=0.003	r=0.003
	Abnormal ECG	50	46			
Gold stage of COPD	I	16	2	57.188	P<0.001	r= 0.610
	II	40	34			
	III	30	30			
	IV	14	14			

## DISCUSSION

This study was conducted in patients with chronic obstructive pulmonary disease to know the prevalence of left ventricular diastolic dysfunction. This study population included 100 patients who were diagnosed as chronic obstructive pulmonary disease by clinical, imaging and pulmonary function test. All 100 patients were evaluated for cardiac status by electrocardiography and echocardiography and were screened for left ventricular diastolic dysfunction.

In the present study, male predominance was seen (81%). The common affected age group was 51-60 years. About 77% of the study population was smokers. This was consistent with the findings of Kannan et al.<sup>7</sup>

Several mechanisms explain the etiology of LVD dysfunction in COPD patients. The most important among them is chronic hypoxemia leading to intracellular calcium transport disturbances which might result in abnormalities of myocardial relaxation.<sup>8,9</sup> This usually occurs in severe cases of COPD. Second is the presence of pulmonary hypertension with chronic right ventricular

hypertrophy which may develop in COPD patients followed by right ventricle dilatation.<sup>10,11</sup> In this study pulmonary hypertension was seen in 50% of patients.

Thirdly, the presence of emphysema and hyperinflation which has been related to impaired left ventricle filling.<sup>12,13</sup> In this series left ventricular systolic dysfunction was observed in 6% and left ventricular diastolic dysfunction was noticed in 80% of study population. The fourth cause is the inflammation which is considered to be one of the systemic manifestations of COPD.<sup>14</sup> In a study done by Malerba et al, LVD dysfunction was observed in 65% of COPD patients.<sup>15</sup> In another study by Steinberg et al the prevalence rate of LVD dysfunction was 78% in COPD patients.<sup>16</sup>

From the findings of the present study, it was confirmed that as the age advances, prevalence of LV diastolic dysfunction also increases. So LVD dysfunction was more common in older individuals compare to younger individuals. This correlation was observed in Kannan et al.<sup>7</sup> In the present study, duration of symptoms played a significant role in the prevalence of LVD dysfunction. Among 54% of the COPD patients, the symptoms were

seen in 40% population. This was in agreement with the findings of Caram et al.<sup>2</sup>

In this series the disease status was assessed by chest X-ray, ECG and echocardiograph readings. Significant correlation was observed with the findings of chest X-ray ( $p < 0.001$ ), ECG ( $p = 0.003$ ) and the incidence of LVD dysfunction.

In the present study age and stages of COPD was significantly related with the incidence of LVD dysfunction ( $p < 0.001$ ). This was in contrast to the findings of Caram et al.<sup>2</sup> The status of smoking was also significantly related to the incidence of the disease ( $p < 0.05$ ) and is considered to be the main modifiable risk factor related to the disease.<sup>17,18</sup>

## CONCLUSION

In conclusion, the findings of the study reveal that the prevalence rate of LVD dysfunction was more common in COPD patients. All patients with COPD should undergo cardiac evaluation by echocardiography particularly to assess the LV diastolic function and diastolic heart failure. All patients should be educated about pulmonary rehabilitation programme including exercise training and smoking cessation, which improves the survival of the patient and significantly reduce the co morbidities associated with COPD.

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