



A study of cardiovascular manifestations of COPD

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Abstract:

Objective: To confirm various cardiovascular manifestations in Chronic Obstructive Pulmonary Disease (COPD) patients and to observe correlation with its severity. **Methodology:** This prospective cross sectional study conducted at Department of TB & Chest Diseases, Hamidia Hospital, Gandhi Medical College, Bhopal between March 2008 to Dec 2013. Patient having diagnosed COPD were subjected to this study. Purpose of study was explained and informed consent was obtained. **Results:** Total 37% (n=74) males and 4% (n=8) females were found to have cardiovascular complications in the study group. Cardiovascular manifestations were most commonly observed in very severe stage of COPD, which were 54 out of 76 (71.05%). In mild cases no patient was diagnosed with cardiovascular manifestations, moderate 4 out of 38 (10.5%) and severe disease stage 24 patients out of 62 (38.7%). Majority of the patients= 97(48.5%) were in the age group of 60-70 years, out of which 41(20.5%) were having cardiovascular complications. Likewise, 28(14%) out of 74 (37%) patients were having cardiovascular complication in the age group of 50-60 years and 13(6.5%) out of total 29(14.5%) were with cardiovascular complication in 40-50 years. **Conclusion:** Stage of COPD is proportional to prevalence and severity of Pulmonary artery hypertension (PAH). Electrocardiogram (ECG) can be used for screening of COPD with most common parameters observed may be Right axis deviation, P pulmonale, and Right Ventricular Hypertrophy. 2D-Echocardiography (ECHO) may be better modality for detection of Left Ventricular dysfunction. Most common complication detected in ECHO is PAH. Duration of smoking (smoking index) increases the incidence of Cardiovascular manifestations. ECG and ECHO being noninvasive and easily available, can be routinely recommended for COPD patients.

Key words: COPD, Cardiac manifestation, ECG, ECHO, PAH

Introduction

Chronic Obstructive Pulmonary Disease (COPD) is a major cause of chronic morbidity and mortality, being 4th leading cause of death worldwide and further increase in its prevalence and mortality can be expected in coming years. This disease process is manifest by progressive airflow limitation, hyperinflation and air trapping, hypoxemia, hypercapnea, and elevations in pulmonary vascular pressures. Clinically, individuals with COPD develop breathlessness, cough, sputum production and disease exacerbations that impair quality of life. Factors that portend a poor prognosis include severity of airflow limitation, ventilatory capacity, hypercapnea, and pulmonary hypertension [1]. Cardiovascular manifestations are most important among them. Pulmonary arterial hypertension (PAH) and chronic cor-pulmonale are major cardiovascular complications. Right ventricular dysfunction is common in patients with COPD particularly in those with low oxygen tension. It can further reduce exercise tolerance, increase dyspnea and decrease in functional status. Patient with COPD also carry increased risk of mortality due to cardiac arrhythmias, ischemic heart disease, myocardial infarction, and congestive heart failure. Pulmonary hypertension in COPD is placed in group 3 of the 2003 WHO classification of PAH, i.e., PAH associated with disorders of the respiratory system and/or hypoxemia. PAH associated with lung disease is defined as resting mean PAP (mPAP) greater than 20 mm Hg, which is different from the definition of primary pulmonary hypertension (mPAP >25 mm Hg) [2]. There is scarcity of data in this segment of correlation of cardio-pulmonary disease and so this study was planned to confirm various cardiovascular manifestations in COPD patients and to find out correlation of cardiovascular complications with its severity.

Materials and Methods:

This prospective cross sectional study was conducted on 200 patients (age group >40 and <70 years) of COPD, presenting in indoor and outdoor at Department of TB & Chest Diseases, Hamidia Hospital, Gandhi Medical College, Bhopal, from March 2008 to Dec 2013. After permission of departmental ethical committee and taking informed consent, the enrolled COPD patients were diagnosed on the basis of history, clinical examination, spirometry (pre and post bronchodilator), and chest X-ray PA view. ECG and echocardiography was also done. All patients underwent above mentioned

procedure and correlation between stages of COPD (as per GOLD guideline criteria) and cardiovascular complications was studied. All patients having known respiratory disease like old treated PTB, bronchiectasis, bronchial asthma, as well as diabetes, systemic hypertension and rheumatic, congenital or ischaemic heart disease were kept out of the study.

Results:

This study had been conducted on 200 diagnosed patients of COPD, Out of these 178 were males and 22 were females. Patients were in age group of 40-70years with mean age of 57.76+7.919. Patients were categorized in four stages of COPD as mild(n=24) moderate(n=38), severe(n=62) and very severe(n=76), as per GOLD criteria. Total 37%(n=74) males and 4%(n=8) females were found to have cardiovascular complications in the study group. In this study, cardiovascular manifestations were most commonly observed in very severe stage of COPD, which were 54 out of 76 (71.05%). In mild cases no patient was diagnosed with cardiovascular manifestations, moderate 4 out of 38 (10.5%) and severe disease stage 24 patients out of 62 (38.7%). Majority of the patients= 97(48.5%) were in the age group of 60-70 years, out of which 41(20.5%) were having cardiovascular complications. Likewise, 28(14%) out of 74 (37%) patients were having cardiovascular complication in the age group of 50-60 years and 13(6.5%) out of total 29(14.5%) were with cardiovascular complication in 40-50 years

Smoking determinant: in this study all the males were smoker and females were non smoker. It has been observed in the study as the smoking index increases, the percentages of cardiovascular complications also increased, out of 30 patients with smoking index >1200, 26(86.66%) were having cardiovascular complications, followed by 18(64.2%) out of 28 with smoking index (900-1200), 26(31.70%) among 82 with smoking index 600-900 and 4(10.52%) of 38 with smoking index 300-600 were detected to have cardiovascular complication. Overall incidence of cardiovascular manifestations among smokers is 41.57% and non smoker is 36.36%. As the severity of the disease increases, the incidence of cardiovascular complications increases among smokers. In very severe disease among smokers, 52(76.47%) out of 68 were with cardiovascular complications, followed by 18(36%) out of 50 in severe disease, 4(11.1%) out of 36 in moderate disease were with cardiovascular complications. There were no patient with

cardiovascular complications in mild disease (n=24) though all were smokers.

Among non smokers that were all females, only 4(50%) among 8 in very severe diseases group and 4(33.3%) out of 12 in severe disease group were showing cardiac disease. There were no patient with cardiovascular manifestations among mild and moderate disease in female (n=2) group.

Duration of symptoms; in the smokers, it was observed that, as the duration of symptoms increases, the incidence of cardiovascular manifestations increases, for the duration of > 4years, 62(75.60%) out of 82 were present with cardiovascular complications with total of 94 including non smokers, in duration of 2-4years, 16(36.36%) out of 44 with total of 50 and duration < 2 years, 4(7.69%) out of 52 with total of 56 including non smokers were having cardiovascular complications.

Pulmonary hypertension; as the severity stage of COPD increases, the prevalence and severity of Pulmonary artery hypertension (as indirect ECHO evidenced) also increases. Overall 41% (n=82) patients were having PAH. In very severe disease, 54(71.05%) out of 76 have PAH, in which 34(44.73%) belongs to severe PAH grade, 18(23.68%) in moderate PAH, 2(2.63%) in mild PAH. In severe disease, 24(38.70%) out of 62 were having PAH in which 10(16.12%) severe PAH, 10(16.12%) in moderate PAH and 4(6.45%) in mild PAH. In moderate disease, 4(10.52%) of 38 were having PAH. There were only 2(5.26%) with mild PAH and 2(5.26%) with moderate PAH. There were no patient of PAH in mild COPD (n=24).

ECG changes in COPD: Over all there were 56% patients with ECG changes. Incidence of ECG changes seen to increase with severity of COPD. Majority of patients were in very severe disease, 64(86.48%) out of 76, followed by 30(48.38%) of 62 in severe stage, 12(31.57%) of 38 in moderate and 6(25%) of 24 in mild disease.

Table 1: Analysis of ECG among COPD Patients:

ECG features	No. of patients	Percentages %
Right Axis Deviation	80	40
P pulmonale	78	38
RVH	73	36.5
Poor progression of R wave	59	29.5
Increase R in V1	18	09
Left ventricular hypertrophy	21	10.5
Incomplete RBBB	15	7.5

ECHO Findings in COPD; all the diagnosed patients of COPD with cardiovascular complications have number of echo findings, in which pulmonary hypertension(41%), core pulmonale (38.5%), right ventricular dilation(33.5%) and right ventricular hypertrophy(28.5%) are the major observations.

Table 2: Analysis of ECHO findings Among COPD patients:

Echo features	No. of patients	Percentages%
LVD	73	36.5
PAH	82	41%
Cor-pulmonale	79	39.5
RV dilation	67	33.5
RA dilation	59	29.5
Right ventricular hypertrophy	69	34.5
RV failure	27	13.5
Left ventricular hypertrophy	21	10.5
Bi-ventricular failure	21	10.5

Discussion

Majority of the patients in were in the age group of 60-70 years with mean age 57.76+/-7.92years, which was almost similar to previous studies. In studies like Benjamin Burrows et al 1972[1] mean age was 56.5+/-7.4 years, Keller & Shepard et al 1986 (59+/-7 years) [2] and Putnik and Povazan 1998 (59.25 years) [3]. Patients of age group of 50-70 years form the majority admitted patients, these were more symptomatic mostly due to longer duration of symptoms, tobacco exposure and probably repeated respiratory infections.

In this study, male: female ratio was 8.09. Males also had been dominating among study group, in different studies like J. C. Banerjea 1966 (80%) [4]. Benjamin Burrows et al 1972 (92%) [1] and V. K. Singh et al 1989(94.6%) [5].

The higher prevalence in males can be attributed to smoking, in our study none of the female were smoker but it was noticed that most of them had history of cooking with dried cow dung or dried wood fuel in a poorly ventilated kitchen. Even in the smokers, number and severity of cardiovascular complications are higher in patients with high smoking index. It is highly significant in smoking index of more then or equals to 900. These patients were more likely to have cardiovascular complications. Although the type of smoke (bidi/cigarette/ others) was not studied.

Duration of the symptoms is also significant, mean duration of disease was 5.78 years with range of 2 to 20 years. In the groups of duration 2-4years and >4 years cardiovascular complications are highly significant and severe, as compare to the <2 years duration of symptoms. In the present study 37.37% patients (n=34) belonged to stage 4 of COPD.

ECG Findings; in the study, the prevalence of all the ECG findings except incomplete RBBB, increases as the severity of the diseases increased, but this relation was not found to be statistically significant.

Comparison of prevalence of different findings,

1. RVH; in our study RVH prevalence was 40%. In other studies like FJC Millard 1967[6] it was 45.7%, Padmavati & Raizada, 1972 (59.7%) [7], Murphy & Hutcheson, 1974 (43.66%) [8], Gupta & Khastgir 1989(50%) [9].

2. RAD; in our study it was 36%, its prevalence may be ranging from 19%-74%, evident from different studies, Padmavati & Pathak 1959(74%), Silver & Calatayud, 1971(19%) [10], Padmavati & Raizada, 1972(43.2%) [7], Gupta & khastgir 1989(33.3%),

3. R wave in V1; Meyer et al [11] mentions qR in V1 as one of the diagnostic criteria for RVH. In this study it was 10% and in Murphy & Hutcheson 1974 it was 15%.

4.

5. Prevalence of P-pulmonale; in this study it was 39% and in other studies Silver & Calatayud 1970(46.2%), Gupta & Khastgir 1989(43.3%) and Caird and Wilcken 1962 (36.7%) [12]. P-pulmonale has been used as an indirect evidence of RVH by various authors as Winternitz 1935[13] Hecht 1937 [14]. Others regarded it as positional changes due to hyperinflation, lowering of diaphragm and vertical position of heart. Padmavati and Raizada state that its occurrence may attributed largely to positional and partly to hemodynamic changes, but it can not be designated an unequivocal criteria of RVH.

Comparison of ECHO findings; maximum prevalence was found in the most severely affected patients. In the present study 41% had echocardiographic evidence cardiovascular complications. Comparison of prevalence of Echo findings with Himelmann 1958 [15] and B Shetha et al 2009 [16] studies are given below (table 3 & 4):

Table no. 3

Echo findings	Himelmann 1958(%)	Our study(%)
RV dilation	55%	33.5%
RA enlargement	39%	29.5%
RV hypertrophy	25%	34.5%
PAH	49%	41%
Cor pulmonale	75%	39.5%

Table no. 4

Echo findings	B Shrestha et al 2009(%)	Our study(%)
LV hypertrophy	14.1%	10.5%
LV failure	20.6%	10.5%
LVEDD	38.7%	36.5%

Pulmonary Hypertension; prevalence in moderate, severe and very severe disease groups are found to be fairly correlating with the inference drawn by Thabut et al,[17] and Weitzenblum et al [18]. In severe to very COPD disease the increment of PAH is highly significant so, as severity of COPD increases, severity of PAH also increases. In our study 41% of patients had PAH. 9.756% had mild PAH, 36.58% had moderate PAH, 53.65% had severe PAH. In 175

patients of COPD Weitzenblum *et al*, PAH is found in 35%. Thabut *et al* showed that, out of 215 patients of COPD, Mild PAH in 36.7%, moderate PAH in 9.8% and severe PAH in 3.7%. National emphysema treatment trial, [19] study of 120 patients of COPD with PAH, undergone transthoracic Doppler echocardiography, mild to moderate PAH was present in 95% and severe PAH in 5% cases only. In our study the severity of PAH is significantly different from others. It could be due to different genetic, racial, or other factors. Meilen K. Han *et al* also had given conclusion that severe PAH is unusual in COPD and when found other causes of PAH should be excluded.

Conclusion and Recommendations:

Stage of COPD is proportional to prevalence and severity of PAH. ECG can be used for screening of COPD with most common parameters observed may be Right axis deviation, P pulmonale, and Right Ventricular Hypertrophy. But, ECHO may be better modality for detection of Left Ventricular dysfunction as compared to ECG. Most common complication detected in ECHO is PAH. Also, Duration of smoking (smoking index) increases the incidence of cardiovascular manifestations with highest incidence in patients who smoked for longer duration.

Although ECG and ECHO are less informative as compared to pulmonary artery catheterization, ECHO being noninvasive and easily available, can be routinely recommended among COPD patients.

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Conflict of Interest: None

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