RESEARCH ARTICLE

DOI: 10.4274/ijca.2025.73745
Int J Cardiovasc Acad 2025;11(4):179-184

A Study of Clinical Profile, Chest X-ray, ECG Changes, and 2D Echocardiography in Patients with Chronic Cor Pulmonale

Md Zia Ul Haq, Parvaiz Kadloor, Sayed Mohmmed Hussain Bangi

Department of Cardiology, Deccan College of Medical Sciences, Princess Esra Hospital, Hyderabad, India

Abstract

Background and Aim: Chronic obstructive pulmonary disease may result in chronic cor pulmonale, which is defined as right ventricular dilatation and/or hypertrophy resulting from pulmonary hypertension. A non-spesific clinical presentation and limited access to advanced diagnostic tools in resource-constrained settings make early diagnosis challenging. To evaluate the clinical profile and diagnostic findings from chest radiography, electrocardiography (ECG), and two-dimensional echocardiography in patients with clinically confirmed chronic cor pulmonale.

Materials and Methods: A retrospective observational study was conducted at a tertiary care center from October 2016 to September 2018. A total of 50 patients aged 30 to 80 years with clinically diagnosed chronic cor pulmonale were enrolled. Clinical symptoms, radiographic changes, ECG findings, pulmonary function tests (PFTs), and echocardiographic parameters were studied.

Results: The mean age of patients in our study was 51.7 years, with a male predominance (92%). The most common presenting features included breathlessness (100%), productive cough (100%), swelling of the feet (86%), and loss of appetite (92%). Chronic bronchitis with emphysema was the most frequent etiology, accounting for 58% of cases. Chest X-rays revealed chronic bronchitis with emphysema in 58% of patients, increased transverse cardiac diameter in 40% of patients, and a right descending pulmonary artery diameter greater than 16 mm in 62% of patients. ECG findings included right axis deviation (86%), P pulmonale (74%), low-voltage QRS complexes (52%), and arrhythmias (72%). Obstructive patterns were observed in 96% of PFTs. Echocardiography demonstrated dilation of the right ventricle and right atrium in all patients, right ventricular hypertrophy in 84% of patients, pulmonary hypertension in 90% of patients, and tricuspid regurgitation in 90% of patients. Moderate-to-severe pulmonary hypertension was observed in 74% of patients.

Conclusion: In the present study, chronic bronchitis with emphysema was the predominant cause of chronic cor pulmonale among middle-aged males. Multimodal assessment using clinical, radiographic, ECG, and echocardiographic findings enables early diagnosis. Echocardiography serves as a critical tool for evaluating right heart involvement and guiding timely intervention in chronic cor pulmonale.

Keywords: Cor pulmonale, electrocardiography, echocardiography, pulmonary hypertension, right ventricle

INTRODUCTION

Cor pulmonale is characterized by right ventricular hypertrophy (RVH) and/or dilatation resulting from elevated resistance or hypertension in the pulmonary circulation, attributable to conditions that impair lung function and structure.[1,2] The primary etiology of cor pulmonale is chronic obstructive pulmonary disease (COPD), followed by idiopathic pulmonary fibrosis and chronic thromboembolic pulmonary hypertension.[3]

To cite this article: Haq MZU, Kadloor P, Bangi SMH. A study of clinical profile, chest X-ray, ECG changes, and 2D echocardiography in patients with chronic cor pulmonale. Int J Cardiovasc Acad. 2025;11(4):179-184

Address for Correspondence: Prof. Dr. Parvaiz Kadloor, Department of Cardiology, Deccan College of Medical Sciences, Princess Esra Hospital, Hyderabad, India
E-mail: parvaizkadloor@gmail.com
ORCID ID: orcid.org/0009-0000-5151-9417

Received: 10.07.2025
Accepted: 12.11.2025
Publication Date: 12.12.2025

These disorders typically cause persistent hypoxemia and/or remodeling of the pulmonary circulation, necessitating that the right ventricle (RV) adapt to the increased mechanical load required to pump blood through the lungs.[3] Echocardiography is the primary non-invasive technique for the diagnosis and monitoring of cor pulmonale.[4,5]

However, structural and functional adaptation of the RV in cor pulmonale is often detected late in clinical practice due to its subtle and progressive nature.[6] Right heart dysfunction is often underdiagnosed until the disease reaches an advanced stage because early symptoms, such as exertional dyspnea or fatigue, are commonly mistaken for primary pulmonary disease.[3] Irrespective of left ventricular function or pulmonary parameters, right heart impairment is known to predict adverse outcomes in patients with chronic lung disease.[5,7] Furthermore, cor pulmonale in COPD has been linked to higher hospitalization rates and an increased healthcare burden, particularly in low- and middle-income countries. In addition to echocardiography, chest radiography and electrocardiography (ECG) continue to play an essential role in the initial diagnosis, particularly in resource-limited settings.[7,8] Chest X-rays can reveal features such as cardiomegaly, enlarged pulmonary arteries, and hyperinflated lungs, while ECG may detect right axis deviation (RAD), P pulmonale, and RVH all of which are important indirect indicators of cor pulmonale. A comprehensive understanding of these diagnostic modalities and of their correlations with clinical features is crucial for early recognition, timely intervention, and long-term management of patients with chronic respiratory illnesses. Given the high incidence of COPD and the prognostic importance of RV dysfunction, cor pulmonale is a critical clinical entity associated with significant morbidity and mortality. This study was designed to evaluate the clinical and diagnostic profiles of patients with clinically confirmed chronic cor pulmonale and to assess the characteristic findings on chest radiography, ECG, and two-dimensional (2D) echocardiography.

METHODS

Study Design and Population

This was a retrospective observational study conducted at a tertiary care center between October 2016 and September 2018. Inclusion criteria were adult patients aged 30 to 80 years who presented with clinical features suggestive of chronic cor pulmonale, with the diagnosis subsequently confirmed by chest X-ray, ECG, and 2D transthoracic echocardiography.

Exclusion criteria include patients with a primary diagnosis of bronchial asthma; interstitial lung disease; known left ventricular systolic dysfunction (e.g., ischemic heart disease); poorly controlled hypertension; significant valvular heart disease; congenital heart disease; and poor echogenic windows that precluded echocardiographic examination.

Data Collection and Methodology

Every patient who was enrolled received comprehensive clinical evaluations, including a detailed medical history and a physical examination for signs of right heart failure. Posteroanterior chest X-rays were used to measure transverse heart diameter, right descending pulmonary artery diameter, prominence of the pulmonary conus, and pulmonary artery dilatation. Pulmonary function tests (PFTs) were performed using a computerized spirometer. This was done to detect obstructive lung diseases. Based on PFTs, patients were classified as having restrictive, obstructive, or mixed ventilatory abnormalities. To identify cor pulmonale characteristics such "P" pulmonale, RAD, RVH, and right bundle branch block (RBBB), an ECG was conducted. To evaluate right ventricular dilatation, pulmonary hypertension, and tricuspid regurgitation (TR), 2D echocardiography was performed using a 3.5 MHz transducer, primarily in the parasternal long-axis view. All clinical, radiological, and echocardiographic data were recorded on a standardized pro forma and compiled into a master chart for analysis. RVH is defined as the thickening of the right ventricular wall that develops in response to increased afterload due to pulmonary hypertension, and it may serve as an early indicator of disease. A wall thickness greater than 5 mm is considered abnormal. RA dilation is the enlargement of the right atrium, the heart's upper chamber that receives deoxygenated blood from the body.

Statistical Analysis

SPSS software (version 20, SPSS, Inc., Chicago, IL, USA) was used to analyze the data. The mean and standard deviation were used to characterize continuous variables, whereas frequency counts and percentages were used to characterize categorical variables.

Ethical Statement

This research was authorized by the Institutional Human Ethics Committee of MNR Medical College & Hospital (decision number: ECR/834/1/TG/2016, date: 26.11.2016). All patients provided written informed consent, and the study was approved by the institutional ethics committee.

RESULTS

The study included 50 patients with a diagnosis of chronic cor pulmonale. The mean age of the patients in the study was 51.7 years; 92% were male, indicating a significant male predominance. Nearly half of the patients (48%) had been symptomatic for between two and five years. All patients

presented with cough with expectoration and with exertional breathlessness. Constitutional symptoms were also prevalent, with loss of appetite reported in 92% of patients, swelling of the feet in 86%, and abdominal pain in 82%. Demographic and clinical characteristics (n=50) are presented in Table 1.

On general physical examination, pedal edema, cyanosis, and digital clubbing were observed in 86%, 64%, and 20% of patients, respectively. All patients (100%) had respiratory signs, including tachypnea, reduced chest expansion, rhonchi, and crepitations. Cardiovascular examination findings included a loud second pulmonary heart sound (P2) in 96% of patients, a left parasternal heave in 74%, and raised jugular venous pressure (JVP) in 72%. General physical, respiratory, and cardiovascular examinations (n=50) are presented in Table 2.

Chronic bronchitis with emphysema was the most frequent underlying etiology, identified in 58% of the study population. In 58% of patients, chest radiography showed characteristics suggestive of emphysema and chronic bronchitis. A total of 62% of patients had a right descending pulmonary artery diameter greater than 16 mm, and 40% had cardiomegaly with an enlarged transverse cardiac diameter. ECG findings in patients showed a high prevalence of right heart strain patterns, with P pulmonale present in 74%, RAD in 86%, low-voltage QRS complexes in 52%, and cardiac arrhythmias in 72%. PFTs reported obstructive pulmonary function in 96% of patients. Etiological factors, radiographic and ECG findings, and PFTs in the study population (n=50) are shown in Table 3.

Table 1: Demographic and clinical characteristics (n=50)

Parameters	n (%)
Age distribution	
30-39 years	8 (16%)
40-49 years	11 (22%)
50-59 years	21 (42%)
60-69 years	7 (14%)
70-79 years	3 (6%)
Mean age	51.7 years
Gender	
Male	46 (92%)
Female	4 (8%)
Duration of illness	
≤1 year	1 (2%)
2-5 years	24 (48%)
6-10 years	15 (30%)
11-20 years	8 (16%)
≥21 years	2 (4%)
Presenting symptoms	
Cough with expectoration	50 (100%)
Breathlessness	50 (100%)
Swelling of feet	43 (86%)
Loss of appetite	46 (92%)
Pain abdomen	41 (82%)
Fever	15 (30%)
Hemoptysis	10 (20%)
Palpitation	9 (18%)
Chest pain	5 (10%)

Table 2: General physical, respiratory and cardiovascular examinations (n=50)

Parameters	n (%)
General physical examination	
Cyanosis	32 (64%)
Clubbing	10 (20%)
Pedal edema	43 (86%)
Respiratory signs	
Tachypnoea	50 (100%)
Barrel-shaped chest	36 (72%)
Decreased chest expansion	50 (100%)
Decreased breath sounds	38 (76%)
Rhonchi	50 (100%)
Crepitations	50 (100%)
Cardiovascular signs	
Raised jugular venous pressure	36 (72%)
Left parasternal heave	37 (74%)
Dullness in left 2nd intercostal space	31 (62%)
Loud second pulmonary heart sound (loud P2)	48 (96%)
Tricuspid regurgitation	24 (48%)

All patients had RVH and right atrial (RA) dilatation on echocardiography. Pulmonary hypertension was detected in 90% of the patients; severity was moderate in 32% and severe in 42%. TR was also noted in 90% of patients: 40% had mild TR, 20% had moderate TR, and 30% had severe TR. The right ventricular internal diameter at end-diastole (RVIDED) ranged from 3.4 to 3.8 cm in 50% of patients. Echocardiographic findings (n=50) are presented in Table 4.

DISCUSSION

By offering valuable insights into the clinical presentation and diagnostic features of the syndrome, as observed in a resource-limited tertiary care setting, the current study emphasizes the burden of chronic cor pulmonale among patients with chronic pulmonary disease. In our cohort of 50 patients diagnosed with chronic cor pulmonale, the mean age was 51.7 years, and there was a pronounced male predominance (92%). This aligns with the findings of Goswami et al.[6] who reported a mean age of 54.87±13.76 years and a male predominance of 61%, which highlights the greater vulnerability of males, possibly due

Table 3: Etiological factors, radiographic findings, electrocardiographic findings, and pulmonary function test in the study population (n=50)

Parameters	n (%)
Etiology	
Chronic bronchitis with emphysema	29 (58%)
Bronchial asthma	7 (14%)
Bronchiectasis	5 (10%)
Old pulmonary tuberculosis	7 (14%)
Kyphoscoliosis	2 (4%)
Chest X-ray findings	
Chronic bronchitis with emphysema	29 (58%)
Enlarged transverse cardiac diameter	20 (40%)
Prominent pulmonary conus	17 (34%)
Right descending pulmonary artery >16 mm	31 (62%)
Bronchiectasis	5 (10%)
Old pulmonary tuberculosis	7 (14%)
Kyphoscoliosis	2 (4%)
Electrocardiographic findings	
P pulmonale	37 (74%)
RAD	43 (86%)
RVH	21 (42%)
RBBB	1 (2%)
Low-voltage complexes	26 (52%)
Arrhythmias	36 (72%)
Pulmonary function tests	
Obstructive	48 (96%)
Restrictive	2 (4%)

RAD: Right axis deviation, RVH: Right ventricular hypertrophy, RBBB: Right bundle branch block

Table 4: Echocardiographic findings (n=50)

Parameters	n (%)
Echocardiographic findings	
Right ventricular enlargement	50 (100%)
Dilated right atrium	50 (100%)
Right ventricular hypertrophy	42 (84%)
Right ventricular systolic dysfunction	36 (72%)
Pulmonary hypertension	45 (90%)
Tricuspid regurgitation	45 (90%)
Right ventricular internal diameter in end-diastole	
2.3-2.8 cm	0 (0%)
2.9-3.3 cm	6 (12%)
3.4-3.8 cm	25 (50%)
>3.8 cm	19 (38%)
Pulmonary arterial hypertension	
Mild (30-50 mmHg)	8 (16%)
Moderate (50-70 mmHg)	16 (32%)
Severe (>70 mmHg)	21 (42%)
Severity of tricuspid regurgitation	
Mild	20 (40%)
Moderate	10 (20%)
Severe	15 (30%)
Absent	5 (10%)

to higher smoking rates and occupational exposures in this demographic group. The majority of our patients had a history of chronic illness spanning 2-10 years, reflecting the insidious progression of underlying pulmonary disease before the development of cardiac complications. Clinical manifestations were dominated by productive cough (100%), breathlessness (100%), peripheral edema (86%), and loss of appetite (92%). These are classical features of right-sided heart failure secondary to chronic hypoxic pulmonary disease. A previous study by Divya et al.[9] also noted similar symptoms: 100% of their patients presented with productive cough and pedal edema, though their reported frequency of loss of appetite was lower, at 30%.

Physical signs such as cyanosis (64%) and cardiovascular signs such as elevated JVP (72%) were predominant in our study. A previous study by Divya et al.[9] reported cyanosis in 39% of patients and raised JVP in 75% of patients. A loud pulmonary component of the second heart sound (P2), present in 96% of our cohort, is a well-established indicator of pulmonary hypertension and right ventricular strain, as documented in prior studies.[6,9,10]

In our analysis, chronic bronchitis with emphysema accounted for 58% of cases, with bronchial asthma, old pulmonary tuberculosis, and bronchiectasis followed closely. Goswami et al.[6] reported a slightly higher rate of chronic bronchitis/emphysema (75%) and post-tuberculosis or bronchiectatic disease in approximately 20% of patients. Radiographic results from our study showed that 58% of patients had emphysematous changes, 40% had an increased transverse heart diameter, and 62% had a right descending pulmonary artery larger than 16 mm. These are consistent with chronic pulmonary vascular remodeling and right heart strain. Consistent with our findings, Jatav et al.[10] reported radiological findings, including emphysema in 72% of patients, cardiomegaly in 20% of patients, and a prominent right descending pulmonary artery in 30% of patients, supporting the high diagnostic yield of chest radiographs in cor pulmonale when interpreted alongside clinical findings.

In this study, ECG analysis showed P pulmonale in 74% patients, RAD in 86%, low-voltage complexes in 52%, and arrhythmias in 72% of patients. A similar study by Goswami et al.[6] reported

P pulmonale in 80% of patients, RAD in 81.25% of patients, low-voltage complexes in 27.5% of patients, and arrhythmias in 5% of patients. Compared with Goswami et al.[6] who noted a lower prevalence of arrhythmias (5%), our findings suggest a higher burden of electrical instability, possibly reflecting more advanced disease at presentation. The relatively low-incidence of RVH and RBBB in our cohort may reflect under-detection due to ECG's limited sensitivity for right-sided structural changes. In our patients, 96% displayed an obstructive pattern on spirometry. In line with our findings, Goswami et al.[6] reported an obstructive pattern on spirometry in 92.5% of patients.

In our study, echocardiography revealed RA and RV dilation in 100% of patients, RVH in 84% of patients, and pulmonary hypertension in 90% of patients. In contrast, Jatav et al.[10] observed RA/RV dilation in only 43% of patients and RVH in 42% of patients. Higher detection rates in our study may be due to improved imaging protocols or more advanced disease. The RVIDED exceeded 3.4 cm in 88% of patients, reinforcing the widespread impact of chronic pulmonary pressure overload. Similarly, Goswami et al.[6] reported ≥3.4 cm RVIDED in 73.75% of patients. Most of our patients (74%) had moderate-to-severe pulmonary arterial hypertension. Our finding was consistent with that of Jatav et al.[10] who reported moderate-to-severe pulmonary arterial hypertension in 77.5% of patients, reiterating the central role of pulmonary hypertension in the pathophysiology and clinical course of cor pulmonale.

Overall, our findings corroborate and expand upon existing literature, reinforcing the diagnostic importance of integrating clinical evaluation with radiographic, ECG, and echocardiographic assessments. Early recognition of cor pulmonale in patients with chronic respiratory disease, especially COPD, remains essential, as timely initiation of pulmonary vasodilators, oxygen therapy, and lifestyle modifications can improve functional capacity and outcomes. To improve the prognosis and treatment of patients with chronic cor pulmonale, future research should concentrate on integrating longitudinal follow-up and RV function metrics, including tricuspid annular plane systolic excursion and RV strain.

Study Limitations

This study has certain limitations. Because this was a retrospective, single-center study, its findings may not be generalizable to the broader population. Additionally, the lack of invasive hemodynamic confirmation and the absence of longitudinal follow-up restrict the evaluation of disease progression and therapeutic outcomes. Prospective, multicenter studies with serial echocardiographic assessments and long-term follow-up are warranted.

CONCLUSION

The findings of this study indicate that the most frequent underlying cause of chronic cor pulmonale is chronic bronchitis with emphysema, predominantly affecting males older than 40 years. Common clinical manifestations observed included breathlessness, productive cough, swelling of the feet, and signs of right-sided heart failure. Radiographic and ECG findings, such as emphysematous changes, cardiomegaly, P pulmonale, and RAD, were consistent across cases. Echocardiography reliably demonstrated RA and RV dilatation, pulmonary hypertension, and TR. For individuals with chronic respiratory diseases, our results highlight the value of early, multimodal examination, particularly echocardiography, for prompt diagnosis and treatment of chronic cor pulmonale.

Ethics

Ethics Committee Approval: This research was authorized by the Institutional Human Ethics Committee of MNR Medical College & Hospital (decision number: ECR/834/1/TG/2016, date: 26.11.2016).

Informed Consent: All patients provided written informed consent.

Footnotes

Authorship Contributions

Surgical and Medical Practices: M.Z.U.H., P.K., S.M.H.B. Concept: P.K., S.M.H.B., Design: M.Z.U.H., P.K., Data Collection or Processing: M.Z.U.H., P.K., Analysis or Interpretation: M.Z.U.H., P.K., S.M.H.B., Literature Search: M.Z.U.H., P.K., Writing: M.Z.U.H., P.K.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study received no financial support.

REFERENCES

1. Patil S, Patil S. Echocardiographic findings in patients with chronic obstructive pulmonary disease. IJRMS. 2019;7:934-7.
2. Sakao S. Chronic obstructive pulmonary disease and the early stage of cor pulmonale: a perspective in treatment with pulmonary arterial hypertension-approved drugs. Respir Investig. 2019;57:325-9.
3. Mandoli GE, Sciaccaluga C, Bandera F, Cameli P, Esposito R, D'Andrea A, *et al.* Cor pulmonale: the role of traditional and advanced echocardiography in the acute and chronic settings. Heart Fail Rev. 2021;26:263-75.
4. Elnoamany M, Khalil T, Soltan G, Fahim N, Omran M. Assessment of right ventricular function in patients with cor pulmonale: strain imaging study. Cardiology and Cardiovascular Research. 2021;5:147-52.
5. Yogeswaran A, Kuhnert S, Gall H, Faber M, Krauss E, Rako ZA, *et al.* Relevance of cor pulmonale in COPD with and without pulmonary hypertension: a retrospective cohort study. Front Cardiovasc Med. 2022;9:826369.

6. Goswami D, Sharma T, Bharadwaj R, Ahmed AB. Clinical profile, electrocardiographic, radiological and echocardiographic changes in chronic cor pulmonale. Int J Med Res Prof. 2017;3:217-24.

7. Boissier F, Katsahian S, Razazi K, Thille AW, Roche-Campo F, Leon R, *et al.* Prevalence and prognosis of cor pulmonale during protective ventilation for acute respiratory distress syndrome. Intensive Care Med. 2013;39:1725-33.

8. Zhang L, Liu Y, Zhao S, Wang Z, Zhang M, Zhang S, *et al.* The incidence and prevalence of pulmonary hypertension in the COPD population: a systematic review and meta-analysis. Int J Chron Obstruct Pulmon Dis. 2022;17:1365-79.

9. Divya M, Mathangi K, Chakravarthi K, Pradeepika MM, Kumar KR. A study on clinical manifestations, radiological features, electrocardiographic and echocardiographic changes in various lung diseases associated with corpulmonale in patients attending Government General Hospital, Kakinada. IP Indian J Immunol Respir Med. 2020;5:110-4.

10. Jatav VS, Meena S, Jelia S, Jain P, Ajmera D, Agarwal V, *et al.* Echocardiographic findings in chronic obstructive pulmonary disease and correlation of right ventricular dysfunction with disease severity. Int J Adv Med. 2017;4:476-80.