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Original Article

Clinical Profile and Echocardiographic Evaluation of Right Heart in Patients of COPD and Its Correlation with Disease Progression

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Kartick Chandra Halder[1*], Syed Obydur Rahman[1]

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*Corresponding Author

ABSTRACT

Introduction: *To assess the clinical profile and echocardiographic evaluation of the right heart in patients of COPD and its correlation with disease progression.* ***Methods & Materials:*** *An observational, cross-sectional study was done on 100 patients with COPD who were admitted at Dept. of Cardiology, Bangabandhu Sheikh Mujib Medical College Hospital, Faridpur, Bangladesh and underwent echocardiographic evaluation from January to December 2022. All echocardiogaphic parameters focused on right heart and its function were assessed.* ***Results:*** *Total 100 COPD patients included in our study. Majority patients of them were female (62 patients, 62%). Male to female ratio is 1:1.6. Ninety-Six patients (96%) studied had significant ECG abnormality out of which P 'pulmonale was the most common (90 patients, 90%) while atrial arrhythmias in the form of Atrial fibrillation (AF) or Multifocal tachycardia (MAT) (12 patients, 12%) being the least common finding. Pulmonary hypertension defined as sPAP>30 mmHg was evident in all of the patients; with 59.0 patients (59.0%), 28 (28.0%) and 13 (13.0 %) patients having severe, moderate and mild pulmonary hypertension respectively. RV dysfunction was evident with reduced average TAPSE values (1.59± 0.38 cm) and elevated RIMP values (0.58±0.16).* ***Conclusion:*** *Majority of COPD patients ultimately developed pulmonary hypertension. Echocardiogram can be a helpful tool to evaluate early changes on the right heart size and function in patients with COPD and also monitor these patients for rapid progression of the illness.*

Keywords: *Clinical Profile, COPD, RV Dysfunction, Pulmonary Hypertension*

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1. *Assistant Professor (Cardiology), Bangabandhu Sheikh Mujib Medical College, Faridpur, Bangladesh*

INTRODUCTION

COPD is an important cause of death and disability worldwide. According to World Bank data it is expectable to move from its status in 2000 as the 4th and 12th most frequent cause of mortality and morbidity, respectively, to the 3rd and 5th leading cause of mortality and morbidity, respectively, in 2020[1,2]. COPD is related with significant extrapulmonary (systemic) effects among which cardiac manifestations are most common. Cardiovascular disease accounts for approximately 50% of all hospitalization and nearly one third of all deaths, if forced expiratory volume in one second (FEV_1)> 50% of predicted[3]. In more advanced disease cardiovascular disease explanation for 20%–25% of all deaths in COPD[4]. COPD affects pulmonary blood vessels, right ventricle, as well as left ventricle leading to development of pulmonary hypertension, corpulmonale, right and left ventricular dysfunction too. Echocardiography provides a rapid, noninvasive portable and accurate method to evaluate the right ventricle function, right ventricular filling pressure, tricuspid regurgitation, left ventricular function and valvular function[5]. Right ventricular (RV) dysfunction is common in patients with COPD, especially those with low oxygen saturation. Pulmonary hypertension (PH) affects the function of the right ventricle, resulting in pulmonary hypertension. Once this disease develops, these patients have a poor prognosis. Therefore, early detection of right ventricular dysfunction and pulmonary hypertension can help treat patients with pulmonary disease and prolong their survival. Echocardiography provides a rapid, noninvasive method to assess right ventricular size and function[6]. This study was conducted to determine the prevalence and extent of pulmonary hypertension by echocardiography in patients with COPD. COPD is associated with a significant increase in mortality due to its systemic, especially cardiac, involvement. When forced expiratory volume in 1 second (FEV1) is greater than 50% of predicted, cardiovascular disease alone is responsible for approximately 50% of all hospitalizations and nearly one-third of all deaths. In more advanced disease, cardiovascular disease accounts for 20-25% of all COPD deaths[6-9]. The association between cardiovascular disease and COPD can be explained by numerous risk factors, including smoking, systemic effects of inflammation, vascular dysfunction, and pulmonary hyperinflation[10]. This association justifies the need to screen all COPD patients for cardiac symptoms. Therefore, early and rapid non-invasive diagnosis of cardiac lesions and disorders in COPD patients is important as it can contribute to a better treatment of these patients. ECG has long been used to diagnose RV hypertrophy. Detection of RV hypertrophy on ECG has a very high specificity but suffers from low sensitivity[11]. In contrast, echocardiography provides a rapid, noninvasive, portable and accurate method to assess right ventricular function, right ventricular filling pressure, tricuspid regurgitation, left

ventricular function and valvular function. Two-dimensional echo has revolutionized the noninvasive evaluation, prognosis and response to treatment of COPD cases[12]. Studies have confirmed that echocardiographic estimates of pulmonary artery pressure are closely correlated with pressures measured by right heart catheterization[10-13].

METHODS AND MATERIALS

An observational, cross-sectional study was done on 100 patients with COPD who were admitted at Dept. of Cardiology, Bangabandhu Sheikh Mujib Medical College Hospital, Faridpur, Bangladesh and underwent echocardiographic evaluation from January to December 2022. All echocardiogaphic parameters focused on right heart and its function were assessed. The inclusion and exclusion criteria were as follows:

Inclusion criteria:

- All COPD patients attending the echocardiography laboratory of the same study period.

Exclusion criteria:

- Patients who cannot lie for long enough to complete the study.
- H/O of diagnosed chronic lung disease other than COPD like - Interstitial lung disease and old pulmonary TB with sequalae.
- Any systemic disease that can cause pulmonary hypertension,
- Patients with congenital heart disease, rheumatic heart disease or valvular heart disease.

All selected patients were questioned in detail about their current, past, family and personal medical history, especially smoking habits, intake of "chola" and history of bronchial asthma. All necessary laboratory tests and transthoracic echocardiography were performed in all patients. Parameters of the right side of the heart were also examined. Tricuspid regurgitant jet and maximum jet velocity were also measured. Right ventricular systolic pressure was estimated using the modified Bernoulli equation and was considered equal to systolic pulmonary artery pressure (sPAP) in the absence of right ventricular outflow tract obstruction. RAP was estimated based on the standard deviation of the inferior vena cava size during inspiration. Tricuspid systolic excursion (TAPSE) was measured in M-mode and used as a marker of RV dysfunction. All required parameters of RV function were calculated and analyzed by echocardiography.

Categorical variables were reported as number and percentage (%), and continuous variables were reported as mean ± SD and median. Normality of the data was checked using the Kolmogorov-Smirnov test. Non-parametric tests were used when normality was rejected. Quantitative variables were compared between two groups using independent t-tests/Mann-Whitney tests (if the dataset was not normally distributed). Qualitative variables were correlated using chi-square tests. Data were entered into MS EXCEL spreadsheets and analyses were performed using Statistical Package for the Social Sciences (SPSS) version 23.

RESULTS

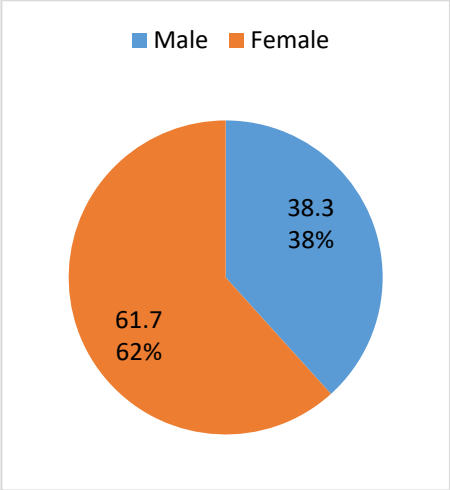

Figure – 1: Gender Distribution of the Study Patients

Total 100 number of patients included in this study. Out of 100 patients, male is 38 (38.0%), female 62 (62.0%). Male to female ratio is 1:1.6. Majority of the patients were female 62.0% (n=62) with the mean age of 60.9 ±11.4 years (**Figure 1**).

Ninety-Six patients (96%) studied had significant ECG abnormality out of which P 'pulmonale was the most common (90 patients, 90%) while atrial arrhythmias in the form of Atrial fibrillation (AF) or Multifocal tachycardia (MAT) (12 patients, 12%) being the least common finding **(Table I)**.

Table – I: ECG Abnormalities in COPD Patients

R/S Ratio	*n*	%
> 1	62	62.0
< 1	35	35
RBBB	38	38.0
AF/MAT	12	12.0

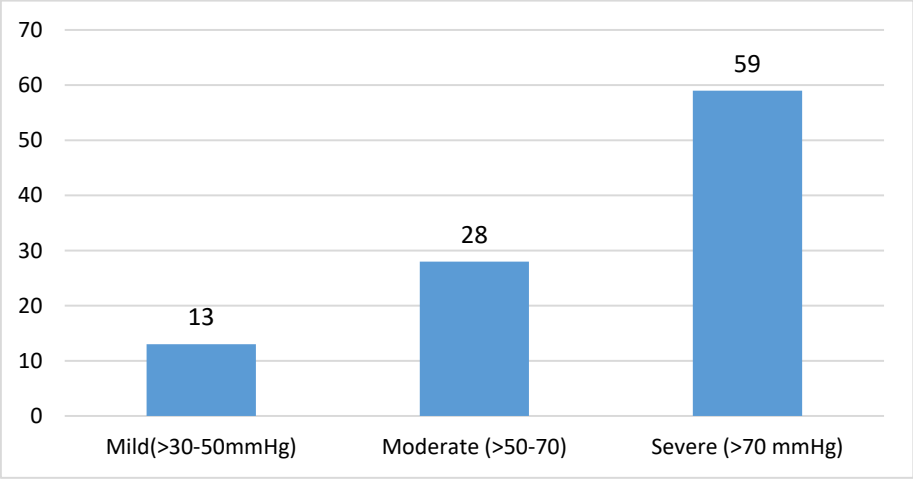

Figure – 1: Pulmonary Hypertension Grade

Echocardiograms performed on the studied patients showed signs of varying degrees of pulmonary hypertension and right-sided ventricular enlargement. Pulmonary hypertension, defined as a peak systolic pulmonary pressure (sPAP) value >30 mmHg, was observed in all patients in the study group. The mean TRPG value studied was 63.76±20.57mmHg with the range of 26-100 mmHg and their corresponding peak systolic pulmonary

artery pressure (PASP) mean value was 75.26 ±21.18 mmHg. Among patients with evidence of pulmonary hypertension, 59 patients (59.0%) had severe PAH, 28 patients (28.0%) had moderate PH and 13 patients (13.0%) had mild degree of pulmonary hypertension as shown in **Figure 1.**

Other parameters of right heart enlargement and function were examined such as RA area, RV base and mean diameter, TAPSE, RIMP, S', etc. Mean RV diameter was increased compared to normal values in adults and RV function parameters such as TAPSE and RIMP also showed that majority of the studied patients had significant RV dysfunction (**Table II**).

Table – II: Echocardiographic RV Parameters

RV Parameters	Mean	SD	Range
RA Area (cm2)	20.57	6.8	8.8-39
RV diameter (base)/cm	5.04	0.66	3.6-6.8
RV diameter (mid)/cm	4.68	0.58	3.4-6.8
RV wall thickness /cm	0.77	0.11	0.5-1.1
TAPSE /cm	1.59	10.38	0.9-2.3
TDI s' /cm/s	11.5	2.95	6.7-19
RV MPI	0.58	0.16	0.35-0.98
TRPG/mmHg	63.76	20.57	26-110
PASP	75.26	21.18	36-120

Inferior venacava diameter (IVCd) at diastole is a surrogate marker for increased right atrial pressure and is useful for estimation of peak pulmonary artery pressure. The mean IVC diameter was 1.88±0.35 cm as shown in (**Table III**).

Table – III: Echocardiogrpahic LV Parameters and IVC Size

LV Parameters & IVC Size	Mean	SD	Range
LVDD /cm	4.01	0.64	2.8-5.7
LVSD/cm	2.48	0.63	1.5-4.5
IVS/cm	0.79	0.09	0.6-1.1
PW/cm	0.82	0.01	0.6-1.2
EF %	60.34	3.89	50-65
IVC d/cm	1.88	0.35	1-2.4

DISCUSSION

The increasing incidence of COPD worldwide and in our country due to increasing smoking habits and pollution warrants the need to monitor and evaluate factors associated with increased and mortality and morbidity. The cardiac manifestations of COPD are numerous. Among them, right ventricular dysfunction and pulmonary vascular disorders are known to complicate the clinical course of COPD and are inversely correlated with survival. Significant structural changes occur in the pulmonary circulation of COPD patients. All of these lead to a significant increase in pulmonary vascular resistance, causing pulmonary hypertension. Impairment of RV function and pulmonary vascular changes are known to complicate the clinical course of COPD and are inversely correlated with survival. Long-

term changes involving chronic pulmonary vascular remodeling and vasoconstriction result in an increase in RV afterload, eventually causing RV dilation and later manifesting as pulmonary dysfunction. The true prevalence of PH in COPD is unknown, but it has been reported that 20% to 90% of patients experience elevated pulmonary artery pressures as measured by right heart catheterization[14]. The level of PH has a prognostic value in COPD patients that has been demonstrated by several studies. In one of these studies, the 5-year survival rates were 50% in patients with mild PH (20–30 mmHg), 30% in those with moderate to severe PH (30–50 mmHg), and 0% in the small group of patients with very severe PH (>50 mmHg). Thus, a high degree of PH bears a poor prognosis in patients with COPD and this also has been observed in COPD patients receiving long-term oxygen therapy[15]. Ninety-Six patients (96%) studied had significant ECG abnormality out of which P 'pulmonale was the most common (90 patients, 90%) while atrial arrhythmias in the form of Atrial fibrillation (AF) or Multifocal tachycardia (MAT) (12 patients, 12%) being the least common finding. In our study, all 100 patients had evidence of pulmonary hypertension (sPAP> 30 mmHg) with majority of them (59%) having higher grades of pulmonary hypertension maybe because of the chronicity of the disease and the study was mainly done in admitted patients with COPD. There were significant evidence of right ventricular enlargement as well as decline in RV systolic function through various parameters studied by echocardiography. All COPD patients studied had shown an increase in RV enlargement in form of increased RV diameters (RV base = 5.04±0.66 and RV mid =4.68±0.58 cm). RV systolic function as assessed by TAPSE and RIMP also showed values below normal adult population values which indicate majority of COPD patients studied had evidence of RV dysfunction as well. (TAPSE, mean = 1.59 ±0.38, RIMP = 0.58±0.16). ***Saxena N et al.*** showed tricuspid annular systolic velocity (TAPSE) is a useful measurement in determining right ventricular systolic function regardless of pulmonary artery pressures in a study of 87 patients[16]. Evidence of right ventricular hypertrophy was also seen in most patients with the average RV wall thickness of 0.77±0.11 mm as compared to normal adult value of 3-5 mm. These consequences imply that similarly large-scale research the use of a greater correct evaluation technique for PH are warranted, to attain a greater specific evaluation of the RV disorder related to COPD. Some research imply that LV characteristic remainders regular in individuals with COPD, while others recommend that LV disorder can be present[17]. Echocardiographic assessment of proper coronary heart may be used as an critical threat evaluation device for assessing RV characteristic and pulmonary artery strain and ought to create a part of a periodic screening device for all COPD sufferers. Regular cardiac tracking via way of means of echo in those COPD sufferers can assist to become aware of people prone to extended morbidity and

mortality, warranting near tracking and competitive remedy to save you or put off complications. Major quandary of the have a look at became that it became a unmarried centre have a look at and with a small pattern length in addition to the sufferers studied have been simplest individuals who have been admitted withinside the sanatorium with acute exacerbations. The actual correlation to the severity of pulmonary high blood pressure with pulmonary characteristic take a look at of sufferers with every COPD sufferers additionally couldn't be done. So, loads of COPD sufferers with slight to slight shape have been now no longer protected which made a bias that better institution established extreme shape of pulmonary high blood pressure.

CONCLUSION

The echocardiographic features of RV dysfunction and PAH may not be otherwise detected by routine investigations. ECHO in addition provides a simple tool to assess right heart function in long standing COPD cases to better prognosticate and manage them. It may be a sort of warning sign for further lifestyle management in such patients. Echocardiographic right heart profile assessment should be an additional tool to detect and prognosticate patients with various degrees of pulmonary hypertension.

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Conflict of Interest

The authors declare no conflict of interest.

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