



Mediscope



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**ORIGINAL ARTICLE**DOI: <https://doi.org/10.3329/mediscope.v7i1.47139>**Study on association between echocardiographic findings in COPD patients with severity of COPD****MA Kabir<sup>1</sup>, SD Haque<sup>2</sup>, A Baker<sup>3</sup>, MK Alam<sup>4</sup>, SA Rahman<sup>5</sup>****Abstract**

**Background:** Patients with chronic obstructive pulmonary disease (COPD) are at increased risk of developing cardiovascular disease. Echocardiography (ECHO) carries information about cardiac diseases and prognosis in COPD patients. **Objective:** To find out the Echocardiography changes in COPD patients and to assess Right ventricular (RV) dysfunction by echocardiography and correlate with the disease severity. **Methods:** A prospective study was conducted on 70 patients admitted with symptoms and signs suggestive of COPD in the Department of Medicine, Gazi Medical College and Hospital (GMCH), Khulna from January 2017 to December 2018. Patients were diagnosed clinically as having COPD with confirmation by spirometry. The patients with asthma, bronchiectasis, tuberculosis, pneumoconiosis, restrictive lung disease like kyphoscoliosis, rheumatic, congenital, ischemic heart disease and hypertension were excluded from the present study. **Results:** Regarding symptoms, majority 65 (92.9%) patients had breathlessness, 58 (82.9%) had cough with sputum, 25 (35.7%) had swelling of feet. Regarding signs, 68 (97.1%) patients had tachypnea, 24 (34.3%) had raised JVP, 23 (32.9%) had loud P2 suggestive of pulmonary arterial hypertension. Regarding echocardiographic findings, 42 (60.0%) patients had Cor pulmonale, 32 (45.7%) had LVDD, 31 (44.3%) had RVH, 30 (42.9%) had PAH, 29 (41.4%) patients had RA/RV dilation, 11 (15.7%) had RVSD and 9 (12.9%) had LVH. Table 08 shows RA/RV dilatation, RVH, Cor pulmonale, PAH and LVDD were statistically significant ( $p < 0.05$ ) when compared with severity of COPD. **Conclusion:** High occurrence of cardiac co morbidities such as PAH, RV dysfunction and LV dysfunction accompanied COPD patients. The severity of complications increased with severity of COPD which makes a linear relation. The 2D-echocardiography is more sensitive than radiography and clinical methods in detecting cardiovascular complications like PAH, 'p' pulmonale and RV dysfunction in COPD patients.

**Key words:** COPD, 2D-ECHO.

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## Introduction

Chronic obstructive pulmonary disease is the fourth leading cause of mortality worldwide. It is defined as a disease categorized by airflow limitation that is not fully reversible. Patients with chronic obstructive pulmonary disease (COPD) are at increased risk of cardiovascular disease. Electrocardiography (ECG) and Echocardiography carries information about cardiac disease and prognosis in COPD patients.<sup>1</sup>

Cardiovascular disease accounts for significant morbidity and mortality in chronic obstructive pulmonary disease (COPD). Its prevalence and mechanisms of association have not been elucidated.<sup>2</sup> Chronic obstructive pulmonary disease (COPD) includes emphysema, an anatomically defined condition characterized by destruction and enlargement of the lung alveoli; chronic bronchitis, a clinically defined condition with chronic cough and phlegm; and small airway disease, a condition in which small bronchioles are narrowed.<sup>3</sup> COPD is a powerful and independent risk factor for cardiovascular morbidity and mortality which includes right ventricular (RV) dysfunction and cor pulmonale secondary to pulmonary arterial hypertension (PAH), left ventricular dysfunction. Echocardiography provides a rapid, noninvasive, portable, and accurate method to evaluate cardiac functions.<sup>4</sup>

## Materials and methods

A prospective study is conducted on 70 patients admitted with symptoms and signs suggestive of COPD in Gazi Medical College and Hospital (GMCH), Khulna from January 2017 to December 2018. Patients were diagnosed clinically as having COPD with confirmation by spirometry. The patients with asthma, bronchiectasis, tuberculosis, pneumoconiosis, restrictive lung disease like kyphoscoliosis, rheumatic, congenital, ischemic heart disease and hypertension were excluded from the study. All enrolled patients

were informed about nature of the study and their rights to refuse. The informed written consent was taken from patients before including in the study. All the 70 randomly selected COPD patients were studied clinically, radiologically, electrocardiographically, echocardiographically and also with pulmonary function tests. Patients were investigated when their disorder stabilized. Patients were asked about the duration of symptoms like breathlessness, cough, nature and diurnal variation of expectoration and severity of breathlessness to clinically categorize them into predominant chronic bronchitis and predominant emphysema. Patients were also inquired about history of pedal edema, puffiness of face, right hypochondriac pain, and distension of abdomen, to know whether the patient had developed RV dysfunction.

A detailed clinical examination was carried out in the proforma. Pulmonary function tests were done in all patients and they were graded according to the severity of COPD with guidelines given by Global initiative for Obstructive Lung Disease (GOLD). Chest x-ray, twelve lead electrocardiogram, and 2-D Echo were done to evaluate the severity of RV dysfunction. Various observations in the study were analyzed and the severity of COPD was correlated with the echocardiographic features of right ventricular dysfunction. The statistical software SPSS 23.0 was used for the analysis of data. Microsoft word and Excel were used to generate graphs, tables etc.

## Results

Table 01 shows majority 29 (41.4%) patients belonged to age 51-60 years with mean age was  $53.7 \pm 9.5$  years. Table 02 shows distribution of study patients according to gender: 57 (81.4%) were males and 13 (18.6%) were females. Male to female ratio was 4.4:1. Table 03 shows majority 19 (33.3%) patients had duration of smoking 20-29 in pack years with

mean duration of smoking in pack  $32.5 \pm 8.4$  years. Table 04 shows that regarding symptoms, majority 65 (92.9%) patients had breathlessness, 58 (82.9%) had cough with sputum, 25 (35.7%) had swelling of feet. Regarding signs, 68 (97.1%) patients had tachypnea, 24 (34.3%) had raised JVP, 23 (32.9%) had loud P2 suggestive of pulmonary arterial hypertension. Table 05 shows mild COPD was found in 3 (4.3%), moderate 17 (24.3%), severe 31 (44.3%) and very severe 19 (27.1%). Table 06 shows more than two third 48 (68.6%) patients had emphysema, 31 (44.3%) had increased bronchovascular marking, 20 (28.6%) had prominent RDA >16 mm and 13 (18.6%) had cardiomegaly. Table 07 shows regarding echocardiographic findings 42 (60.0%) patients had Cor pulmonale, 32 (45.7%) had LVDD, 31 (44.3%) had RVH, 30 (42.9%) had PAH, 29 (41.4%) patients had RA/RV dilation, 11 (15.7%) had RVSD and 9 (12.9%) had LVH. Table 08 shows RA/RV dilatation, RVH, Cor pulmonale, PAH and LVDD were statistically significant ( $p < 0.05$ ) when compared with severity of COPD.

**Table 01: Distribution of the study patients by age (n=70)**

Age (years)	Frequency	Percentage
□40	8	11.4
41-50	23	32.9
51-60	29	41.4
61-70	9	12.9
>70	1	1.4
Mean±SD	53.7±9.5	

**Table 02: Distribution of the study patients by gender (n=70)**

Sex	Frequency	Percentage
Male	57	81.4
Female	13	18.6

**Table 03: Distribution of the study patients by duration of tobacco use (n=57\*)**

Duration of smoking (in pack years)	Frequency	Percentage
<10	5	8.8
10-19	15	26.3
20-29	19	33.3
30-39	11	19.3
>40	7	12.3
Mean±SD	32.5±8.4	

\*only male patients used tobacco.

**Table 04: Distribution of the study patients by sign and symptoms (n=70)**

Sign and symptoms	Frequency	Percentage
<b>Symptoms</b>		
Breathlessness	65	92.9
Cough with sputum	58	82.9
Swelling of feet	25	35.7
Fever	12	17.1
Decreased urine output	2	2.9
<b>Signs</b>		
Tachypnea	68	97.1
Raised JVP	24	34.3
Loud P2 suggestive of pulmonary arterial hypertension	23	32.9
Pedal edema	21	30.0
Parasternal heave	19	27.1
Cyanosis	17	24.3
Ascites	6	8.6

**Table 05: Distribution of the study patients by severity of COPD (n=70)**

Severity of COPD	FEV 1% predicted	Frequency	Percentage
Mild	>80	3	4.3
Moderate	50-79	17	24.3
Severe	30-49	31	44.3
Very severe	<30	19	27.1

**Table 06: Distribution of the study patients by radiological findings (n=70)**

Radiological findings	Frequency	Percentage
Emphysema	48	68.6
Increased bronchovascular Marking	31	44.3
Prominent RDPA>16 mm	20	28.6
Cardiomegaly	13	18.6

**Table 07: Distribution of the study patients by echocardiographic findings (n=70)**

Echocardiographic findings	Frequency	Percentage
Cor pulmonale	42	60.0
LVDD	32	45.7
RVH	31	44.3
PAH	30	42.9
RA/RV dilatation	29	41.4
RVSD	11	15.7
LVH	9	12.9

**Table 08: Association between echocardiographic findings with severity of COPD**

Echocardiographic findings	Total	Mild (n=3)	Moderate n=17 (%)	Severe n=31 (%)	Very severe n=19 (%)	p value
Cor pulmonale	42	0	4 (23.5)	21 (67.7)	17 (89.5)	0.001 <sup>s</sup>
LVDD	32	0	5 (29.4)	13 (41.9)	14 (73.7)	0.014 <sup>s</sup>
RVH	31	0	3 (7.6)	13 (41.9)	15 (78.9)	0.001 <sup>s</sup>
PAH	30	0	6 (35.3)	11 (35.5)	13 (68.4)	0.027 <sup>s</sup>
RA/RV dilatation	29	0	4 (23.5)	12 (38.7)	13 (68.4)	0.012 <sup>s</sup>
RVSD	11	0	1 (5.9)	4 (12.9)	6 (31.6)	0.130 <sup>ns</sup>
LVH	9	0	1 (5.9)	3 (9.7)	5 (26.3)	0.209 <sup>ns</sup>

s=significant; ns=not significant

p value reached from Chi square test

## Discussion

In this study it was observed that, the majority 29 (41.4%) patients belonged to age 51-60 years with mean age 53.7±9.5 years. Khatri et al.<sup>5</sup> reported the mean age was 69.85 ± 10.36 years with youngest being 40 and oldest being 95 years. Jatav et al.<sup>4</sup> observed that the maximum numbers of COPD patients (70%) in their study were in the 6th and 7th decades, mean age of presentation was 63.18 years. Chaudhari and Shrimali<sup>1</sup> showed that the maximum numbers of COPD patients (70%) in their study were in the 6th

and 7th decades, mean age of presentation was 52.54±9.55 years. In our study, it was observed that 57(81.4%) were males and 13(18.6%) were females. Male to female ratio was 4.4:1. Similar observation was found in different studies. Jatav et al.<sup>4</sup> found male to female ratio of 6.14:1 in their study. Number of males in the study by Krishnan et al.<sup>6</sup> and Vikhe et al.<sup>7</sup> were 84% and 88% respectively, which is similar to present study (86%). Chaudhari and Shrimali<sup>1</sup> reported thatn82 were male and 18 were female, with male to

female ratio 4.55:1. Khatri et al.<sup>5</sup> found there were 40 (47%) males and 46 (53%) females in their study population.

In this study it was observed that the majority 19 (33.3%) patients had duration of smoking 20-29 in pack years with mean duration of smoking in pack 32.5±8.4 years. In the study of Jatav et al.<sup>4</sup>, majority of the patients (86%) had history of smoking. The mean duration of smoking observed in the study was 25.06 years. Majority of smokers (56%) had history of smoking more than 20 pack years. In the study by Krishnan et al.<sup>6</sup> mean duration of smoking was 22.62 years which is similar to the present study. In the study of Chaudhari and Shrimali<sup>1</sup>, majority of the patients (86%) had history of smoking. Majority of smokers (80.3%) had history of smoking more than 10 pack years.

In current study it was observed that regarding symptoms, majority 65 (92.9%) patients had breathlessness, 58 (82.9%) had cough with sputum, 25 (35.7%) had swelling of feet. Regarding signs, 68 (97.1%) patients had tachypnea, 24 (34.3%) had raised JVP, 23 (32.9%) had loud P2 suggestive of pulmonary arterial hypertension. In comparison with the study of Jatav et al.<sup>4</sup> they showed most of the patients had cough with sputum (80%) and breathlessness on presentation (96%). 32% presented with swelling of feet, 16% had fever, 4% had decreased urine output. Most common sign at presentation is tachypnea in 96% followed by 35% had loud P2 suggestive of pulmonary arterial hypertension, 30% of the patients had parasternal heave, the clinical evidence of right ventricular hypertrophy. Evidence of congestive cardiac failure like raised JVP in 36%, pedal edema in 32% and ascites in 9% cases. 27% of the patients had cyanosis which is evidence of a hypoxic state. Chaudhari and Shrimali<sup>1</sup> reported breathlessness was the commonest symptom found in all 100% patients followed by cough with expectoration (94%). while right hypochondrial (RHC) pain was the least common

symptom found in 8% patient. The most common sign was tachypnea present in 70% patients (70%), Barrel Shaped chest in 58% patients, pedal edema was 36%; while right hypochondrial (RHC) tenderness was present in 4% patients.

In this study it was showed mild COPD was found in 3 (4.3%), moderate 17 (24.3%), severe 31 (44.3%) and very severe 19 (27.1%). Jatav et al.<sup>4</sup> observed that majority of patients (44%) had severe and very severe COPD (31%), 4% patients had mild COPD and 22% had moderate COPD. Comparing with other studies i.e. Sekhar et al.<sup>8</sup> the present study had almost similar findings. In Dave et al.<sup>9</sup> study maximum number of patients were in very severe category (38%). Chaudhari and Shrimali<sup>1</sup> observed that majority of patients had severe COPD (62%), 4% patients had mild COPD and 3 (4%) had moderate COPD. Freixa et al.<sup>2</sup> reported mild COPD was found 6.0%, moderate 48.0%, severe 39.0% and very severe 8.0%.

In current study it was observed that more than two third 48 (68.6%) patients had emphysema, 31 (44.3%) had increased bronchovascular marking, 20 (28.6%) had prominent RDA > 16 mm and 13 (18.6%) had cardiomegaly. Jatav et al.<sup>4</sup> reported in chest X-ray, 72% of the patients had features of emphysema. 42% of the patients had increased bronchovascular marking suggestive of chronic bronchitis. X-ray evidence of pulmonary hypertension i.e. prominent right descending pulmonary artery (RDPA) was present in 30% of the patients. Cardiomegaly on X-ray was present in 20%. Chaudhari and Shrimali<sup>1</sup> observed that in chest X-ray, 80% of the patients had features of emphysema. 68% of the patients had increased bronchovascular marking suggestive of chronic bronchitis. X-ray evidence of pulmonary hypertension i.e. prominent right descending pulmonary artery (RDPA) was present in 30% of the patients. Cardiomegaly on X-ray was present in 24%. The incidence of chest X-ray signs

correlated with the study of Krishnan et al.<sup>10</sup> and Suma et al.<sup>11</sup>

Regarding echocardiographic findings, 42 (60.0%) patients had Cor pulmonale, 32 (45.7%) had LVDD, 31 (44.3%) had RVH, 30 (42.9%) had PAH, 29 (41.4%) patients had RA/RV dilatation, 11 (15.7%) had RVSD and 9 (12.9%) had LVH. Jatav et al.<sup>4</sup> most common echocardiographic finding was Cor pulmonale, 62% of the patients in this study had echocardiographic evidence of cor pulmonale. Pulmonary arterial hypertension (PAH) which is defined as pulmonary arterial systolic pressure (PASP) > 30mmHg was observed in 44% cases. 43% had features of RA/RV dilatation, 42% had RVH 46% had LVDD, 14% had RVSD and 11% had LVH. Signs correlated with the study of Sekhar et al.<sup>8</sup> and Suma et al.<sup>11</sup> Most common echocardiographic finding was Cor pulmonale, 62% of the patients in this study had echocardiographic evidence of cor pulmonale. Other echocardiographic findings were PAH in 44% cases, RA/RV dilatation in 43%, RVH in 42%, LVDD in 46%, RVSD in 14% and LVH in 11% of cases. Similar observations were present in previous studies.<sup>6-8</sup> Chaudhari and Shrimali<sup>1</sup> reported analysis of echocardiographic findings which showed that most common echocardiographic finding was Pulmonary arterial hypertension (PAH). PAH which is defined as pulmonary arterial systolic pressure (PASP) > 30mmHg was observed in 54% cases. 52% had features of RV dilatation, 42% had RA Dilatation, 28% had RA Hypertrophy, 20% had IVS motion abnormality and 14% RV Failure had 8% Normal. Similar incidences were found in some previous studies.<sup>10-12</sup>

In this study it was observed that RA/RV dilatation, RVH, Cor pulmonale, PAH and LVDD were statistically significant ( $p < 0.05$ ) when compared with severity of COPD. Jatav et al.<sup>4</sup> analysed echocardiographic findings with disease severity, which showed that in mild category no case of RA/RV dilatation was

present while in moderate, severe and very severe categories it was present in 27.27%, 40.90% and 63.33% of cases respectively. RVH was also not present in mild category while in moderate, severe, and very severe categories it was present in 27.27%, 38.63% and 63.33% of cases respectively. Cor pulmonale was observed in 0% cases in mild category patients while in moderate, severe and very severe categories it was present in 27.27%, 68.18% and 86.67% of cases respectively. PAH was observed in 0% cases in mild category patients while in moderate, severe and very severe categories it was observed in 40.90%, 36.36% and 63.33% of cases respectively. RVSD was observed in 0% cases in mild category while in moderate, severe and very severe categories it was observed in 4.94%, 9.09% and 30% of cases respectively. All echocardiographic findings of RV dysfunction i.e. PAH, Cor pulmonale, RA/RV dilatation, RVH and RVSD correlated significantly with disease severity ( $p < 0.05$ ). Chaudhari and Shrimali<sup>1</sup> observed that severe category of COPD has abnormal echocardiographic findings: RVD (74.1%), PAH (67.7%), RAD (54.8%). Moderate COPD had PAH (29.4%), RVD (23.5%), RVH (17.6%) and normal Echo findings (17.6%). The echo signs of right atrium enlargement, right ventricle dilatation and pulmonary hypertension correlated significantly with the severity of COPD ( $p < 0.05$ ).

## Conclusion

High occurrence of cardiac co morbidities such as PAH, RV dysfunction and LV dysfunction accompanied COPD patients. The severity of complications increases with severity of COPD which makes a linear correlation. The 2D-echocardiography is more sensitive than radiography and clinical methods in detecting cardiovascular complications like PAH, 'p' pulmonale and RV dysfunction in COPD patients.

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