



Original Article

Cardiac Involvement in Chronic Obstructive Pulmonary Disease: Findings from a Hospital-Based Observational Study

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ABSTRACT

Background: Chronic obstructive pulmonary disease (COPD) is a leading global cause of morbidity and mortality, especially in low- and middle-income countries. It is characterized by chronic airflow limitation and exacerbations, with cardiac comorbidities significantly affecting disease severity and outcomes. This study aims to evaluate the cardiological manifestations of COPD patients presenting with acute exacerbations in a tertiary care hospital.

Methods: This hospital-based observational study included 145 adults with confirmed COPD presenting with acute exacerbations, in whom demographic details, smoking status, clinical features, chest X-ray findings, electrocardiographic and echocardiographic parameters were assessed.

Results: Most patients were elderly (>60 years, 70.4%), female (58.6%), and from rural areas (78.6%), with smoking exposure in 71.7% and disease duration >10 years in 64.9%. Breathlessness was universal, followed by cough (58.6%). Chest X-ray commonly showed a tubular heart shadow (52.4%) and features of hyperinflation. ECG abnormalities were frequent, particularly first-degree AV block (16.6%) and atrial changes. Echocardiography showed preserved mean ejection fraction ($56.5 \pm 4.1\%$) with predominant right-sided involvement, including dilated RA/RV (40.7%), diastolic dysfunction (46.2%), moderate tricuspid regurgitation (45.5%), and pulmonary hypertension (41.4%).

Conclusion: COPD patients with acute exacerbations frequently have significant cardiac involvement and characteristic radiologic features. Routine echocardiographic assessment and guideline-based management lead to improved clinical outcomes.

Keywords: COPD, acute exacerbation, echocardiography, radiology, pulmonary hypertension, clinical profile.

INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) remains a major cause of morbidity and mortality worldwide, particularly in low- and middle-income countries where exposure to smoking, biomass fuel, and environmental pollutants is widespread [1]. COPD is characterized by persistent airflow limitation that is not fully reversible and represents a major global cause of chronic morbidity and mortality [2]. COPD includes emphysema with alveolar destruction and enlargement, chronic bronchitis with chronic cough and phlegm, and small airway disease marked by narrowed bronchioles [3].

In many resource-limited settings, patients present late in the disease course, often with recurrent exacerbations and underdiagnosed comorbidities. Disease progression is often accelerated by recurrent exacerbations, which are associated with rapid declines in lung function and quality of life [4,5], and from which some patients never fully recover [6]. Cardiovascular disease is a common comorbidity and leading cause of death in COPD [7], reflecting the complex and interconnected pathobiological and clinical relationships between these conditions [8].

The common cardiovascular manifestations of chronic obstructive pulmonary disease include right ventricular dysfunction, pulmonary hypertension, coronary artery disease, and cardiac arrhythmias [9,10]. Although right ventricular dysfunction and pulmonary hypertension are common, increases in mean pulmonary artery pressure are usually mild to moderate [10]. The prevalence of pulmonary hypertension in COPD has been estimated at 20–30% and tends to worsen with increasing severity of airflow obstruction [11,12]. In a large cohort of nearly 400,000 patients, coronary artery disease was significantly more prevalent in individuals with COPD than in matched individuals without COPD. [13]. COPD is also associated with an increased risk of cardiac dysrhythmias, likely related to hypoxemia, acidosis, and reduced FEV₁ [14].

This study aims to characterize the clinical profiles, radiological features, and cardiological manifestations in patients with chronic obstructive pulmonary disease patients admitted with acute exacerbations in a tertiary care hospital.

Materials and Methods

This hospital-based observational study was conducted in the Department of Tuberculosis and Respiratory Diseases at a tertiary care hospital of North Kashmir region of India. Patients diagnosed with COPD according to standard clinical and spirometric criteria were enrolled over the study period. Patients with alternative causes of respiratory symptoms, significant structural heart disease unrelated to COPD, or incomplete clinical data were excluded.

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. A structured proforma was used to record demographic details (age, sex, residence), smoking history (active, passive, ex-smoker, or non-smoker), duration of COPD, and prior hospitalization due to acute exacerbations. Clinical symptoms at presentation—including breathlessness, cough, fever, sputum production, oedema, and other associated complaints—were documented.

Radiological evaluation was done thorough chest X-rays. Cardiological assessment was done through echocardiography and echocardiography by a trained cardiologist. Echocardiographic assessments were performed to evaluate cardiac structure, systolic and diastolic function, valvular abnormalities, and pulmonary artery pressures. Left ventricular ejection fraction was recorded.

Data were compiled and analysed in Microsoft office excel. Continuous variables were expressed as mean \pm standard deviation (SD), while categorical variables were presented as frequencies and percentages.

Results

The study population was predominantly elderly, with 70.4% of patients aged above 60 years. Females constituted a higher proportion (58.6%) than males (41.4%). Most patients were from rural areas (78.6%). Smoking exposure was present in 71.7% of participants, including active (20.0%), ex-smokers (29.7%), and passive smokers (22.1%). The majority had long-standing disease, with 64.9% having COPD for more than 10 years. Recent hospitalization in the past year was reported by 40.0% of patients. Most hospital stays were short, with 62.8% hospitalized for less than 7 days, while only 3.4% required hospitalization for 14 days or more. (Table 1)

Table 1. Sociodemographic and Clinical Characteristics of the Study Population

Characteristics	Number	Percentage
Age		
≤ 40 years	5	3.4%
41- 50 years	15	10.3%
51- 60 years	23	15.9%
61- 70 years	51	35.2%
> 70 years	51	35.2%
Gender		
Male	60	41.4%
Female	85	58.6%
Residence		
Rural	114	78.6%
Urban	31	21.4%
Smoking status		
Active Smoker	29	20.0%
Ex Smoker	43	29.7%
Passive smoker	32	22.1%
Non-Smoker	41	28.3%
Duration of COPD		
< 10 years	38	26.2%
10-14 years	52	35.9%
15-19 years	42	29.0%

≥ 20 years	13	9.0%
Recent Hospitalization in past one year		
Yes	58	40.0%
No	87	60.0%
Duration of hospital stay		
< 7 days	91	62.8%
7-13 days	49	33.8%
≥ 14 days	5	3.4%

Breathlessness was the universal presenting symptom, reported by all patients (100%). Cough was present in 58.6% of cases, followed by fever (18.6%) and sputum production (16.6%). Systemic symptoms such as body ache or weakness were noted in 13.8% of patients. Features suggestive of fluid overload, including generalized body swelling (9.7%) and pedal oedema (4.8%), were less common. Nausea or vomiting was reported by 6.2% of patients, while other symptoms were observed in 11.7%. (Table 2)

Table 2. Distribution of Presenting Symptoms among the COPD patients

Symptoms	Number	Percentage
Breathlessness	145	100.0%
Cough	85	58.6%
Fever	27	18.6%
Sputum	24	16.6%
Bodyache/Weakness	20	13.8%
Generalised body swelling	14	9.7%
Nausea/Vomiting	9	6.2%
Pedal oedema	7	4.8%
Others	17	11.7%

The most common chest X-ray finding was a tubular heart shadow (52.4%), followed by a low, flattened diaphragm (37.9%) and hypertranslucent lung fields (34.5%). Cardiomegaly was observed in 32.4% of patients. Consolidation was seen in 24.1%, and bilateral pleural effusion in 15.9%. Less frequent abnormalities included collapse (9.0%), unilateral pleural effusion (4.8%), and bilateral miliary mottling (3.4%). (Table 3)

Table 3. Chest X-ray Findings in COPD Patients

X-Ray Findings	Number	Percentage
Tubular heart shadow	76	52.4%
Low flat diaphragm	55	37.9%
Hypertranslucent lung field	50	34.5%
Cardiomegaly	47	32.4%
Consolidation	35	24.1%
B/L Plural effusion	23	15.9%
Collapse	13	9.0%
U/L Plural effusion	7	4.8%
B/L miliary mottling pattern	5	3.4%

ECG abnormalities were frequently observed. First-degree atrioventricular block was the most common finding (16.6%), followed by negative P waves in limb leads (11.7%) and P pulmonale (9.7%). Axis deviations were also noted, with left axis deviation in 9.7% and right axis deviation in 8.3% of patients. Pathological Q waves were present in 8.3%. Atrial arrhythmias, including paroxysmal atrial fibrillation (6.2%) and atrial fibrillation (2.8%), along with other conduction abnormalities, were less frequently observed. (Table 4)

Table 4. Electrocardiographic Findings in Study Participants

ECG Findings	Number	Percentage
First degree block	24	16.6%
Negative P wave in limb leads	17	11.7%
P pulmonale	14	9.7%
Left axis deviation	14	9.7%
Right axis deviation	12	8.3%
Pathological Q wave	12	8.3%

Narrow QRS complex	11	7.6%
Paroxysmal atrial fibrillation	9	6.2%
Mobitz type 1 block	6	4.1%
Wide QRS complex	5	3.4%
Atrial fibrillation	4	2.8%
Left anterior hemiblock	3	2.1%
Sinus tachycardia	1	0.7%
Sinus arrhythmia	1	0.7%

Echocardiographic evaluation revealed mean ejection fraction of the study population around $56.5 \pm 4.1\%$, with values ranging from 45% to 65%. The structural abnormalities were dominated by dilated RA/RV (40.7%) and dilated MPA (17.2%), while concentric LVH and RV hypertrophy were each present in 9% of patients. Diastolic dysfunction was common, with Grade 1 in 30.3% and Grade 2 in 15.9%. Valvular abnormalities were mainly tricuspid-related, with moderate TR being the most frequent finding (45.5%), followed by mild MR (24.8%) and moderate MR (16.6%). Pulmonary hypertension was also noted, predominantly moderate PAH (22.8%), with mild and severe PAH observed in 8.3% and 10.3% of cases, respectively. (Table 5)

Table 5. Echocardiographic Findings in the COPD Patients

Echocardiographic findings	Number	Percentage
1. Cardiac Structure		
Concentric LVH	13	9.0%
RV Hypertrophy	13	9.0%
Dilated RA/RV	59	40.7%
Dilated MPA	25	17.2%
2. Diastolic Dysfunction		
Grade 1	44	30.3%
Grade 2	23	15.9%
3. Valvular Findings		
Mild MR	36	24.8%
Moderate MR	24	16.6%
Mild TR	30	20.7%
Moderate TR	66	45.5%
Mild AR	1	0.7%
4. Pulmonary Pressures		
Mild PAH	12	8.3%
Moderate PAH	33	22.8%
Severe PAH	15	10.3%

DISCUSSION

Chronic obstructive pulmonary disease (COPD) is no longer regarded solely as a pulmonary disorder but a systemic endothelial disorder driven by age-related chronic inflammation affecting multiple organ systems. This persistent inflammatory state contributes to multimorbidity and explains the frequent coexistence of cardiovascular diseases in COPD patients [15,16]. Evidence indicates that low-grade inflammation persists during stable disease and intensifies during exacerbations, substantially increasing the risk of arrhythmias, ischemic heart disease, pulmonary hypertension, and heart failure [17,18]. Therefore, improved understanding of COPD–cardiovascular interactions is crucial, as early detection and prevention of cardiac comorbidities can significantly enhance clinical outcomes [19].

In this hospital-based observational study, we evaluated the clinical, radiological, and echocardiographic characteristics of patients presenting with acute exacerbations of COPD. Smoking exposure was identified in nearly three-fourths of patients, including active, ex-, and passive smokers, reaffirming smoking as a principal etiological factor for COPD [21,22]. However, the risk of COPD extends beyond conventional smoking patterns and includes a range of interrelated factors such as household and ambient air pollution, occupational exposures, early-life insults, recurrent infections, and socioeconomic disparities—particularly relevant in low- and middle-income countries [23].

Most patients had a disease duration exceeding 10 years, indicating long-standing COPD. Chronic hypoxia, persistent pulmonary vasoconstriction, and vascular remodeling in such patients predispose them to pulmonary hypertension and secondary cardiac involvement [10,24]. These findings emphasize the importance of longitudinal disease monitoring and integrated cardiopulmonary care.

Radiological abnormalities were common, with tubular heart shadow, hyperinflation changes, and cardiomegaly being the most frequent findings. These reflect chronic lung hyperinflation and secondary cardiac changes commonly observed in long-standing COPD. Consolidation and pleural effusion, although less frequent, may indicate infectious triggers or overlapping cardiac dysfunction.

Electrocardiographic abnormalities were frequently observed, reflecting both electrical conduction disturbances and structural cardiac changes. First-degree atrioventricular block was the most common ECG abnormality, possibly related to chronic hypoxia, electrolyte imbalance, or age-related degeneration of the conduction system. Atrial abnormalities such as negative P waves in limb leads and P pulmonale suggest right atrial enlargement secondary to chronic pulmonary disease [25]. Axis deviations further indicate ventricular remodeling and coexisting cardiac pathology.

Echocardiographic evaluation revealed a substantial burden of cardiac involvement. Right atrial and right ventricular dilatation were the most common structural abnormalities, consistent with findings from previous studies [26,27]. Chronic elevation of pulmonary arterial pressure in COPD leads to right ventricular dilation and hypertrophy, initially preserving stroke volume. However, during acute exacerbations, a sudden increase in right ventricular afterload may precipitate acute cor pulmonale and right heart failure [18,28]. However, the average ejection fraction remained within the normal range, indicating preserved left ventricular systolic function in the majority of patients.

Pulmonary vascular remodelling in COPD increases right ventricular afterload, and even clinically stable patients across all disease severities may harbor subclinical right ventricular dysfunction, highlighting the early and often unrecognized onset of cardiovascular comorbidities [29]. Dilatation of the main pulmonary artery and right ventricular hypertrophy further support the presence of long-standing pulmonary vascular disease [30]. Pulmonary hypertension was observed in 41.4% of patients, with moderate and severe pulmonary arterial hypertension noted in a significant proportion, consistent with prior reports [26,31]. Pulmonary hypertension in COPD is associated with increased exacerbation frequency and reduced survival, despite limited therapeutic options [32].

Additionally, lung hyperinflation and increased pulmonary vascular resistance due to hypoxic vasoconstriction contribute to elevated pulmonary artery pressures, which may impair right ventricular filling and lead to right ventricular diastolic dysfunction [33]. Left ventricular diastolic dysfunction was observed in nearly half of the patients, predominantly Grade 1 and Grade 2, corroborating findings from earlier studies [26,31]. Importantly, left ventricular diastolic dysfunction may occur even in the absence of systolic dysfunction or overt symptoms, yet is associated with heart failure and poorer prognosis [34,35]. Early detection of such dysfunction is therefore critical in the comprehensive management of patients with COPD.

CONCLUSION

COPD patients presenting with acute exacerbations exhibit significant pulmonary and cardiac manifestations. Chest X-ray findings reflect chronic lung changes, while echocardiography demonstrates a high prevalence of pulmonary hypertension and right heart involvement. Routine radiological and echocardiographic evaluation should be considered essential in comprehensive COPD care. Further research with larger sample sizes and longitudinal follow-up is recommended to better understand long-term disease progression and the impact of cardiovascular disease in COPD.

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