



## CORRELATION OF PULMONARY FUNCTION TEST AND ECHOCARDIOGRAPHIC FINDINGS IN PULMONARY HYPERTENSION IN COPD PATIENTS

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**ABSTRACT** **Introduction:** The coexistence of COPD and coronary artery disease occurs frequently. The spectrum of cardiovascular & pulmonary vascular disease associated with COPD increases morbidity and worsens survival. **Aim & Objective:** To study correlation of pulmonary function test and echocardiographic findings in pulmonary hypertension in COPD patients. **Materials & Methods:** This cross sectional observational study was conducted during the period from January 2018 – June 2019 in the department of Medicine in Government Medical College & Hospital Aurangabad a tertiary care centre In Maharashtra state on 100 study subjects. **Results:** There is a strong positive correlation ( $p < 0.001$ ) between severity of COPD (GOLD guidelines) and severity of pulmonary hypertension in our study population. **Conclusion:** There was no correlation between the types of COPD with results of PFT and severity of pulmonary hypertension.

**KEYWORDS :** Pulmonary hypertension, COPD, Pulmonary Function Test.

### INTRODUCTION

Chronic obstructive lung disease (COPD) is a common, preventable and treatable disease that is characterized by persistent respiratory symptoms and airflow limitation that is due to airway and/or alveolar abnormalities usually caused by significant exposure to noxious particles or gases. The chronic airflow limitation that is characteristic of COPD is caused by mixture of small airway disease (e.g. obstructive bronchiolitis) and parenchymal destruction (emphysema) the relative contribution of which vary from person to person<sup>1</sup>

Cigarette smoke exposure may affect the large airways, small airways ( $\leq 2$  mm diameter), and alveoli. Changes in large airways cause cough and sputum, while changes in small airways and alveoli are responsible for physiologic alterations. Emphysema and small airway pathology are both present in most persons with COPD.<sup>2</sup>

Impairments of right ventricular dysfunction and pulmonary vascular disease are well known to complicate the clinical course of COPD and correlate inversely with survival. The coexistence of COPD and coronary artery disease occurs frequently. The spectrum of cardiovascular disease includes right ventricular (RV) dysfunction, pulmonary hypertension (PH), coronary artery disease (CAD), and arrhythmias. Pulmonary vascular disease associated with COPD increases morbidity and worsens survival.<sup>3,4</sup>

In view of above literature, the present study was conducted in a tertiary care centre having significant number of COPD patient admissions daily to find out correlation between PFT's and echocardiographic findings in COPD patients having pulmonary hypertension

### MATERIALS & METHODS:

This cross sectional observational study was conducted during the period from January 2018 – June 2019 in the department of Medicine in Government Medical College & Hospital Aurangabad a tertiary care centre In Maharashtra state.

This study was done on patients admitted under Medicine department, in the tertiary care centre and fulfilling the inclusion and exclusion criteria. All adult patients of COPD as per GOLD guidelines, Patients having pulmonary hypertension on echocardiography, Patients who performed PFT's as per procedure protocol & Patients who give consent for study were included in study.

Those patients with history or clinical evidence of chronic pulmonary disease other than COPD i.e. Patients with pulmonary tuberculosis & Patients with restrictive lung disease were excluded from the study.

The prevalence of pulmonary hypertension in COPD was 38.7 %<sup>3</sup> and with allowable error of 10% & with 95% confidence interval, sample size was calculated as 100.

A proforma of detailed clinical history, risk factors, physical examination, investigations was prepared. Clinical history was taken from patients. Complete physical examination and the Hematological, Biochemical, Chest radiograph, electrocardiography etc investigations were done at the institute.

Echocardiography was performed by cardiologist at the institute on echocardiography machine model Phillips IE 33 matrix model 2014 and all findings reported and included in the case report of each patient. Spirometry was performed in these patients during afternoon hours in wards/ COPD clinics using Spirometry Machine-MIR spirolab III Diagnostic spirometer machine. Spirometric parameters like Pre FVC, Pre FEV<sub>1</sub>, Pre FEV<sub>1</sub>/FVC ratio, post FVC, post FEV<sub>1</sub>, post FEV<sub>1</sub>/FVC ratio were noted before and 10-15 mins after giving short acting bronchodilator (400µg of salbutamol) through nebulisation. Both FVC and FEV<sub>1</sub> should be the largest value obtained from any of three technically satisfactory curves and FVC and FEV<sub>1</sub> values in these curves should vary by no more than 5% or 100 ml, whichever is greater, the FEV<sub>1</sub>/FVC is calculated using the maximum FEV<sub>1</sub> and FVC from technically acceptable (not necessarily the same) curves. Reversibility with bronchodilator is observed to distinguish Asthma from COPD. The GOLD guidelines recommend an increase in FEV<sub>1</sub> that is both greater than 200 ml and 12% above the pre-bronchodilator FEV<sub>1</sub> is considered significant to categorize them as Asthma. As per Spirometric findings patients were categorized as per GOLD (Global initiative for chronic obstructive lung disease) guidelines.

Data was entered on Microsoft excel sheet on regular basis and results were obtained. Analysis of data was done using SPSS trial version 20. Qualitative variables were expressed as mean, standard deviation (SD), range, frequencies (number of cases) and percentages. t test was used to compare qualitative variables and to test the significance. Correlation is evaluated by Pearson's correlation coefficient (r). Quantitative variables were presented in terms of mean  $\pm$  standard deviation. Level of significance "p" value was evaluated, where p value  $< 0.05$  was considered statistically significant.

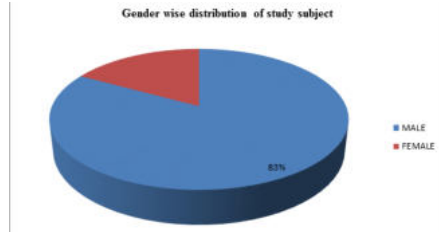
### RESULTS

**Table 1: Age wise distribution of Study population**

AGE GROU (IN YEARS)	FREQUENCY	PERCENTAGE
31-40	4	4
41-50	10	10

51-60	30	30
61-70	43	43
≥71	13	13
<b>TOTAL</b>	<b>100</b>	<b>100</b>

The study population age ranged between 35 years – 85 years and maximum number of cases was in age group of 61-70 years constituting 43 %, followed by 51-60 years age group constituting 30 %. The mean age found in study population was 60.74 + 9.66 years.



Males constituting 83 % and 17% were females. Male: Female sex ratio was 4.88: 1.

**Table 2: Severity of COPD (GOLD stage) distribution of patients studied (n = 100)**

Severity of COPD	Patients having pulmonary hypertension	% Patients
Stage 1(Mild)	2	2
Stage2 (Moderate)	23	23
Stage 3 (Severe)	63	63
Stage 4 (Very Severe)	12	12

Maximum no. of patients- 63 (63%) in the study population were in severe grade (GOLD 3) COPD -followed by 23 patients (23%) in moderate (GOLD 2), 12 patient (12%) in very severe (GOLD 4) stage and 2 patients (2%) in mild (GOLD 1) stage COPD.

**Table no 3: Age distribution correlation with severity of Pulmonary Hypertension**

Age in years	Mild PH	MODERATE PH	SEVERE PH	P VALUE
31-40	4	0	0	0.599
41-50	8	1	1	
51-60	20	6	4	
61-70	24	15	4	
≥ 71	9	3	1	
<b>Total</b>	<b>65</b>	<b>25</b>	<b>10</b>	<b>100</b>

Maximum no. of patients having Mild Pulmonary hypertension (PH) was in age group 51-60 yrs and 61-70 yrs. Similarly Moderate PH and Severe PH were found maximally in 51-70 years age group. There was no statistically significant correlation (p > 0.05) between age and severity of pulmonary hypertension.

**Table no.4: Gender correlation with severity of pulmonary hypertension**

Gender	MILD PH	MODERATE PH	SEVERE PH	p value
Male	53	20	10	0.323
Female	12	5	0	
Total	65	25	10	

Maximum no of patient’s i.e 53% were male patients having Mild PH. Also Severe PH was found solely in male patients. There was no statistically significant correlation (p > 0.05) between gender and severity of pulmonary hypertension.

**Table no 5: Correlation of severity of COPD (GOLD guidelines) to severity of pulmonary hypertension.**

COPD STAGE	MILD PH	MODERATE PH	SEVERE PH	P Value
Stage 1 (Mild) [n-2]	2[100%]	0	0	0.00025
STAGE 2 [Moderate] [n-23]	19[83%]	4[17%]	0	
STAGE 3 [Severe] [n-63]	41[65%]	17[27%]	5[8%]	
STAGE 4 [Very Severe] [n-12]	3[25%]	4[33%]	5[42%]	

Maximum 41(65%) number of patients in the study population of Stage 3 Severe grade of COPD had Mild Pulmonary hypertension and 17(27%) of patients had Moderate Pulmonary hypertension. A statistically significant of p value of 0.00025 (p< 0.05) was found between severity of COPD and severity of pulmonary hypertension.

**Table No.6: Severity of COPD with echocardiography findings in study population.**

COPD STAGE	RA DILATED	RV DILATED	LV DIASTOLIC DYSFUNCTION	LVH	P Value
Stage 1(Mild)	0	0	0	0	0.8961
Stage 2(Moderate)	13	13	16	1	
Stage 3(Severe)	38	38	48	4	
Stage 4 (Very Severe)	12	12	12	2	
Total	63	63	76	7	

On analysis of echo-cardiography data of study population it was observed that maximum 76(76%) number of patients of COPD had Left ventricular diastolic dysfunction. 48(48%) of these patients had Stage 3 GOLD Severe COPD. Second most common finding was RA/RV Dilatation found in 63 patients (63%) out of which most of these patients had Stage 3 (Severe) COPD i.e. 38%. 7 patients(7%) showed left ventricular hypertrophy. Above correlation between severity of COPD and echocardiographic findings was statistically non-significant with p value of 0.8961(> 0.05).

**Table no. 7: Types of COPD with severity of COPD**

TYPE OF COPD	MILD [STAGE 1] COPD	MODERATE [STAGE 2] COPD	SEVERE [STAGE 3] COPD	VERY SEVERE [STAGE 4] COPD
EMPHYSEMA [n-67]	1[2%]	11[16%]	46[69%]	9[13%]
CHRONIC BRONCHITIS [n-21]	1[5%]	7[33%]	12[57%]	1[5%]
MIXED [n-12]	0	5[41.5%]	5[41.5%]	2[17%]

Maximum no of patients i.e. 46 patients had Emphysema with Severe [stage 3] COPD followed by 12 patients having severe [stage 3] COPD. In all 3 variants of COPD maximum number of patients were found in Severe (stage 3) COPD.

**Table no 8: Types of COPD with severity of pulmonary hypertension**

TYPES OF COPD	MILD PH	MODERATE PH	SEVERE PH	P Value
EMPHYSEMA [n-67]	43[64%]	15[22%]	11[14%]	0.16415
CHRONIC BRONCHITIS [n-21]	15[71%]	5[24%]	1[5%]	
MIXED [n-12]	7[58%]	5[42%]	0	

Maximum number of patients i.e. 43 patients had Emphysema with Mild PH. Mild PH was most common Pulmonary hypertension severity in all 3 variants of COPD. Maximum number of patients - 11(14%) having severe Pulmonary Hypertension had emphysema.

**Table no 9: Multivariate analysis with pulmonary hypertension**

VARIABLE	F VALUE	P VALUE	SIGNIFICANCE
AGE	1.327	0.27	NON SIGNIFICANT
SEX	1.187	0.309	NON SIGNIFICANT
RISK FACTORS	2.998	0.055	NON SIGNIFICANT
GOLD STAGE	8.614	0.001	SIGNIFICANT
TYPES OF COPD	1.989	0.142	NON SIGNIFICANT

On multivariate analysis of study population a significant correlation was found between severity grade (GOLD) of COPD with Pulmonary hypertension (p < 0.001).

**DISCUSSION:**

Pulmonary hypertension is a frequent complication in the natural history of chronic obstructive pulmonary disease (COPD). Its presence

is associated with shorter survival rates and it has been identified as a predictive factor of worse clinical outcomes and frequent use of health resources

The present study was aimed to correlate pulmonary function test with echo-cardiographic findings in patients with pulmonary Hypertension in COPD. 100 (83 males and 17 female) subjects amongst the COPD patients admitted in the tertiary care centre fulfilling the inclusion and exclusion criteria were selected for the study.

Patients included in the study were in the age group of 33-85 years (mean age & SD 60.74 ± 9.66) with maximum numbers in the 6<sup>th</sup> and 7<sup>th</sup> decades. In present study there was no significant correlation between pulmonary hypertension and age ( $p > 0.05$ ). Mean age group in other studies varied from 52.54 yrs in **Chaudhari et al**<sup>5</sup> study, 63.18 yrs in **Jatav et al. Study**<sup>6</sup>, 59.2 yrs in **Kaur et al.**<sup>7</sup> study, Hence mean age of all past studies varied from 5<sup>th</sup> to 6<sup>th</sup> decade.

The sex wise distribution in this study showed male predominance with Male: Female ratio of 4.88:1 and males constituting 83% and females for 17 %. In the present study the gender correlation with severity of pulmonary hypertension was non-significant with p value of 0.323. Male to Female ratio in various studies showed 3:1 in, 4.55: 1 in **Chaudhari et al**<sup>5</sup> study, 6.14:1 in **Jatav et al**<sup>6</sup> study, 2.33:1 in **Kaur et al**<sup>7</sup> study, 60.7 yrs in **Aggrawal et al.**<sup>8</sup> study and. Hence there was male predominance in all the studies conducted previously.

The distribution of study population according to severity of COPD was 2 % in Mild grade (FEV1 ≥ 80% of predicted), 23 % in Moderate Grade (50% ≤ FEV1 < 80% predicted), and the maximum number 63 % in Severe grade (30% ≤ FEV1 < 50% predicted) and 12 % of study population had Very severe grade (FEV1 < 30% predicted) COPD. In **Venkateshwara Rao et al**<sup>9</sup> study it was 37% in moderate, 35% severe and 27.4% in very severe grade. In **Jatav VS et al**<sup>6</sup> study it was 4 % in mild, 22% in moderate, 44% severe and 31% in very severe grade. In **Gupta et al**<sup>10</sup> study it was 45 % in mild, 27.5% in moderate, 12.5% severe and 15% in very severe grade. On the contrary in **Mahisale et al**<sup>11</sup> study it was 25.7 % in mild, 30.8% in moderate, 25% severe and 18.3% in very severe grade. So the severity of COPD in study population in various studies varied widely.

There was a strong positive correlation ( $p < 0.001$ ) between severity of COPD (GOLD guidelines) and severity of pulmonary hypertension in the present study population with a statistically significant p value of 0.00025 ( $p < 0.001$ ). Severity of pulmonary hypertension increases with increasing severity of COPD. Above comparison showed maximum 41 (65%) number of patients in the study population of Stage 3 Severe grade of COPD having Mild Pulmonary hypertension and 17 (27%) of patients having moderate Pulmonary hypertension. Similar comparison was found only in **Venkateshwara et al**<sup>9</sup> study and it showed similar increase in severity of pulmonary hypertension with increasing severity of COPD but its statistical significance data was not available.

In present study maximum number of patients i.e. 65% had Mild PH followed by 25% patients having Moderate PH and 10 % patients having Severe pulmonary hypertension. Similar values were obtained from **Venkateshwara et al**<sup>10</sup> study and **Gupta et al**<sup>11</sup> study.

In this study there was statistically significant correlation between severities of COPD (based on GOLD guidelines on PFT) with echocardiography findings in COPD patients having pulmonary hypertension ( $p < 0.05$ ). In our study most common finding was Left ventricular diastolic dysfunction in 76% patients followed by 63% patients showing RA/RV dilatation and 7 % patients showing LVH. This comparison showed maximum no of patients i.e. 48 patients were in Stage 3 (Severe) COPD and having Left ventricular diastolic dysfunction.

#### CONCLUSION:

Mild Pulmonary Hypertension was most common i.e 65% followed by Moderate pulmonary hypertension in 25 % and severe pulmonary hypertension in 10% study population. There is a strong positive correlation ( $p < 0.001$ ) between severity of COPD (GOLD guidelines) and severity of pulmonary hypertension in our study population. There was no correlation between the types of COPD with results of PFT and severity of pulmonary hypertension.

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