International Journal of Medical and Pharmaceutical Research
Published online 12 June, 2015 (http://www.scienceresearchlibrary.com)

Vol. 01, No. 01, pp. 18-21

Research Article **Open Access**

Correlation of spirometric value to 2D Echocardiographic parameters in Chronic obstructive pulmonary disease

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Received: 21 January, 2015 / Accepted: 18 March, 2015
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A bstract

Study was undertaken to compare the Echocardiographic changes, with respect to severity of the disease and to observe its association with right ventricular dysfunction, so that the patients can be identified at an earlier stage of the disease. Total of 59 patients confirmed by clinical history, chest radiology, and spirometry were selected and diagnosed as COPD. Patients with history of other lung disease, primary cardiac disease and systemic disease that can cause pulmonary hypertension were excluded. Subjects were further classified according to GOLD guidelines and subjected to resting 2D Transthoracic Doppler echocardiography. Echocardiography reviewed to assess the pericardium, valvular anatomy and function, left and right side chamber size, Pulmonary artery systolic pressure and cardiac function. Patients with moderate, severe, and very severe obstruction were 12/59 = 20.3%, 24/59 = 40.6%, and 23/59 = 38.6%, respectively. Pulmonary Hypertension defined as Pulmonary artery systolic pressure (PASP) > 30 mmHg was seen in 21 patients (21/59 = 35.6%). Frequencies of Pulmonary Hypertension in moderate, severe, and very severe obstruction were 1/12 (8.3%), 6/24 (25%), 16/23 (69.5%), respectively. Significant association was seen between FEV1 (Forced Expiratory Volume in one second) P-value=0.035, FVC (Forced Expiratory Volume) P-value=0.001 and Pulmonary artery systolic pressure. We found an association of FEV1 % predicted, FVC% predicted with pulmonary arterial systolic pressure. Furthermore, FEV1 and FVC are associated with an increased risk of pulmonary hypertension. The implications of these findings may be important in the development of new diagnostic algorithms and treatment regimes.

Keywords: Airway obstruction, Echocardiography, Forced expiratory volume, Pulmonary circulation, Ventricular Dysfunction.

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Introduction

As defined by the Global Initiative for Chronic obstructive pulmonary disease (GOLD),[1] Chronic Obstructive Pulmonary Disease (COPD) a common preventable and treatable disease, is characterized by persistent airflow limitation that is usually progressive and associated with an enhanced chronic inflammatory response in the airways and the lung to noxious particles or gases. Exacerbations and comorbidities contribute to the overall severity in individual patients. WHO predicts that COPD will become the third leading cause of death (currently fourth) and fifth leading cause of disability (currently twelfth) worldwide by year 2020.[2]

Subjects and Methods:

A total of Fifty-nine patients of COPD confirmed by clinical history, radiology of chest, and pulmonary function test was selected from pulmonary medicine department of R.D.Gardi Medical College, Ujjain. In our study, Patients with history of chronic lung disease other than COPD, Active Pulmonary Tuberculosis, hypertension, any known primary cardiac disease, systemic disease that can lead to pulmonary hypertension, and patients who were unable to perform spirometry were excluded from the study. CECT was done to rule out pulmonary vascular alteration.

All selected patients were subjected to routine investigations, including complete blood count, blood urea, serum creatinine, blood sugar, electrocardiography, etc on, as needed basis.

All the patients were investigated by spirometry and diagnosed and classified according to GOLD guidelines (postbronchodilator FEV1/ (FVC) ratio < 70% predicted), mild ($FEV_1 \geq 80\%$ of predicted), moderate ($50\% \leq FEV_1 < 80\%$

predicted), severe (30% ≤ FEV_1 < 50% predicted), and very severe (FEV_1 < 30%predicted), respectively.

All patients were subjected to resting two-dimension Transthoracic Doppler Echocardiography on **GE Logiq 500 MD ultrasound machine** in the cardiology department at R.D.Gardi Medical College, Ujjain under supervision of cardiologists. Echocardiography was reviewed to assess the pericardium, valvular anatomy and function, left and right side chamber size and cardiac function. Tricuspid regurgitant flow was identified by colour flow Doppler technique and the maximum jet velocity was measured by continuous wave Doppler without the use of intravenous contrast. Right ventricular systolic pressure was estimated based on the modified Bernoulli equation and was considered to be equal to PASP if there is no right ventricular outflow obstruction: PASP (mmHg) = right ventricular systolic pressure = trans-tricuspid pressure gradient (TTPG) +right atrial pressure (RAP), where trans-tricuspid gradient is 4*v*2 (*v* = peak velocity of tricuspid regurgitation, m/s).[6,8,9] RAP was estimated to be 5, 10, or 15 mmHg based on the variation in the size of inferior vena cava with inspiration as follows: complete collapse, RAP = 5 mmHg; partial collapse, RAP = 10 mmHg; and no collapse, RAP = 15 mmHg.[10]

Pulmonary hypertension (PH) was defined in this study as PASP ≥ 30 mmHg.[11] This value was chosen according to the definition of pulmonary hypertension. PH was classified into mild, moderate, and severe category as PASP 30–50, 50–70, >70 mmHg, respectively (using Chemla formula, mean pulmonary arterial pressure (MPAP) =0.61 PASP + 2 mmHg and putting value of 25–35, 35–45, and >45 mmHg of MPAP for mild, moderate, and severe pulmonary hypertension, respectively)[12].

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%).

Results:

In our study, total of 59 patients were recruit and out of them, the number of patients with moderate, severe, and very severe COPD according to GOLD guidelines were 12/59 = 20.3%, 24/59 = 40.6%, and 23/59 = 38.6%, respectively [Table no.1]

Table 1 – Severity of obstruction in our COPD patients

S.no	FEV1	No. of patients	Percent
1	50-80%	12	20.3
2	30-50%	24	40.6
3	<30%	23	38.6
	Total	59	100

On Echocardiography, tricuspid regurgitation (TR) was observed in 21 patients (21/59 = 35.6%).PH defined as PASP > 30 mmHg was observed in 21 patients (21/59 = 35.6%) of the total study population) [Table no.2].

Table .2 Analysis of Echocardiography findings

S.no	2D ECHO finding	No. of patients	Percent
1	R. A. dilatation	21	35.6
2	R.V. dilatation	21	35.6
3	IVS motion abnormality	7	12
4	Pulmonary hypertension	21	35.6
5	Pericardial effusion	2	3.3
6	TR	21	35.6

Out of those 21 patients with pulmonary hypertension, 10 patients were in mild PH (PASP 30–50 mmHg) (10/59 = 16.9%) (10/21 = 47.6%), 7 were in moderate PH (PASP 50–70 mmHg) (7/40 = 11.8%) (7/21 = 33.3%), and 6 were in severe PH (PASP > 70 mmHg) (6/59 = 10.1%) (6/17 = 28.5%). The frequencies of PH in moderate, severe, and very severe COPD were 1/12 (8.3%), 6/24 (25%), 16/23 (69.5%), respectively[Table no.3].

Table no.3 Echocardiography findings with severity of obstruction

S.No	ECHO finding	FEV1					Chi-square test
		50-80%	30-50%	<30%	Total	%	
1	R.V. dilatation	1(12)	7(24)	13(23)	21	35.5	p.value=0.025
2	IVS motion abnormality	1(12)	3(24)	3(23)	7	12	
3	Pulmonary hypertension	1(12)	7(24)	13(23)	21	35.5	
4	TR	1(12)	6(24)	13(23)	20	34	p.value=0.007
5	Pericardial effusion	0	0	2(23)	2	3.3	

Thus we can see that there is a good co-relation between the frequency of PH and severity of COPD. The frequencies of cor pulmonale in patients with mild, moderate, and severe PH were 40%, 100%, and 100%, respectively; so we can also see a good co-relation between severity of PH and the development of cor pulmonale[Table no.6].

Table 6

S.no	Severity of PAH	frequency of cor pulmonale
1	mild (10)	4(40%)
2	moderate (12)	12(100%)
3	severe (4)	4(100&)

Correlation of PAH with cor pulmonale

Significant association was seen between FEV_1(p-value=0.035) FVC(p-value=0.001) and PASP [Table no.4 and 5].

Table 4 and 5

S. no	PASP	FEV1					Pearson chi-square test, p-value=0.035 (significant)
		50-80 %	30-50 %	<30 %	Total	Percent	
1	<30	11	18	7	36	61	
2	30-50	1	3	6	10	16.9	
3	50-70	0	0	7	7	11.8	
4	>70	0	3	3	6	10.1	
		12	24	23	59	100	

PASP		FVC					Total	p-value=0.001 (significant)
		>80	60-80	50-60	35-50	<35		
1	<35	0	0	0	1	3	4	
2	35-50	0	0	0	3	3	6	
3	50-70	0	4	2	3	3	12	
4	>70	5	13	14	2	2	36	
Total		5	17	16	9	11	58	

As the severity of obstruction increased, there is progressive increased in Pulmonary artery systolic pressure as calculated from 2D-ECHO.

Comparative study of various stages of severity of COPD reveals that as severity of COPD increases the prevalence of cardiac dysfunction increases, so more severe COPD is associated with more prevalent and more severe cardiac manifestations.

Discussion:

Although the actual prevalence of PH in COPD is unknown, an elevation of pulmonary arterial pressure is reported to occur in 20%–90% of patients when measured by right heart catheterization with some evidence that pulmonary hemodynamic worsens with worsening airflow obstruction.[13-18]

The level of PH has a prognostic value in COPD patients that has been demonstrated by several studies. In study by Oswald-Mammosser et al, the 5-year survival rates were 50% in patients with mild PH (20–30 mmHg), 30% in those with moderate-to-severe PH (30–50 mmHg), and 0% in the small group of patients with very severe PH (>50 mmHg). Thus a high degree of PH bears a poor prognosis, and this also has been observed in COPD patients receiving long-term oxygen therapy.[19] The present study reveals 35.6% patients of various severity of COPD have pulmonary hypertension, that is similar to prevalence seen in previous studies. The frequencies of PH in moderate, severe, and very severe COPD were 9%, 25%, and 69.5%, respectively. In study by, Higham et al it was found to be 25%, 43%, and 68% in mild, moderate, and severe COPD, respectively.[20] In our study it is also observed that severe PH is present only in patients with severe or very severe obstruction. To conclude, the incidence of PH is directly proportional to severity of disease. Previous studies by Chaouat A et al and Thabut G et al showed the frequencies of severe PH in COPD from about 1%– 3%, [21,22] but in this study it is 10.1%; this may be due to small study population comprising more percentage of severe and very severe COPD patients. We found an association of FEV1 % predicted and FVC % predicted with pulmonary arterial systolic pressure. Furthermore, FEV1 and FVC are associated with an increased risk of pulmonary hypertension.

Cor pulmonale is present in 35% of patients in our study and 29% of patient were admitted with heart failure. Approximately 25% patients with COPD ultimately develop cor pulmonale.[23] Cor pulmonale was found in 40% patients with COPD in autopsy study by Rigolin et al.[24,25] According to estimate, every year between 10% and 30% of all hospital admissions for heart failure in the United States are due to cor pulmonale[26] and approximately 85% patients with cor pulmonale have Chronic obstructive pulmonary disease.[23]

CONCLUSION :

As we know, COPD is a significant health problem in the rural as well as urban areas. Cardiovascular complications are the most significant co-morbidity associated with it. The present study shows high prevalence of pulmonary hypertension, cor pulmonale, complicating COPD.

Significant association was seen between FEV_1, FVC and PASP. As the severity of obstruction increased, there is progressive increased in Pulmonary artery systolic pressure as calculated from 2D-ECHO

We suggest screening of all COPD patients for cardiac complications by 2D Echocardiography and monitoring of progression. This would help in assessment of prognosis, and assist in identifying individuals likely to suffer increased cardiac morbidity and mortality warranting intense treatment.

References

Anthonisen N, Connett JE, Kiley JP, Altose MD, Bailey WC, *et al.*Effects of Smoking Intervention and the Use of an Inhaled Anticholinergic Bronchodilator on the Rate of Decline of FEV1. JAMA 1994;272:149

Bredikis AJ, Liebson PR. The echocardiogram in COPD: Estimating right heart pressures. J Respir Dis 1998;19:191-8.

Burrow B ,Keetel LJ,Niden AH, Rabinowitz M,diener CF.Patterns of cardiovascular dysfunction in chronic obstructive lung disease.*Med 1972;286:912-918*

Burrows B, Kettel LJ, Niden AH, Rabinowitz M, Diener CF. Patterns of cardiovascular dysfunction in COPD. N Engl J Med 1972;286:912-8

Chaouat A, Bugnet AS, Kadaoui N, Schott R, Enache I, Ducoloné A, *et al.*Severe pulmonary hypertension and chronic obstructive pulmonary disease. Am J Respire Care Med 2005;172:189-94

Chemla D, Castelain V, Humbert M, Simonneau JLHG, Lecarpentier Y, Hervé P. New Formula for Predicting Mean Pulmonary Artery Pressure Using Systolic Pulmonary Artery Pressure: Chest 2004;126;1313-17

Chhabra SK, Gupta M, Indian j Chest allied sci 2010;225-238

Fishman AP. State of the art: Chronic cor pulmonale. Am Rev Respir Dis 1976;114:775-94

Fishman AP. State of the art: Chronic Cor Pulmonale. Am Rev Respire Dis 1976;114:775-94.

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

Macnee W. Pathophysiology of cor pulmonale in chronic obstructive pul mona ry disea se. Pa rt One. Am J R espi re Cri t Ca re Med 1994;150:833-52

Morrison LK, Harrison A, Krishnaswamy P, Kazanegra R, Clopton P, Maisel A. Utility of a rapid B-natriuretic peptide assay in differentiating congestive heart failure from lung disease in patients presenting with dyspnea. J Am Coll Cardiol 2002;39:202– 9.

Murray CJ,Lopez AD,Global mortality,disability and contribution of risk factors: Global burden of Disease study.*lancet 1997:349;1436-42*

Oswald-Mammosser M, Weitzenblum E, Quoix E, Moser G, Chaouat A, Charpentier C, et al.Prognostic factors in COPD patients receiving long-term oxygen therapy. Chest 1995;107:1193-8.

Pauwels RA, Buist AS, Ma P, Jenkins CR, Hurd SS. Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease: National Heart, Lung, and Blood Institute and World Health Organization Global Initiative for Chronic Obstructive Lung Disease (GOLD): executive summary. Respir Care 2001;46: 798– 825

Pietra G. Pathology of the pulmonary vasculature and heart. In; Cherniack N, editor. COPD. Philadelphia: WB Saunders; 1996. p. 21-6.

Rappaport E. Cor pulmonale. In, Murray JJ, Nadel JA, Mason RM, Boushey H (eds). Textbook of respiratory medicine, 4th Edition. Philadelphia, W.B. Saunders 2000;1631-48

Rigolin VH, Robiolio PA, Wilson JS, Harrison JK, Bashore TM. The forgotten chamber: The importance of the right ventricle. Cathet Cardiovasc Diagn 1995;35:18-28

Sin DD, Anthonisen NR, Soriano JB, Agusti AG. Mortality in COPD: Role of comorbidities. Eur Respir J 2006;28:1245-57.

Springhouse. Respiratory disorders. In, Springhouse (ed). Professional Guide to Diseases.9th Edition.Philadelphia, Lippincott William and Wilkins 2008;120.

Thabut G, Dauriat G, Stern JB, Logeart D, Lévy A, Marrash-Chahla R, *et al*: Pulmonary haemodynamics in advanced COPD candidates for lung volume reduction surgery or lung transplantation. Chest 2005;127:1531-6

Thabut G, Dauriat G, Stern JB, Logeart D, Lévy A, Marrash-Chahla R, *et al*. Pulmonary Haemodynamics in advanced COPD candidate for lung volume reduction surgery or lung transplantation. Chest 2005;127:1531-6

Tramarin R, Torbicki A, Marchandise B, Laaban JP, Morpurgo M. Doppler echocardiographic evaluation of pulmonary artery pressure in chronic obstructive pulmonary disease. A European multicentre study. Eur HeartJ 1991;12:103-11

Weitzenblum E, Hirth C, Ducolone A, Mirhom R, Rasaholinjanahary J, Ehrhart M. Prognostic value of pulmonary artery pressure In chronic COPD: Thorax 1981;36:752-8.

Weitzenblum E, Sautegeau A, Ehrhart M, Mammosser M, Hirth C, Roegel E. long term course of pulmonary artery pressure In chronic COPD. Am Rev Respir Dis 1984;130:993-8

Yock PG, Popp RL. Noninvasive estimation of right ventricular systolic pressure by Doppler ultrasound in patients with tricuspid regurgitation. Circulation 1984;70:657-62

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