Section: Respiratory Medicine

Original Research Article

CORRELATION OF CLINICAL, RADIOLOGICAL FEATURES AND ECG WITH ECHOCARDIOGRAPHY IN CLINICALLY DIAGNOSED CHRONIC CORPULMONALE

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ABSTRACT

Background: Cor pulmonale is a major complication of chronic respiratory diseases such as chronic obstructive pulmonary disease (COPD) and interstitial lung disease (ILD). Early diagnosis is important to reduce morbidity and mortality. Echocardiography is considered a useful non-invasive modality for early detection of cor pulmonale. The objective is to compare clinical, radiological, and electrocardiographic findings with echocardiographic findings in patients with clinically suspected chronic cor pulmonale.

Materials and Methods: This hospital-based observational study was conducted at MNR Medical College and Hospital over 18 months. Fifty patients with clinically suspected chronic cor pulmonale secondary to respiratory disease were included. Detailed clinical examination, chest radiography, ECG, spirometry, and 2D echocardiography were performed in all patients.

Results: Among the 50 patients, 40 (80%) had COPD and 10 (20%) had ILD. The mean age was 56 years. Male predominance was noted among COPD patients, whereas females were more commonly affected in ILD. Among COPD patients, 45% had mild airflow limitation, 30% had moderate disease, and 25% had severe disease, indicating that cor pulmonale may occur even in mild COPD. Radiological features suggestive of pulmonary hypertension were more common in advanced disease. ECG findings suggestive of cor pulmonale were observed in 28% of mild COPD patients and in all patients with moderate and severe disease. Echocardiographic evidence of cor pulmonale was identified in 61% of mild COPD patients and in all moderate and severe cases. Similar findings were observed in ILD patients. Echocardiography detected significantly more cases compared with clinical, radiological, and ECG evaluation.

Conclusion: Echocardiography is a sensitive, reliable, and non-invasive tool for early diagnosis of cor pulmonale and is superior to clinical examination, chest radiography, and ECG in detecting early disease.

Keywords: Cor Pulmonale; Chronic Obstructive Pulmonary Disease; Interstitial Lung Disease; Echocardiography; Electrocardiography; Pulmonary Hypertension; Chronic Respiratory Disease; Right Ventricular Dysfunction.

INTRODUCTION

Cor pulmonale can be defined as alteration in structure and function of right ventricle resulting from diseases affecting the structure and/or function of the lungs. Pulmonary hypertension is often the link between lung dysfunction and heart in cor pulmonale. In chronic respiratory diseases pulmonary

hypertension results from increased pulmonary vascular resistance. Majority of cor pulmonale patients have copd as underlying cause.[1] Even though ECG, chest Xray supports the diagnosis, 2DECHO is commonly used as non invasive affordable investigation for accurate diagnosis of corpulmonale. 2DECHO is used to assess the presence of right ventricular hypertrophy and/or dilatation and pulmonary hypertension and prognostic outcomes in various conditions of corpulmonale.[2] DE is able to assess hemodynamics only indirectly, but with good correlation to invasive measurements in experienced hands. Indeed, the echocardiographic exam could help the clinician to identify the patients that could benefit from a particular treatment and most importantly could attest the success of the adopted therapeutic strategy.

MATERIALS AND METHODS

The cases analyzed in this study were patients who have come to the department of pulmonary medicine. MNR medical college and hospital, sangareddy, over a period starting from December 2019 to September 2021.

After recording the presenting complaints, specific history regarding coronary heart disease, congenital heart diseases, heart failure, active tuberculosis and vascular diseases is obtained.

A complete general physical examination is done. Patients with signs and symptoms of cor pulmonale with underlying lung disease whose diagnosis has been established and are willing to be checked are included in the study.

The clinical presentation, Radiological examination, PFT electrocardiographic and echocardiograph changes noticed among the patients is noted. After noting the findings from the study population observations and results are drawn.

Clinical features suggestive of corpulmonale include raised JVP, loud P2, third heart sound on auscultation, pedal edema, hepatomegaly, pansystolic murmur. Radiologic findings suggestive of cor pulmonale include prominent pulmonary conus, cardiomegaly and prominent right heart border.electrocardiographic changes include right axis deviation, p pulmonale, R/S in V1>1, R/S in V6<1, RBBB and S1Q3T3. Echocardiograpgic features suggestive focorpulmonale include right atrial and ventricular dilation, tricuspid regurgitation and elevated right ventricular systolic pressures.

Sampling Method:

Sample size calculation done by using formula

N= Z2(1-α/2)p(1-p)/d2

Formula values:

Z(1-α/2)= standard normal variant=1.96 at 95 % Confidence Interval

P= expected prevalence of study condition in given population based on previous) Q = 1-p

d=Absolute precision or Relative precision

Applying it in the formula,

Z2(1-α/2)= (1.96)2 = 3.841 (normal deviate for 95% confidence limits)

p= 68% (the prevalence of chronic corpulmonale in copd)

d = 15% (absolute precision)

Substituting these values in above mentioned formula;

Sample Size (n) = 3.841 x 0.68 x (1-0.68) / 0.15×0.15 == 3.841 x 0.68x 0.32 / 0.0225

= 37.146 (minimal sample size)

Sample Size: 50 (higher than minimum sample size)(Sayami et al.[3])

Inclusion Criteria : Patients of age group 40 to 80 yrs patients were included in the study with chronic corpulmonale of both the genders as cases. General physical examination suggesting signs of Right ventricular failure.

Exclusion Criteria : LV dysfunction, Known coronary artery disease, Valvular and congenital heart disease, Active pulmonary TB, Primary pulmonary hypertension, Biventricular heart failure and Vascular diseases.

RESULTS

A total of 50 patients with clinical features suggestive of cor pulmonale were included in the present study. Among them, 40 patients (80%) had underlying chronic obstructive pulmonary disease (COPD), while 10 patients (20%) had interstitial lung disease (ILD). Among the COPD patients, 18 (45%) had mild COPD, 12 (30%) had moderate COPD, and 10 (25%) had severe COPD according to GOLD severity criteria. Among the ILD patients, 7 (70%) had early ILD changes and 3 (30%) had advanced ILD changes based on HRCT and spirometric findings.

Table 1: Age-wise Distribution of Study Population

Age Group (Years)	Mild COPD	Moderate COPD	Severe COPD	Early ILD	Late ILD
41–50	2	1	0	1	0
51–60	7	3	7	3	1
61–70	6	7	2	3	1
71–80	3	1	1	0	1
Gender					
Male	16	9	8	3	1
Female	2	3	2	4	2

The majority of patients belonged to the 51–60 years age group (42%), followed by the 61–70 years age group (38%). Patients aged 71–80 years constituted 12% of the study population, while only 8% were

between 41–50 years of age. Mild COPD was predominantly observed in the 51–60 years age group, whereas moderate COPD was more common among patients aged 61–70 years. Severe COPD and late ILD were more frequently seen in older individuals.

Among the 50 patients, 37 (74%) were males and 13 (26%) were females, with a male-to-female ratio of 2.8:1. COPD was more common among males, whereas females constituted a relatively higher proportion among ILD patients.

Table 2: Severity of Illness

Severity of Illness	Male	Female	Total
Mild COPD	16	2	18
Moderate COPD	9	3	12
Severe COPD	8	2	10
Early ILD	3	4	7
Late ILD	1	2	3

Among COPD patients, mild COPD constituted the largest subgroup (45%), followed by moderate COPD (30%) and severe COPD (25%). In ILD patients, early ILD changes were more frequently encountered than advanced disease.

Table 3: Clinical Signs

Signs	Mild COPD	Moderate COPD	Severe COPD	Early ILD	Late ILD
Tachypnea	2	2	10	2	3
Cyanosis	0	1	2	0	1
Clubbing	0	1	8	0	3
Pedal Edema	0	2	9	0	3

Tachypnea was the most common clinical sign observed, present in 19 patients (38%). Clubbing was observed in 12 patients (24%), mainly among severe COPD and late ILD cases. Cyanosis and pedal edema were more frequently associated with severe disease.

Table 4: Systemic Examination Findings in COPD

Systemic Examination Findings	Mild COPD (18)	Moderate COPD (12)	Severe COPD (10)	Early ILD	Late ILD
Raised JVP	2	9	8	2	3
Loud P2	1	7	8	2	3
S3	0	2	4	0	2
Pansystolic Murmur	0	0	2	0	0
Rhonchi	16	12	10	0	0
Crepitations	4	8	10	6	3
Hepatomegaly	1	5	8	1	1

Among COPD patients, rhonchi was the most common finding, observed in 38 patients (95%), followed by crepitations in 22 patients (55%). Raised jugular venous pressure (JVP), loud pulmonary component of second heart sound (P2), and hepatomegaly were increasingly observed with disease severity.

Crepitations were the predominant finding among ILD patients, seen in 90% of cases. Raised JVP and loud P2 were each present in 50% of ILD patients. Features suggestive of right heart failure such as hepatomegaly and S3 were more common in advanced ILD.

Table 5: Radiological Findings in COPD

Radiological Findings	Mild COPD	Moderate COPD	Severe COPD	Early ILD	Late ILD
Emphysema	12	8	4	0	0
Cardiomegaly	3	2	10	0	3
Prominent Pulmonary Conus	4	2	10	2	3
Increased Bronchovascular Markings	4	1	6	2	3

Emphysematous changes were the most frequent radiological finding in COPD patients, present in 60% of cases. Prominent pulmonary conus and cardiomegaly were more common among patients with severe COPD.

Increased reticular markings and prominent pulmonary conus were the most common radiological findings among ILD patients, each seen in 50% of cases. Cardiomegaly was observed predominantly in advanced ILD.

Table 6: Electrocardiographic Changes

ECG Findings	Mild COPD	Moderate COPD	Severe COPD	Early ILD	Late ILD
P-pulmonale	0	3	10	1	3

R/S in V1 >1	0	3	10	0	3
R/S in V6 <1	0	2	10	0	3
Right Axis Deviation	3	3	10	1	3
RBBB	2	1	6	0	2
S1S2S3 / S1Q3T3	0	1	3	0	1
RAD	13	12	10	4	3
RVD	12	12	10	4	3
RVSD	1	7	9	0	2
Mild TR	4	8	0	2	0
Moderate TR	1	4	6	0	3
Severe TR	0	0	4	0	0
Mild RVSP	11	7	0	5	0
Moderate RVSP	0	5	5	0	3
Severe RVSP	0	0	5	0	0

Right axis deviation (RAD) was the most common ECG abnormality, observed in 20 patients (40%). P-pulmonale was noted in 17 patients (34%), while R/S ratio abnormalities in V1 and V6 were observed in 30% of patients each. ECG abnormalities were more pronounced among severe COPD and late ILD patients.

Echocardiography revealed right atrial dilatation (RAD) in 84% and right ventricular dilatation (RVD) in 82% of patients. Tricuspid regurgitation (TR) was present in 64% of patients, while elevated right ventricular systolic pressure (RVSP) was noted in 82% of cases. Severe TR and severe RVSP were predominantly associated with severe COPD.

Table 7: Comparison of Clinical Features with 2D Echo Findings

Clinical Features in patients	Identified patients	2D Echo	P-value
COPD	11	34	0.01
ILD	3	10	
Radiological Findings in patients			
COPD	16	34	0.038
ILD	3	10	
ECG Findings			
COPD	17	34	0.04
ILD	4	10	

2D echocardiography detected a significantly higher number of cor pulmonale cases compared to clinical examination, radiological findings, and ECG changes in both COPD and ILD patients. Cor pulmonale was identified by 2D echo in 34 COPD patients and all 10 ILD patients, whereas clinical features, radiological findings, and ECG changes detected fewer cases. The differences were statistically significant with p-values of 0.01, 0.038, and 0.04 respectively, indicating that 2D echocardiography is a more sensitive modality for the detection of cor pulmonale.

DISCUSSION

Cor pulmonale is characterized by structural and functional alterations of the right ventricle secondary to diseases affecting the lungs and pulmonary vasculature. COPD remains the leading cause of chronic cor pulmonale worldwide, accounting for nearly 80–90% of cases, while ILD represents another important cause associated with pulmonary hypertension and right ventricular dysfunction.

In the present study, COPD was the predominant underlying respiratory disease, accounting for 80% of cases, whereas ILD contributed to 20% of cases. Similar observations were reported by Chaouat A,[4] who demonstrated that COPD is the most frequent etiology associated with chronic cor pulmonale.

The majority of patients in the present study belonged to the 51–60 years age group, with a mean age of approximately 56 years. This finding is comparable to the observations made by Jatav VS,[5] who also reported a higher prevalence of cor pulmonale among middle-aged and elderly individuals due to the chronic progressive nature of COPD and ILD.

A marked male predominance was observed among COPD patients in the present study. Similar male predominance has been reported by Agustí A,[6] in studies evaluating COPD epidemiology, which attributed the higher prevalence among males to smoking habits and occupational exposure. However, among ILD patients in the present study, females constituted a greater proportion. This finding correlates with studies by Raghu G,[7] who demonstrated increased prevalence of autoimmune-related ILDs among women.

In the present study, 45% of COPD patients with cor pulmonale had mild airflow limitation, while 30% and 25% had moderate and severe COPD respectively. Similar observations were made by Chaouat A and Thabut G,[4,8] who reported that pulmonary hypertension and cor pulmonale can occur even in patients with mild COPD due to pulmonary vascular remodeling and endothelial dysfunction.

Among ILD patients in the present study, 70% had early ILD changes. Similar findings were observed by Nathan SD,[9] who demonstrated that pulmonary hypertension may develop early in connective tissue disease-associated ILD and advanced idiopathic pulmonary fibrosis.

Tachypnea was the most common clinical sign in the present study, followed by clubbing, pedal edema, and cyanosis. Raised JVP and loud P2 were frequently observed in advanced disease. Comparable findings were reported by Suma KR,[10] who identified tachypnea and signs of right heart strain as common manifestations of chronic cor pulmonale.

Radiological evaluation in the present study showed emphysematous changes and prominent pulmonary conus as the commonest findings among COPD patients, whereas reticular opacities predominated in ILD patients. Similar radiographic findings were reported by Gupta NK et al,[11] in their studies evaluating chest radiographic abnormalities in cor pulmonale.

Right axis deviation (RAD) was the most frequent ECG abnormality in the present study, followed by P-pulmonale and RBBB. Similar ECG findings were observed by Murphy ML,[12] who described RAD and right ventricular hypertrophy patterns as common electrocardiographic manifestations of chronic cor pulmonale.

Echocardiographic abnormalities such as right atrial dilatation, right ventricular dilatation, tricuspid regurgitation, and elevated RVSP were highly prevalent in the present study. Similar echocardiographic observations were made by Rao VV, et al,[13] who demonstrated the usefulness of echocardiography in early identification of pulmonary hypertension and right ventricular dysfunction.

In the present study, echocardiography detected significantly more cases of cor pulmonale compared with clinical examination, radiography, and ECG. Similar findings were reported by Jatav VS et al,[5] who concluded that echocardiography is more sensitive than conventional clinical and electrocardiographic methods in diagnosing cor pulmonale, particularly during the early stages of disease.

The findings of the present study therefore emphasize that echocardiography is a valuable, non-invasive, and highly sensitive diagnostic modality for early detection of cor pulmonale in patients with COPD and ILD. Early identification through echocardiographic screening may help initiate timely treatment, reduce complications, and improve overall prognosis.

CONCLUSION

Radiological and electrocardiographic abnormalities including emphysematous changes, prominent pulmonary conus, right axis deviation, P-pulmonale, and right ventricular hypertrophy were frequently observed; however, these findings showed limited sensitivity in early disease detection.

Echocardiography proved to be the most sensitive and reliable non-invasive modality for diagnosing cor pulmonale. It detected significantly more cases when compared with clinical examination, chest radiography, and ECG, particularly in patients with mild COPD and early ILD. Echocardiographic findings such as right atrial dilatation, right ventricular dilatation, tricuspid regurgitation, and elevated right ventricular systolic pressure were strongly associated with cor pulmonale.

The statistically significant correlation between echocardiographic findings and clinical, radiological, and ECG changes highlights the importance of 2D echocardiography in the early diagnosis of cor pulmonale. Early echocardiographic screening in patients with chronic respiratory diseases may facilitate prompt therapeutic intervention, reduce morbidity, and improve quality of life and prognosis.

Summary

This study was done in MNR medical college and hospital, sangareddy. Patients having chronic corpulmonalewere included in the study. The study was conducted for a period of 18 months.

The study was done to compare the clinical, radiological features, ecg with echocardiography in clinically suspected chronic cor pulmonale patients.

A total of 50 patients were included in the study whose underlying lung disease was diagnosed and now presented with clinical features suggestive of cor pulmonale. Among these 40 individuals had COPD as the underlying lung disease and the remaining 10 individuals had underlying ILD.

The mean age of patients presenting with signs and symptoms of cor pulmonale was 56 years in the present study indicating that development of pulmonary hypertension leading to signs and symptoms is a chronic event.

Male preponderance among the patients with COPD as the underlying respiratory disease. Contrasting observation has been noticed among individuals presenting with ILD.

Among patients with COPD as the underlying cause 45% had mild airflow limitation as measured by spirometry. 30% of them had moderate and the remaining 25% had severe airflow limitation. These findings suggest that cor pulmonale is even seen in patients with mild disease.

Among the individuals with ILD, features suggestive of corpulmonale are seen in early course of the disease in those individuals who had ILD secondary to connective tissue disorders like systemic sclerosis. 70% of the ILD patients in this study had underlying connective tissue disorders as the cause for ILD. Among those with IPF cor pulmonale was noticed in the advanced stages of the disease.

Prominent pulmonary conus suggestive of pulmonary hypertension resulting in cor pulmonale was seen in 22% of the COPD patients with mild disease and seen in all individuals with moderate and severe disease. In patients with ILD it was noticed in only 28% individuals with early disease course and seen in all patients with advanced ILD.

ECG findings suggestive of cor pulmonale were seen in 28% of COPD patients with mild disease and seen in all individuals with moderate and severe COPD.

Among ILD patients it was seen in 57% of the individuals with early ILD and seen in all individuals with advanced ILD. Many studies have proved that echocardiography is more sensitive than electrocardiography in detecting RV dysfunction in COPD

2d ECHO findings suggestive of cor pulmonale was seen in 61% of COPD patients with mild COPD and seen in all individuals with moderate and severe disease. among patients with ILD it was seen in 72% of individuals with early ILD and in all individuals with advanced disease. Echocardiography serves as a non invasive tool for the diagnosis of cor pulmonale in the early stages.

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