

STUDY OF ECHOCARDIOGRAPHY OF COPD PATIENTS IN EMERGENCY DEPARTMENT IN TERTIARY CARE HOSPITAL

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Abstract

Background: Echocardiography provides a rapid, non-invasive and accurate modality for evaluating cardiac dysfunction in COPD patients. The objective is to assess the prevalence of systolic and diastolic dysfunction in copd patients. To assess the prevalence and grading of PH in COPD patients. **Materials and Methods:** We studied 80 (eighty) adult patients with COPD. Blood examination included lipid profile, CBC, blood sugar, blood urea, serum creatinine, cxr, ecg, spirometry and echocardiography were carried out to study the severity of COPD and associated cardiac abnormalities. **Result:** Out of 80 COPD patients; 36 (45%) patients had mild COPD, 22 (27.5%) had moderate COPD, 10 (12.5%) had severe COPD, 12 (15%) had very severe COPD respectively. 34 (42.5%) patients revealed pulmonary hypertension. 10 (83.3%) very severe COPD patients demonstrated pulmonary hypertension. 4 (67%) patients with pulmonary hypertension revealed cor pulmonale. **Conclusion:** Abnormal echo findings related to cardiac dysfunction predicted the severity and outcomes in COPD patients.

INTRODUCTION

COPD is a leading cause of death globally and among chronic diseases, it is associated with the worst quality of life.^[1] The Global Initiative for Chronic Obstructive Lung Disease (GOLD) defined the concept of Chronic Obstructive Pulmonary Disease (COPD) as 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 produced by major exposure to harmful particles or fumes. Heart disease is highly prevalent in COPD beyond the rate expected due to common risk factors of smoking, exposure to dust, advanced age and socio-economic deprivation leading to worse health status, increased hospitalization and mortality.^[2]

COPD impacts pulmonary vasculature and leads to the development of pulmonary hypertension (PH), right ventricular hypertrophy (RVH) and right ventricular (RV) and left ventricular (LV) dysfunction. Due to ventricular interdependency, raised right-sided pressure shifts the interventricular septum to the left and may increase LV end-diastolic pressure resulting in left ventricular diastolic dysfunction (LVDD). Subsequently, this mechanism causes decreased LV size, stroke volume and underfilling of left ventricle resulting in LV systolic dysfunction.^[3]

Echocardiography provides a rapid, non-invasive and accurate modality for evaluation of cardiac dysfunction. Hence, an attempt is made to study echocardiography in COPD patients.^[4]

MATERIALS AND METHODS

80 (eighty) adult patients with COPD aged between 35 to 65 visited the Emergency Department of Narayana Medical College Hospital, Nellore, Andhra Pradesh-524002 were studied. The duration of study was from September 2024 to February 2025. The ratio of male and female was 2:1.

Inclusion Criteria

The COPD diagnosed by suggestive symptoms and confirmed by clinical, radiographic and pulmonary function tests (PFT). The patients who gave their consent in writing for the study were selected for the study.

Exclusion Criteria

The patients with an established diagnosis of bronchial asthma, COPD overlap syndrome, pulmonary malignancies (primary or secondary), pulmonary tuberculosis, pneumonia, history of primary coronary disease, hypertension were excluded from the study.

Method: Every selected patient was subjected to routine investigation including complete blood count,

lipid profile, blood sugar, blood urea, serum creatinine, cxr, ecg and electrocardiography.

All the selected patients were investigated by post bronchodilator spirometry test (FEV1/ FVC ratio < 70%) and classified according to GOLD guidelines:

Stage I: Mild COPD: FEV1 > 80% predicted

Stage II: Moderate COPD: 50% < FEV1 < 80% predicted

Stage III: Severe COPD: 30% < FEV1 < 50% predicted and

Stage IV: Very Severe COPD: FEV1 < 30% predicted respectively.

All the patients were subjected to resting two-dimensional transthoracic Doppler echocardiography. The machine used was the VIVID-7 model of the GE healthcare system with a multi-frequency probe with a range of 2-4.3 MHz. Both 2D and M-mode studies were done.

Echocardiography was reviewed to assess the pericardium, valvular anatomy and function, left and right side chamber size and cardiac function. Tricuspid regurgitation flow was identified by color flow Doppler technique and the maximum jet velocity was measured by Continuous Wave (CW) Doppler. Based on the modified Bernoulli equation; right ventricular systolic pressure (RVSP) is equal to sum of trans-tricuspid pressure gradient (TTPG) + right atrial pressure (RAP) [RVSP = TTPG + RAP] and in the absence of right ventricular outflow obstruction; RVSP was considered to be equal to systolic pulmonary artery pressure (sPAP). Therefore, sPAP = RVSP = TTPG + RAP; where $TTPG = 4V^2$ (V = peak velocity of tricuspid regurgitation m/s).

Pulmonary hypertension (PH) was defined in this study as sPAP \geq 30 mmHg. PH classified into mild, moderate and severe category when sPAP is 30–50, 50–70, >70 mmHg respectively. (using Chamla formula, mean pulmonary arterial pressure (mPAP) = $0.61 \times$ PASP + 2 and putting value of 25–35, 35–45, and >45 mmHg of mPAP for mild, moderate, and severe pulmonary hypertension respectively).

Right ventricle dimension was measured by M-Mode echo and right ventricular dilation or cor pulmonale was said to be present when it exceeded the normal range of 0.9–2.6 cm. Right ventricle contractility was also noted and right ventricular systolic dysfunction was said to be present when it was hypokinetic.

Left ventricular function was also assessed by using the following parameters: EF (ejection fraction) = measure of how much end-diastolic value is ejected from LV with each contraction (56%–78%). FS (fractional shortening) = it is a percentage change in LV dimension with each LV contraction (28%–44%).

E/A = diastolic filling of left ventricles usually classified initially on the basis of the peak mitral flow velocity of the early rapid filling wave (E), peak velocity of the late filling wave caused by atrial contraction (A). Left ventricular diastolic

dysfunction (LVDD) is said to be present when E/A is < 1.3

Statistical Analysis: The statistical analysis was carried out using SPSS software. Classification of patients as per severity of COPD, echocardiography findings in COPD, Frequency of PH with severity of COPD patients, frequency of cor pulmonale with severity of pulmonary hypertension, echocardiographic findings according to severity of copd were studied.

RESULTS

[Table 1] Classification of patients according to severity of COPD

- 36 (45%) had mild COPD (FEV1 > 80% predicted).
- 22 (27.50%) had moderate COPD (50% < FEV1 < 80% predicted).
- 10 (12.5%) had severe COPD (30% < FEV1 < 50% predicted).
- 12 (15%) had very severe COPD (FEV1 < 30% predicted).

[Table 2] Echocardiographic findings in COPD – 40 (50%) patients had normal study, 34 (42.5%) patients had pulmonary hypertension (PH), 20 (25%) patients mild PH, 8 (10%) patients had moderate PH, 6 (7.5%) patients had severe PH. 14 (17.5%) patients had RVH, 6 (7.5%) patients had RVSD, 18 (22.5%) patients had LVH, 38 (47.5%) patients had LVDD, 6 (7.5%) patients had LVSD.

[Table 3] Study of frequency of pulmonary hypertension with severity of COPD –

- **Mild COPD:** Out of 36 patients, 6 (16.6%) had PH.
- **Moderate COPD:** Out of 22 patients, 12 (54.5%) had PH.
- **Severe COPD:** Out of 10 patients, 6 (60%) had PH.
- **Very severe COPD:** Out of 12 patients, 10 (83.3%) had PH.

[Table 4] Study of frequency of Cor pulmonale with severity of pulmonary Hypertension (PH)

- **Mild PH:** Out of 20 patients, 2 (10%) had cor pulmonale
- **Moderate PH:** Out of 8 patients, 6 (75%) had cor pulmonale
- **Severe PH:** Out of 6 patients, 4 (67%) had cor pulmonale

[Table 5] Study of Echocardiographic Findings According to Severity of COPD

- **Normal:** 26 mild, 10 moderate, 4 severe, 0 very severe.
- **PH:** 6 mild, 12 moderate, 6 severe, 10 very severe.
- **RVSD:** 1 mild, 2 moderate, 1 severe, 2 very severe.
- **RVH:** 4 mild, 6 moderate, 2 severe, 2 very severe.
- **LVDD:** 12 mild, 8 moderate, 6 severe, 12 very severe.
- **LVH:** 6 mild, 4 moderate, 4 severe, 4 very severe.

- **LVSD:** 2 mild, 0 moderate, 2 severe, 2 very severe.

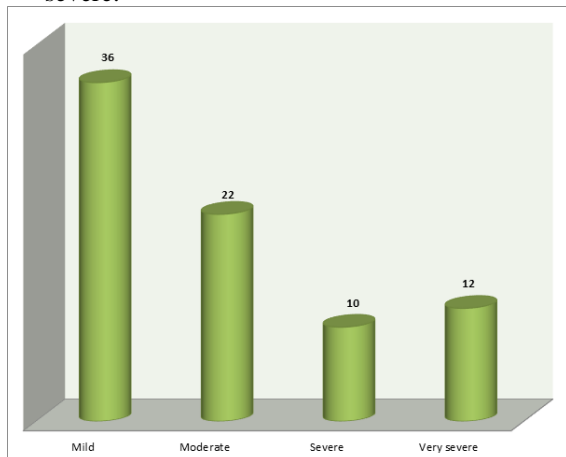


Table 1: Classification of patients according to severity of COPD

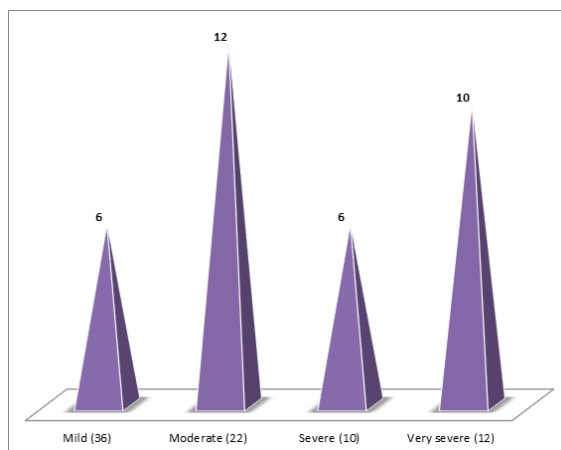


Figure 3: Study of Frequency of PH value with severity of COPD

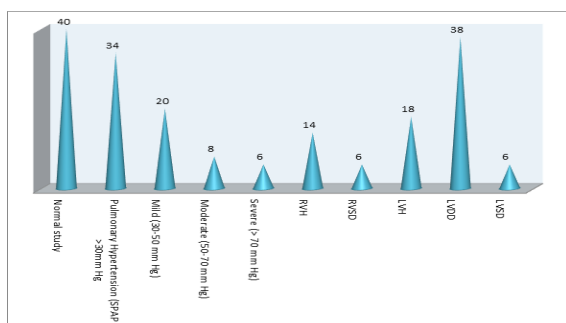


Figure 2: Echocardiographic Finding in COPD patients

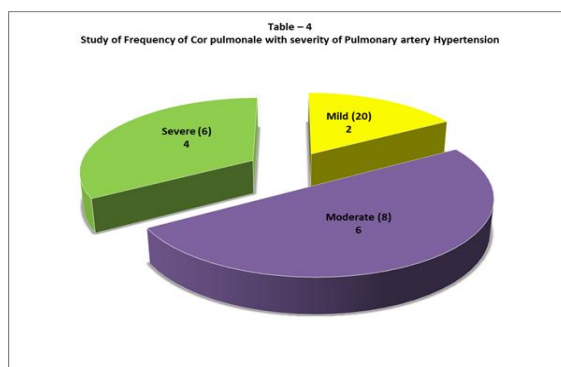


Table - 4
Study of Frequency of Cor pulmonale with severity of Pulmonary artery Hypertension

Table 1: Classification of patients according to severity of COPD.

Severity of COPD	No. of patient (80)	Percentage (%)
Mild (FEV1>80% predicted)	36	45
Moderate (50%<FEV1 < 80% predicted)	22	27.50
Severe (30%<FEV1<50% predicted)	10	12.50
Very severe (FEV1<30%) predicted	12	15

FEV1 = Forced expiratory volume in one second

COPD = chronic obstructive pulmonary disease

Table 2: Echocardiographic Finding in COPD patients

Findings	No. of patient (80)	Percentage (%)
Normal study	40	50
Pulmonary Hypertension (sPAP >30mm Hg)	34	42.50
Mild (30-50 mm Hg)	20	25
Moderate (50-70 mm Hg)	8	10
Severe (> 70 mm Hg)	6	7.50
RVH	14	17.5
RVSD	6	7.5
LVH	18	22.50
LVDD	38	47.50
LVSD	6	7.5

Table 3: Study of Frequency of PH value with severity of COPD

Severity of COPD	Number and Percentage with PH value (Pulmonary Hypertension)
Mild (36)	6 (16.6%)
Moderate (22)	12 (54.5%)
Severe (10)	6 (60%)
Very severe (12)	10 (83.3%)

Table 4: Study of Frequency of Cor pulmonale with severity of Pulmonary Hypertension (PH)

Severity of PH	Frequency of Cor pulmonale
Mild (20)	2 (10%)

Moderate(8)	6 (75%)
Severe (6)	4 (67%)

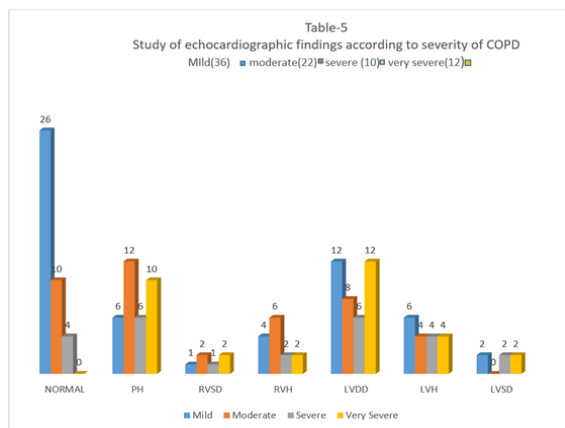
Table 5: Study of Echocardiographic Findings according to severity of COPD

Status of COPD	Mild (36)	Moderate (22)	Severe (10)	Very severe (12)
Normal	26	10	4	0
Pulmonary Hypertension	6	12	6	10
RVSD	1	2	1	2
RVH	4	6	2	2
LVDD	12	8	6	12
LVH	6	4	4	4
LVSD	2	0	2	2

RVSD = Right Ventricular dysfunction LVDD = Left Ventricular diastolic dysfunction

LVH = Left ventricular hypertrophy LVSD = Left ventricular systolic dysfunction

RVH=right ventricular hypertrophy



DISCUSSION

This echocardiographic study of 80 COPD patients aimed to investigate the relationship between COPD severity and echocardiographic abnormalities, particularly pulmonary hypertension (PH) and cor pulmonale.^[5]

The study revealed that PH was present in 34 (42.5%) patients, with a significant increase in frequency with COPD severity (Mild: 16.6%, Moderate: 54.5%, Severe: 60%, Very Severe: 83.3%). This finding is consistent with previous studies, which have shown that PH is a common complication of COPD, particularly in advanced stages.^[6]

Cor pulmonale defined as RVH and/or RVSD. The frequency of cor pulmonale increased with PH severity, with 10% of patients with mild PH, 75% with moderate PH, and 67% with severe PH having cor pulmonale. This suggests that PH is a significant contributor to the development of cor pulmonale in COPD patients.^[7]

Left ventricular dysfunction, including LVDD, LVH, and LVSD was also common in this study population, affecting 62 (77.5%) patients. This finding highlights the importance of evaluating left ventricular function in COPD patients, as comorbid cardiovascular disease is common in this population.^[8]

The results of this study have important implications for the management of COPD patients. Early detection and treatment of PH and cor pulmonale may improve outcomes in these patients. Furthermore, the high prevalence of left ventricular

dysfunction emphasizes the need for comprehensive cardiovascular evaluation and management in COPD patients.

It is also found that LVD is significantly impaired and its magnitude is related to an increase in pulmonary artery pressure in COPD patients. Moreover, patients with low FEV1 (<35% predicted) and hemodynamic instability and hypotension are at risk of developing diastolic dysfunction.^[9]

In conclusion, this study demonstrates a significant relationship between COPD severity and echocardiographic abnormalities, particularly PH and cor pulmonale. These findings highlight the importance of echocardiography in the assessment and management of COPD patients.

In COPD patients, underdiagnosis of cardiac diseases is inevitable because the symptoms of heart disease and COPD overlap; breathlessness caused by heart failure has no unique characteristics and patients with COPD have atypical chest pain during acute coronary syndrome.^[10] It is also hypothesized that unrecognized coronary artery disease (CAD) could contribute to the signs and symptoms of exacerbation of COPD (ECOPD). The undiagnosed CAD compared with LVSD may reflect the multiple routes to impaired heart function in COPD beyond ischemic cardiomyopathy. These include myocardial inflammation and fibrosis and direct impairment of cardiac filling due to the increased intrathoracic pressure that accompanies lung hyperinflation.^[11] Hence every COPD patient must be correlated with cardiac dysfunction and must be treated simultaneously for better prognosis.

CONCLUSION

In the present study of echocardiographic evaluation in COPD patients, there is a high prevalence of pulmonary hypertension, cor pulmonale, and LVD complicating severe COPD. We suggest screening of all COPD patients for cardiac complications. This would contribute to the assessment of prognosis in these patients and assist in identifying individuals likely to suffer with increased mortality and morbidity; hence warranting close monitoring and intense treatment.

Limitation of study: Owing to the tertiary location of the research centre, a small number of patients lack the latest techniques, and we have limited findings and results.

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