International Journal of Advances in Medicine
Jatav VS et al. Int J Adv Med. 2017Apr;4(2):476-480
http://www.ijmedicine.com
pISSN2349-3925 | eISSN 2349-3933
DOI: http://dx.doi.org/10.18203/2349-3933.ijam20171045

Original Research Article

Echocardiographic findings in chronic obstructive pulmonary disease and correlation of right ventricular dysfunction with disease severity

Vinod Singh Jatav*, S. R. Meena, Shivcharan Jelia, Pankaj Jain, Devendra Ajmera, Vinit Agarwal, Chirangee L. Dayma, Mohd. Arif

Department of Medicine, Government Medical College, Kota, Rajasthan, India

Received: 09 January 2017
Accepted: 07 February 2017

***Correspondence:**
Dr. Vinod Singh Jatav,
E-mail: drvinodsinghjatav5@gmail.com

ABSTRACT

Background: COPD is a powerful and independent risk factor for cardiovascular morbidity and mortality which includes right ventricular (RV) dysfunction and cor pulmonale secondary to pulmonary arterial hypertension (PAH), left ventricular dysfunction. Echocardiography provides a rapid, noninvasive, portable, and accurate method to evaluate cardiac functions. Early diagnoses and intervention for cardiac comorbidities would reduce mortalities in COPD patients. The aim of this study is to find echocardiographic changes in COPD patients and to assess RV dysfunction by echocardiography and correlate with the disease severity.
Methods: 100 patients of COPD fulfilling the inclusion criteria coming to OPD/wards of NMCH, Kota were recruited. They were staged by pulmonary function test (PFT) and evaluated by echocardiography. Statistical analysis of correlation was done with chi square test and statistical significance was taken $p<0.05$.
Results: Most common echocardiographic finding was cor pulmonale, which was present in 62% of cases, other echocardiographic findings were PAH in 44% cases, RA/RV dilatation (43%), RVH (42%), LVDD (46%), RVSD (14%) and LVH in 11% of cases. Echocardiographic signs of RV dysfunction observed are PAH, cor pulmonale and RVSD which are correlated with the severity of the disease ($p<0.05$).
Conclusions: Echocardiographic examination is reliable in following COPD patients with PAH instead of repeated cardiac catheterization. The incidence of RV dysfunction is more common as the severity of COPD increases and there is a significant correlation between the degree of air flow limitation (FEV1) and RV dysfunction.

Keywords: Chronic obstructive pulmonary disease, Cor pulmonale, Echocardiography, RV dysfunction

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is defined as a disease state characterized by airflow limitation that is not fully reversible. Chronic obstructive pulmonary disease (COPD) includes emphysema, an anatomically defined condition characterized by destruction and enlargement of the lung alveoli; chronic bronchitis, a clinically defined condition with chronic cough and phlegm; and small airway disease, a condition in which small bronchioles are narrowed.[1]

The epidemiological scenario is expected to worsen and the World Health Organization predicts that COPD will become the third leading cause of death (currently fourth) and the fifth leading cause of disability (currently twelfth) worldwide by the year 2020.[2,3] Global initiative for chronic obstructive lung disease (GOLD) has described COPD as a disease that is preventable and curable.[4] The

most important risk factor for COPD is cigarette smoking. Chronic obstructive pulmonary disease (COPD) has considerable effects on cardiac functions, including those of the right ventricle, left ventricle, and pulmonary blood vessels. Most of the increased mortality associated with COPD is due to cardiac involvement. RV dysfunction is common in patients with COPD secondary to development of pulmonary arterial hypertension, which lead to cor pulmonale. Once developed the patient with cor pulmonale has poor prognosis. So, the early recognition of RV dysfunction and PAH may help in treatment and prolonging the survival of the patients with cor pulmonale.[5] Echocardiography provides a rapid, noninvasive, portable, and accurate method to evaluate cardiac functions. Early diagnoses and intervention for cardiac comorbidities would reduce mortalities in COPD patients. The aim of this study is to find echocardiographic changes in COPD patients and to assess RV dysfunction by utilizing RV parameters obtained by echocardiography and correlate with the severity of airflow limitation in COPD patients.

METHODS

100 patients of COPD diagnosed by suggestive symptoms and confirmed by physical, radiographic and pulmonary function test (PFT) were selected randomly attending outpatient clinic or admitted in New hospital medical college Kota for this study. The patients with Asthma, Bronchiectasis, Tuberculosis, Pneumoconiosis, Rheumatic heart disease, Ischaemic heart disease and hypertension were excluded from the present study.

All selected patients were subjected to routine investigations, including complete blood count, lipid profile, blood sugar, blood urea, serum creatinine, electrocardiography, and so on, as needed.

A detailed history and thorough clinical examination was done as indicated in the performa. Pulmonary function tests were done in all patients and patients were graded according to the severity of COPD with guidelines given by Global initiative for obstructive lung disease (GOLD). The patients were subjected to radiological examination and 2D echo were done to assess the severity of right ventricular dysfunction.

Various observations in the study were analysed and the severity of COPD was correlated with the echocardiographic features of right ventricular dysfunction.

RESULTS

The maximum numbers of COPD patients (70%) in this study were in the 6th and 7th decades, mean age of presentation was 63.18 years. Total number of patients in study was 100, out of which 86 were male and 14 were female, with male to female ratio 6.14:1 (Table 1).

Table 1: Showing age and sex wise distribution.

Age interval (years)	Male	Female	Total	Percentage
40–49	9	0	9	9%
50–59	27	1	28	28%
60–69	31	11	42	42%
70–79	18	2	20	20%
>80	1	0	1	1%
Total	86	14	**100**	

Majority of patients (48%) in the study had symptoms for 6-10 years at presentation. The mean duration of symptoms was 7.58 years. In the present study, majority of the patients (86%) had history of smoking. All female (14%) patients were chulha smokers. The mean duration of smoking observed in the study was 25.06 years. Majority of smokers (56%) had history of smoking more than 20 pack years (Table 2).

Table 2: Duration of tobacco use.

Duration of smoking (in pack years)	No. of cases (n=86)	Percentage
<10	8	8%
10-19	22	22%
20-29	30	30%
30-39	16	16%
>40	10	10%

Most of the patients had cough with sputum (80%) and breathlessness on presentation (96%). 32% presented with swelling of feet, 16% had fever, 4% had decreased urine output. Most common sign at presentation is tachypnea in 96% followed by 35% had loud P2 suggestive of pulmonary arterial hypertension, 30% of the patients had parasternal heave, the clinical evidence of right ventricular hypertrophy. Evidence of congestive cardiac failure like raised JVP in 36%, pedal edema in 32% and ascites in 9% cases. 27% of the patients had cyanosis which is evidence of a hypoxic state.

Table 3: Severity of COPD.

Severity of COPD	FEV 1% predicted	No. of cases	percentage
Mild	>80	4	4%
Moderate	50-79	22	22%
Severe	30-49	44	44%
Very severe	<30	31	31%

Majority of patients (44%) had severe and very severe COPD (31%), 4% patients had mild COPD and 22% had moderate COPD (Table 3).

In chest X-ray, 72% of the patients had features of emphysema. 42% of the patients had increased

brochovascular marking suggestive of chronic bronchitis. X-ray evidence of pulmonary hypertension i.e. prominent right descending pulmonary artery (RDPA) was present in 30% of the patients. Cardiomegaly on X-ray was present in 20% (Table 4).

Table 4: Radiological findings.

Chest X-ray	No. of cases	Percentage
Emphysema	72	72%
Increased bronchovascular Marking	42	42%
Cardiomegaly	20	20%
Prominent RDPA>16mm	30	30%

Analysis of echocardiographic findings showed that most common echocardiographic finding was cor pulmonale, 62% of the patients in this study had echocardiographic evidence of cor pulmonale. Pulmonary arterial hypertension (PAH) which is defined as pulmonary arterial systolic pressure (PASP)> 30mmHg was observed in 44% cases. 43% had features of RA/RV dilatation, 42% had RVH 46% had LVDD, 14% had RVSD and 11% had LVH (Table 5).

Analysis of echocardiographic findings with disease severity showed that in mild category no case of RA/RV dilatation was present while in moderate, severe and very severe category it was present in 27.27%, 40.90% and 63.33% of cases respectively. RVH was also not present in mild category while in moderate, severe, and very severe it was present in 27.27%, 38.63% and 63.33% of cases respectively.

Table 5: ECHO Findings.

ECHO finding	No. of cases	Percentage
RA/RV dilatation	43	43%
RVH	42	42%
Cor pulmonale	62	62%
PAH	44	44%
LVDD	46	46%
RVSD	14	14%
LVH	11	11%

Cor pulmonale was observed in 0% in mild category patients while in moderate, severe and very severe it was present in 27.27%, 68.18% and 86.67% of cases respectively. PAH was observed in 0% in mild category patients while in moderate, severe and very severe it was observed in 40.90%, 36.36% and 63.33% of cases respectively. RVSD was observed in 0% in mild category while in moderate, severe and very severe it was observed in 4.94%, 9.09% and 30% of cases respectively.

All echocardiographic findings of RV dysfunction i.e. PAH, Cor pulmonale, RA/RV dilatation, RVH and RVSD linear correlated significantly with disease severity ($p<0.05$) (Table 6).

Table 6: ECHO findings with disease severity.

ECHO Finding	Mild (4)	Moderate (22)	Severe (44)	Very severe (30)	P-value
RA/RV dilatation	0	6 (27.27%)	18 (40.90%)	19 (63.33%)	0.020
RVH	0	6 (27.27%)	17 (38.63%)	19 (63.3%)	0.017
Cor pulmonale	0	6 (27.27%)	30 (68.18%)	26 (86.67%)	<0.001
PAH	0	9 (40.90%)	16 (36.36%)	19 (63.33%)	0.041
LVDD	0	8 (36.36%)	19 (43.18%)	19 (63.3%)	0.06
RVSD	0	1 (4.94%)	4 (9.09%)	9 (30%)	0.029
LVH	0	1 (4.54%)	3 (6.81%)	7 (23.3%)	0.09

DISCUSSION

Chronic obstructive pulmonary disease is one of the leading cause of chronic morbidity and mortality worldwide. This study consisted of 100 patients admitted to New hospital medical college Kota, Rajasthan, India.

There are various cardiac changes seen in the patients suffering from COPD. In this study echocardiographic changes seen in COPD patients were studied and correlated to severity of the disease. The maximum numbers of COPD patients in the present study were in 6th and 7th decades (70%) with the mean age 63.18 years, which is similar to previous studies.[6,7] Patients between 50-70 years form the maximum number of patients admitted, mainly because of the longer duration of tobacco exposure and repeated respiratory tract infections, which would have compromised their quality of life.

In this study male to female ratio was 6.14:1. This higher incidence of COPD in males can be attributed to smoking habits. All females in present study had history of indoor air pollution in the form of cooking with dried cow dung or dried wood fuel. Number of males in the study by Radhakrishnan et al and vikram et al were 84% and 88%

respectively, which is similar to present study (86%).[5,8] In this study most of the patients 48% gave history of symptoms of 6-10 years duration, with a mean duration of symptoms was 7.58 years. This is similar to the study conducted by Radhakrishnan et al in which the mean duration of symptoms was 8.4 years.[5]

In this study, majority of cases belong to severe (30-49%) category. In mild category 4% cases, in moderate category 22% cases, in very severe 30% cases were present. Majority of cases with mild and moderate COPD were admitted for exacerbations. Comparing with other studies i.e. Sekhar et al the present study had almost similar findings.[6] In Dave L et al study maximum number of patients were in very severe category (38%).[9]

In the present study majority had the habit of smoking for more than 20 years (60%). The mean duration of smoking observed in the study was 25.06 pack years with a range of 6 to 47 pack years. In the study by Radhakrishnan et al mean duration of smoking was 22.62 years which is similar to the present study.[5] Almost all the patients had breathlessness and cough with sputum on presentation. Breathlessness is the symptom that commonly causes the patient to seek medical attention, and is usually the most disabling of these symptoms. Patients often date the onset of their illness to an acute exacerbation of cough with sputum production, which leaves them with a degree of chronic breathlessness. Close questioning usually reveals the presence of a "smokers cough" (which is usually disregarded by the patient), with scanty mucoid sputum, mainly in the morning for many years, shortness of breath, Pedal edema, Reduced urine output. Similar findings were observed in study of Radhakrishnan et al.[5]

Almost All the patients in the present study had tachypnea on presentation. Most of them had signs of hyperinflation, and also diminished breath sounds with prolonged expiratory phase. Clinical sign of right ventricular hypertrophy (parasternal heave) was present in 30% (30/100) of the patients and pulmonary hypertension (loud P2) in 35% (35/100) of the patients. Similar finding were observed in study by Radhakrishnan et al and Sekhar et al.[5,6]

Majority of the patients in the present study had evidence of emphysema i.e. signs of hyperinflation like low flat diaphragm, hypertranslucency etc. The incidence of chest X-ray. Signs correlated with the study of Sekhar et al and Suma et al.[6,7] Most common echocardiographic finding was cor pulmonale, 62% of the patients in this study had echocardiographic evidence of cor pulmonale. Other echocardiographic findings were PAH in 44% cases, RA/RV dilatation in 43%, RVH in 42%, LVDD in 46%, RVSD in 14% and LVH in 11% of cases. Similar observations were present in previous studies (Table 7).[6-8]

Table 7: Comparison of ECHO findings with previous study.

ECHO findings	RA/RV dilatation	RVH	Cor pulmonale	PAH	RVSD
Sekhar study	40%	44%	60%	60%	-
Present study	43%	42%	62%	44%	14%

In the present study, the incidence of all the ECHO findings, increased as the severity of the disease (as measured by FEV1 and graded according to GOLD criteria) increased. Statistical correlation were found with echo findings suggestive of RV dysfunction in COPD patients i.e. PAH, RVH, Cor pulmonale, RA/RV dilatation and RVSD which were also significant (i.e. $p<0.05$). This means that the increase in incidence of the above ECHO findings, with increasing disease severity (decreasing FEV1) was statistically significant. Other studies correlating the ECHO findings with severity of the disease have also made similar observations, and also have given different explanations for their observation.

CONCLUSION

The study shows high prevalence of cardiac co-morbidities such as PAH, Cor pulmonale, RV dysfunction and LV dysfunction in COPD patients. The severity of complications increases with severity of COPD and makes a linear relation. 2D echocardiography is more sensitive than radiography and clinical methods in detecting cardiovascular complications like PAH, cor pulmonale and R. V. dysfunction in COPD patients. Echocardiography provides a rapid, non-invasive, portable, and accurate method to evaluate cardiac functions. Early diagnoses and intervention for cardiac comorbidities would reduce mortalities in COPD patients.

ACKNOWLEDGEMENTS

The Authors acknowledge the help of NMCH laboratory and medicine ward nursing staff for their cooperation in the study.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the institutional ethics committee

REFERENCES

1. J. Reilly, Silverman. chronic obstructive pulmonary disease. In: Kasper Dennis,Hauser Stephen, Jameson J. Larry, S. Fauci anthony, Longo, Loscalzo. Harrison's principles of internal medicine 19th edition, from New York, NY:McGraw Hill. 2015;2:1700.
2. Chen JC, Mannino DM. Worldwide epidemiology of chronic obstructive pulmonary disease. Curr Opin Pulm Med. 1999;5:93-9.
3. Murray CJ, Lopez AD. Global mortality, disability, and the contribution of risk factors: Global Burden of Disease Study. Lancet. 1997;349:1436-42.
4. Global Initiative for Chronic Obstructive Lung Disease. Global strategy for the diagnosis, management and prevention of chronic obstructive pulmonary disease. Executive summary. Medical Communications Resources, Inc; 2007:1-43.
5. Krishnan RD and Srihari B. A study on the severity of right ventricular dysfunction in correlation with the severity of Lung dysfunction in chronic obstructive pulmonary disease patients- COPD. Am J Sci Med Res. 2015;1(1):112-9.
6. Sekhar CG, Sammaiah P, Bookya K, Balaji B. Study of cardiovascular complications in chronic obstructive pulmonary disease with reference to ECG and 2D echocardiography findings. Am J Pharm Health Res. 2016;4(1):97-111.
7. Suma KR, Srinath PS. Electrocardiographic and echocardiographic changes in chronic obstructive pulmonary disease (COPD) of different grades of severity. J Evol Med Dent Sci. 2015;4(30):5093-101.
8. Vikhe VB, Shende PS, Patil RS, Tamakuwala KK, Patil AS, Gupta AP. Cardiovascular complications in chronic obstructive pulmonary disease with reference to 2D echocardiography findings. Natl J Med Res. 2013;3(4):385-8.
9. Dave L, Dwivedi P, Srivastava N, Yadav BS, Dohre R. A study of cardiovascular manifestations of COPD. Int J Res Health Sci[Internet]. 2014;2(3):812-7.
10. Kaushal M, Shah PS, Shah AD, Francis SA, Patel NV, Kothari KK. Chronic obstructive pulmonary disease and cardiac comorbidities: A cross-sectional study. Lung India. 2016;33:404-9.
11. Freixa X, Portillo K. Echocardiographic abnormalities in patients with COPD at their first hospital admission. Eur Respir J. 2013;41:784-91.
12. Gupta R, Mann S. Correlation between COPD and echocardiographic features with severity of disease. Natl J Integr Res Med. 2016;7(1):26-30
13. Gupta NK, Agrawal RK, Srivastav AB, Ved ML. Echocardiographic evaluation of heart in chronic obstructive pulmonary disease patient and its co-relation with the severity of disease. Lung India. 2011;28:105-9.
14. Vizza CD, Lynch JP, Ochoa LL, Richardson G, Trulock EP. Right and left ventricular dysfunction in patients with severe pulmonary disease. Chest. 1998;113;576-83.
15. Burrows B, Kettel LJ, Niden AH, Rabinowitz M, Diener CF. Patterns of cardiovascular dysfunction in COPD. N Engl J Med. 1972;286:912-8.
16. Higham MA, Dawson D, Joshi J, Nihoyannopoulos P, Morrell NW. Utility of echocardiography in assessment of pulmonary hypertension secondary to COPD. Eur Respir J. 2001;17:350-5.
17. Vonk-Noordegraaf A, Marcus JT, Holverda S. Early changes of cardiac structure and function in COPD patients with mild hypoxemia. Chest. 2005;127:1898-903.
18. Curkendall SM, DeLuise C, Jones JK. Cardiovascular disease in patients with chronic obstructive pulmonary disease, Saskatchewan Canada cardiovascular disease in COPD patients. Ann Epidemiol. 2006;16:63-70.
19. Klinger JR, Hill NS. Right ventricular dysfunction in chronic obstructive pulmonary disease, evaluation and management. Chest. 1991;99:715-23.

Cite this article as: Jatav VS, Meena SR, Jelia S, Jain P, Ajmera D, Agarwal V, Dayma CL, Arif M. Echocardiographic findings in chronic obstructive pulmonary disease and correlation of right ventricular dysfunction with disease severity. Int J Adv Med 2017;4:476-80.