ORIGINAL ARTICLE

CARDIOVASCULAR COMPLICATIONS IN CHRONIC OBSTRUCTIVE PULMONARY DISEASE WITH REFERENCE TO 2D ECHOCARDIOGRAPHY FINDINGS

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ABSTRACT

Background: Chronic Obstructive Pulmonary Disease (COPD) is the disease of lungs primarily but also produces significant systemic consequences like pulmonary arterial hypertension (PAH). COPD results in chronic hypoxemia consequently which causes PAH. PAH then leads to corpulmonale and right ventricular failure late in the course of the COPD. 2D echocardiography is probably the best technique to measure tricuspid regurgitation and pulmonary arterial pressure non-invasively.

Material and Methods: 50 cases above the age of 18 years admitted with signs and symptoms of COPD in our hospital over a period of two years were taken. Diagnosis of COPD was made on basis of history, signs and symptoms, supported by spirometry, electrocardiographic, echocardiographic and radiological data. 2D echocardiography was performed on these patients to detect the presence of tricuspid regurgitation, PAH, right ventricular hypertrophy, right ventricular dilatation and right ventricular failure.

Results: Emphysema and chronic bronchitis was present in 38% and 62% respectively. Echocardiographic evidence of cor-pulmonale and pulmonary hypertension was found in 70% of the patients.

Conclusions: Echocardiography is more sensitive than electrocardiography in detecting PAH and right ventricular dysfunction in COPD.

Keywords: Cardiovascular, Chronic Obstructive Pulmonary Disease, 2D Echocardiography

INTRODUCTION

According to Global Initiative for Chronic Obstructive Lung Disease (GOLD), COPD is defined as "a disease state characterized by airflow limitation that is not fully reversible. The airflow limitation is usually both progressive and associated with an abnormal inflammatory response of the lungs to noxious particles or gases." [1] COPD includes emphysema and chronic bronchitis. [2,3] COPD is by far the main cause of corpulmonale. [4,5,6] Pulmonary arterial hypertension (PAH) results in right ventricular enlargement (hypertrophy and/or dilatation). PAH with time may lead to right heart failure. 2D echocardiography can be used to assess right ventricular dimensions, wall thickness and right ventricular volume over load in patients with COPD and also the presence of pulmonary artery hypertension. [4,7] Detecting tricuspid regurgitation by echocardiography is probably the best technique to measure pulmonary arterial pressure non-invasively. The pulsed Doppler technique can be used to record pulmonary artery flow velocity. [8]

MATERIALS AND METHODS

The study was approved by Institutional research committee and all ethical guidelines of 'WMA Declaration of Helsinki - Ethical Principles for Medical Research Involving Human Subjects' were followed. Written and informed consent from all the adult research participants was obtained.

This was a hospital based clinical study that was conducted during September 2010 to September 2012. 50 cases admitted with signs and symptoms of Chronic Obstructive Pulmonary Disease in our hospital over a period of two years were taken. Diagnosis of COPD was made on basis of history, signs and symptoms, supported by spirometry, electrocardiographic, echocardiographic and radiological data. Patients of bronchial asthma, bronchiectasis, tuberculosis, restrictive lung disease and patients with pre-existing cardiac conditions like coronary artery disease, valvular heart disease presenting with heart failure and cardiac arrhythmias were excluded. Information of socio-demographic characteristics like age, sex, religion, socioeconomic status, social background, occupation

and smoking habits was collected. For diagnosis of COPD, careful and detailed history and clinical examination was done. These were combined with various clinical and radiological tests to confirm the presence of COPD and associated cardiovascular complications to make a complete diagnosis. All cases were subjected for pulmonary function test using spirometric evaluation of; Forced expiratory volume in one second (FEV_1), Forced vital capacity (FVC) and Ratio of FEV_1/FVC. The best of three attempts were taken. The severity of COPD was assessed according to GOLD scale: [9]

Mild (GOLD 1):FEV_1 ≥80% of predicted
Moderate (GOLD 2): FEV_1 50–79% of predicted
Severe (GOLD 3): FEV_1, 30–49% of predicted
Very severe (GOLD 4): FEV_1<30% or chronic respiratory failure symptoms

2D echocardiography was performed to detect the presence of pulmonary hypertension, right ventricular hypertrophy, right ventricular dilatation and right ventricular failure. [4,8,10] Following points were noted in echocardiography: Pulmonary artery diameter, evidence of pulmonary hypertension, right ventricular hypertrophy (RVH), right ventricular dilatation, right atrial dilatation, right ventricular failure and tricuspid regurgitation. RVH was taken if thickness of anterior wall and septum was >6 mm. Right ventricular dilatation was taken if right ventricular diastolic dimension was >25mm. Right atrial dilatation was taken if right atrial was dilatation >3.6 cm. Right ventricular failure was taken if there was presence of tricuspid regurgitation, RV wall motion abnormality, dilatation of inferior venacava and hepatic veins. The presence of right ventricular dilation, right ventricular hypertrophy or right ventricular failure was taken as evidence of cor-pulmonale.

RESULTS

The mean age was 60.1 years, range 40-85 years. The maximum incidence of COPD in the study is among the age group 50-69 years i.e. in the 6th and 7th decade (68%). No patients were less than 40 years and only 2% of the patients were >80 years.

Total number of patients in study was 50, out of which 44 were male and six were female.

Out of these 50 patients, 47 patients had cough, 45 patients had sputum and 44 patients had dyspnoea as symptoms on admission.

In these patients, 12% of the total patients had tobacco use duration less than 19 years while only 6% had it for more than 40 years. Maximum duration was for patients in group 20-29 years (36%). Out of these 50 patients, 18% (nine cases) did not have any history of tobacco use at all. COPD in these patients was presumed to be due to environmental and/or genetic factors. A total of 30 (60%) patients had signs of edema and 27 (54%) patients had Loud P_2 on auscultation. On chest radiograph, 31 (62%) patients had increased bronchovascular markings suggestive of chronic bronchitis, 19 (38%) patients had emphysema and 28 (56%) patients had cardiomegaly. X-ray evidence of pulmonary hypertension i.e. prominent pulmonary conus was present in 48% of the patients.

Table 1: 2D Echocardiography findings in cases in the study group

Echocardiography findings	Cases (%) (n=50)
RA/RV Dilatation	17 (34)
RA/RV Hypertrophy	24 (48)
RVF	26 (52)
PAH	35 (70)
CorPulmonale	35 (70)

Abbreviations: RA, right atrial; RV, right ventricular; RVF, right ventricular failure; PAH, pulmonary arterial hypertension

Table 2: Distribution of cases in the study group as per severity of disease

Severity of disease (FEV_1% predicted)	Cases (%)
Mild COPD (≥80%)	0 (0)
Moderate (50-79%)	21 (42)
Severe (30-49%)	29 (58)
Total	**50 (100)**

Abbreviations: FEV, forced expiratory volume; COPD, chronic obstructive pulmonary disease

Table 3: Association between 2D echocardiography findings and severity of disease in study group

Echocardiography findings		Severity of disease			Chi-square	P Value
		Mild	Moderate	Severe		
RA/RV Dilatation	Positive	0	8	9	0.27	>0.05
	Negative	0	13	20		
RA/RV Hypertrophy	Positive	0	11	13	0.28	>0.05
	Negative	0	10	16		
RVF	Positive	0	14	12	3.12	>0.05
	Negative	0	7	17		
PAH	Positive	0	15	20	0.04	>0.05
	Negative	0	6	9		
CorPulmonale	Positive	0	15	20	0.04	>0.05
	Negative	0	6	9		

Abbreviations: RA, right atrial; RV, right ventricular; RVF, right ventricular failure; PAH, pulmonary arterial hypertension

Table 4: Association between 2D echocardiography findings and Emphysema in study group

Echocardiography findings		Emphysema		Chi-square	P Value
		Positive	Negative		
RA/RV Dilatation	Positive	1	16	11.28	<0.01
	Negative	18	15		
RA/RV Hypertrophy	Positive	8	16	0.42	>0.05
	Negative	11	15		
RVF	Positive	9	17	0.26	>0.05
	Negative	10	14		
PAH	Positive	15	20	1.17	>0.05
	Negative	4	11		
CorPulmonale	Positive	13	22	004	>0.05
	Negative	6	9		

Abbreviations: RA, right atrial; RV, right ventricular; RVF, right ventricular failure; PAH, pulmonary arterial hypertension

Table 5: Association between 2D echocardiography findings & Chronic Bronchitis in study group

Echocardiography findings		Chronic Bronchitis		Chi-square	P Value
		Positive	Negative		
RA/RV Dilatation	Positive	16	1	11.28	<0.01
	Negative	15	18		
RA/RV Hypertrophy	Positive	16	8	0.42	>0.05
	Negative	15	11		
RVF	Positive	17	9	0.26	>0.05
	Negative	14	10		
PAH	Positive	20	15	1.17	>0.05
	Negative	11	4		
CorPulmonale	Positive	22	13	004	>0.05
RA/RV Dilatation	Negative	9	6		

Abbreviations: RA, right atrial; RV, right ventricular; RVF, right ventricular failure; PAH, pulmonary arterial hypertension

Table 6: Incidence of the individual findings in this study and comparing with a previous study is as follows:

Echo findings	Himelmann*et al.*[14], 1958 (%)	Present study (%)
RA/RV Dilatation	89	34
RA/RV Hypertrophy	25	48
RVF	55	52
PAH	49	70
Cor Pulmonale	75	70

Abbreviations: RA, right atrial; RV, right ventricular; RVF, right ventricular failure; PAH, pulmonary arterial hypertension

CONCLUSIONS

2D echocardiography is more sensitive than electrocardiography, radiography and clinical methods in detecting cardiovascular complications like PAH, corpulomale and R. V. dysfunction in COPD. Despite of its benefits, echocardiography in COPD is not without inherent drawbacks. The substernal location of the right ventricle itself and also the difficulties posed by the over inflation of lungs, which reduces the window available for examination, leads to problems in obtaining a good echocardiographic study. But most studies report that adequate examination can be obtained in more than70% of the patients. Reliable echo measurements obtained in different studies like Danchin*et al*[15] was80% and in present study it was 70%.

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