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An Observational Study of Echo-Cardiographic Findings and Factors Affecting Severity of Pulmonary Hypertention in Chronic Obstructive Pulmonary Disease Patients

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Abstract
Introduction:- *India is one of the most affected countries in the world with COPD and contributes significantly to the mortality and morbidity of the disease. CVD is the most prevalent cause of co-morbidities and the second most common cause of mortality, next to respiratory failure. Pulmonary hypertension (PHTN) is the principle cardiovascular complication encountered in COPD.*
Objectives:- *1) To study the prevalence of cardiovascular involvement in COPD patients. 2) To study the relation between severity of PHTN and culprit-factors, if exists.*
Methodology:- *Present study was conducted from August-2020 to Feb-2021 at Department of General Medicine PDU Medical College, Churu, as hospital based cross sectional study including 102 randomly selected cases of clinically suspected COPD who attended OPD or got admitted in the Department. Their socio-demographic details as well as clinical history details were recorded and data were analysed with help of compatible software.*
Result:- *In the present study, among 102 patients, 82 (80.39%) were males and 20 (19.6%) were female. Majority of the patients (90.19%) were smokers. The mean duration of tobacco use was 30.89± 6.80 pack years. Tricuspid regurgitation was measurable in 42(41.17%) patients. Pulmonary hypertension was observed in 38 (37.25 %) and cor-pulmonale in 20 (19.60%) patients.16 patients (15.68 %) had left ventricular diastolic dysfunction.*
Mild PHTN was observed in 13 (34.21%) patients. Moderate PHTN was observed in 15 (39.47 %) patients. Severe PHTN was observed in 10(26.32%) patients. As the severity of COPD increases frequency of PHTN also increases. The patients with PHTN were relatively older ($p < 0.001$). Patients with PHTN experienced significantly more number of exacerbations ($p < 0.001$). Smoking is also a positive factor in development of PHTN ($p < 0.001$).
Conclusion:- *Echo-Cardiography is a helpful tool for timely management of cardiac dysfunction in these patients.*
Keywords:- *COPD, Echo-cardiography, PHTN, Cor-Pulmonale*

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I. Introduction:

Chronic obstructive pulmonary disease (COPD), represents an important public health challenge that is both preventable and treatable[1]. Globally the COPD burden is projected to increase in coming decades because of continued exposure to risk factors and aging[2]. Chronic obstructive pulmonary disease is characterized by persistent airflow limitation that is not fully reversible. The airflow limitation 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[3]. In spite of under recognition and under diagnosis of COPD, it is the FOURTH leading cause of mortality in USA and will become the THIRD leading cause of death worldwide by 2020[2].

In India the prevalence rate of COPD in males varies from 2.12% to 9.4% & 1.4% to 4.08% and in females varies from 1.33% to 1.49% & 1.2% to 2.55% in studies conducted from North India and South India respectively[4]. COPD also has significant extra-pulmonary (systemic) effects that lead to co-morbid conditions. COPD has considerable effects on cardiac function including that of right ventricle and left ventricle as well as of the pulmonary blood vessels[5]. Most of the increased mortality associated with COPD is due to cardiac disease[6]. Pulmonary hypertension (PHTN) is the principle cardiovascular complication encountered in COPD. Right ventricular dysfunction (Cor-Pulmonale) is common in COPD patients particularly those with a low oxygen saturation[7]. The early recognition and management of PHTN may lead to prolonged survival and improved quality of life[8]. Chronic Cor-Pulmonale is a consequence of the increased work of right ventrical,almost invariably due to pulmonary hypertension. In US, Cor-Pulmonale averages about 6 to 7% of all types of adult heart disease and COPD is the most common cause.In Delhi, the incidence has been estimated to about 16%[9] among COPD patients.

The diagnosis of cardiac dysfunction in the setting of COPD poses a major challenge to the physicians. The clinical presentation and physical signs may be similar. Clinical examination, chest radiograph and electrocardiography may not yield a confirmatory diagnosis in many cases. Cardiac catheterization remains the "gold standard" for the measurement of pulmonary arterial pressures[7]. However this procedure is not feasible in all patients due to several reasons. Early and appropriate diagnosis of cardiac dysfunction may result in a significant decline in morbidity and mortality. Echocardiography provides a non-invasive method to evaluate cardiac status like - right ventricular (RV) function, RV filling pressure, tricuspid regurgitation and left ventricular function [10]. Many studies have confirmed that echocardiographically derived estimates of pulmonary artery pressure (PAP) correlate closely with those derived by cardiac catheterization [11,12]

Echocardiography has the advantage of repeatability and has no contraindications. It can also be used in very sick patients at their bed side.

Therefore, this study was undertaken to find out the utility of echocardiography in the assessment of cardiac dysfunction in COPD patients.

II. Material And Methods:

This present study was carried out among 102 randomly selected cases of clinically suspected COPD who attended OPD or got admitted in the Department of General Medicine PDU Medical College, Churu from August-2020 to Feb-2021. Informed consent was taken from all of them for participation in the study. This study was conducted after approval by Institutional Ethical Committee. This was an observational, cross sectional study. The 102 patients selected underwent spirometry and were classified into mild, moderate, severe and very severe COPD as per the Global Initiative for Chronic Obstructive Lung Disease (GOLD) 2015 guidelines. every patient with detailed clinical history (including grade of dyspnea, smoking status and frequency of exacerbation) or physical finding suggestive of copd had undergone a routine investigation such as cbc, esr, chest x-ray, spirometry, sputum for afb by ziehl-nelson method., blood sugar, liver function tests, renal function tests, ECG, and Echo-cardiography.

Chi-square test and Fisher's exact test were used for the analysis of qualitative data. Students't 'test was used for comparison of data summarized as mean and standard deviation. Results were expressed as means ± standard deviation (SD) and as relative frequencies. Statistical significance was set at $p < 0.05$.

III. Results:

In the present study, among 102 patients, 82 (80.39%) were males and 20 (19.6%) were female, majority (52.94%) of the patients were in the age group of 50 to 59 years. The mean duration of illness was 7.30±1.80 years. Maximum number of patients (78.43%) had symptoms for less than 10 years and (21.56 %) of patients had symptoms for $\geq$ 10 years. Nearly 2/3rdof the patients had severe and very severe disease according to the **GOLD classification**. (**Table 1**) Majority of the patients (90.19%) were smokers. The mean duration of tobacco use was 30.89± 6.80 pack years. Tricuspid regurgitation was measurable in 42(41.17%) patients. Pulmonary hypertension was observed in 38 (37.25 %) and corpulmonale in 20 (19.60%) patients.16 patients (15.68 %) had left ventricular diastolic dysfunction. (**Graph 1**)

Mild PHTN was observed in 13 (34.21%) patients. Moderate PHTN was observed in 15 (39.47 %) patients. Severe PHTN was observed in 10(26.32%) patients. Majority (32 out of 38 patients) had severe and very severe COPD. As the severity of COPD increases severity of PHTN also increases. (**Table 2**) The patients with PHTN were relatively older ($p < 0.001$). There was no significant difference in the sex distribution according to the presence of PHTN ($p = 0.3$). The subjects with PHTN had significantly longer duration of the illness ($p < 0.001$). Patients with PHTN experienced significantly more number of exacerbations ($p < 0.001$). Smoking is also a positive factor in development of PHTN ($p < 0.001$). (**Table 3**)

Graph – 1
Distribution according to 2D Echocardiographic findings:

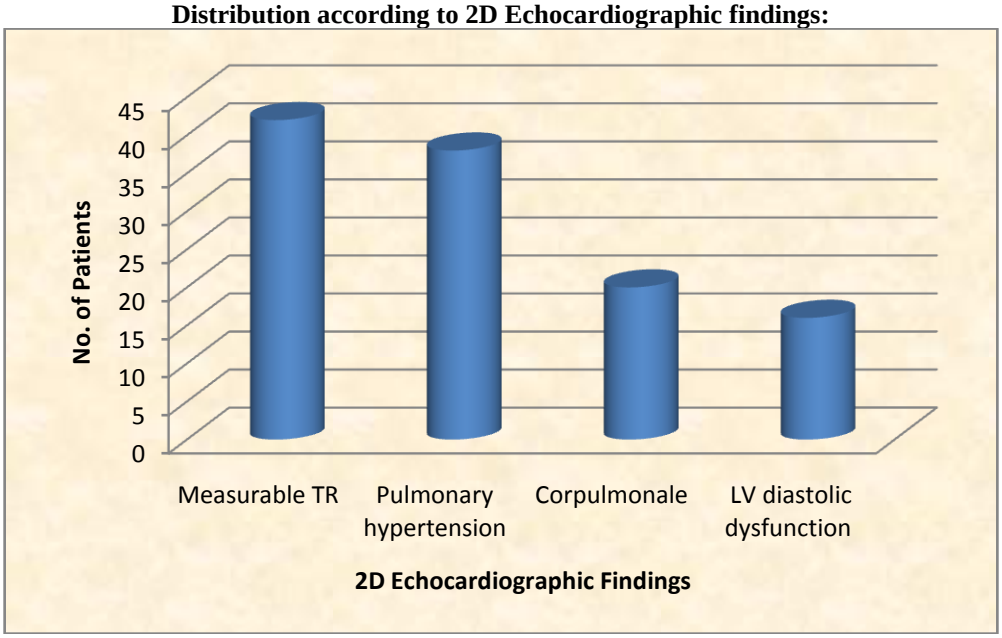

Table 1: Severity of COPD according to GOLD classification:

GOLD stage	No. of patients	Percentage
Mild	18	17.64%
Moderate	22	21.56%
Severe	36	35.30%
Very severe	26	25.50%
Total	102	100.00%

Table 2: Severity of PHTN in relation to Severity of COPD :

Severity of COPD	Severity of PHTN		
	Mild	Moderate	Severe
Mild (18)	0 (0.00%)	0 (0.00%)	0 (0.00%)
Moderate (22)	5 (83.33%)	1 (16.67%)	0 (0.00%)
Severe (36)	7 (41.18%)	6 (35.29%)	4 (23.53%)
Very severe (26)	1 (6.67%)	8 (53.33%)	6 (40.00%)

Table :-3. A Comparative Study Of Factors Affecting Development Of PHTN In COPD Patients

Variables	PHTN		P value
	Present [n=38]	Absent [n=64]	
1. Age in years	59.30 ± 4.10	51.50 ± 4.80	<0.001
2. Duration of illness in years	9.90 ± 1.50	5.80 ± 2.60	<0.001
3. Pack years	38.00 ± 8.90	26.60 ±12.90	<0.001
4. No of exacerbations(in previous year)	2.10 ± 0.67	0.67 ± 0.69	<0.001

Mean ±SD

IV. Discussions:

Chronic obstructive pulmonary disease is known to be associated with various cardiac co-morbidities. The pathogenesis of pulmonary vascular disease in COPD is likely multi-factorial. [13] Pulmonary vascular disease associated with COPD increases morbidity and worsens survival. The Lung Health Study[13] showed that a substantial proportion of deaths in patients with mild COPD was the result of cardiovascular complications.

Increased cardiovascular mortality has been seen particularly in patients older than 65 years with COPD. Pulmonary Hypertension (PHTN) is the principle cardiovascular complication encountered in COPD patients. Pulmonary Hypertension in the adult is said to be present when the Mean Pulmonary Artery Pressure is 25 mm Hg or more at rest or 30mmHg or more with exercise. The severity of Pulmonary Hypertension tends to correlate with the degree of airflow obstruction and severity of hypoxemia[14,15]. Chronic Cor-Pulmonale is a consequence of the increased work of right ventricle, almost invariably due to Pulmonary Hypertension. Evidence of Cor-Pulmonale was found in 40% of patients with COPD in one autopsy study [16]. Pulmonary hypertension and RV dysfunction are well known to complicate the course of illness and adversely affect the survival and quality of life. The presence of PHTN leads to progressive worsening of RV function, resulting in right heart failure.

Clinical signs are not always confirmatory in the assessment of cardiovascular co-morbidities in COPD as there is overlap in symptoms and signs.[17] Furthermore the clinical signs occur late, far after the development of pulmonary hypertension.

Although cardiac catheterization is considered to be the gold standard for the estimation of pulmonary artery pressure, it has many limitations to be used routinely. There are significant risks[18] and cost issues associated with the procedure whereas Echocardiography on the other hand is a rapid, non-invasive tool to assess the cardiac status in COPD patients. Numerous studies have evaluated the usefulness of echocardiography in evaluation of pulmonary hypertension and cardiac changes secondary to COPD[19-22]. Therefore this study was undertaken to evaluate the utility of echocardiography in assessing cardiac dysfunction in 102 COPD patients and also assessing the relation of PHTN (detected by echo), with the duration and severity of disease, if exists. All the 102 subjects had dyspnea. Majority of them 36 patients (35.29%) had grade 3 dyspnea according to MMRC scale. 5 patients (4.91%) were dyspneic at rest (grade 4). This is in contrast to lower dyspnea reported by de Torres[23] in western population with COPD. He showed 15% patients had grade 3 dyspnea and 4% patients had grade 4 dyspnea. This might reflects the delay in seeking medical attention in Indian patients. The present study had more patients with severe and very severe disease (nearly 2/3rd). In a study by Daveet al[24], the frequency of mild, moderate, severe and very severe COPD was 12%, 19%, 31% and 38% respectively. In a study by Sachin D et al[25], the frequency of mild, moderate, severe and very severe COPD was 8%, 22%, 44% and 26% respectively. Smoking is the most important risk factor for COPD worldwide. In the present study majority of the patients 90.20% were smokers. Most of them used bidi. Twelve females (60%) were smokers. The mean duration of tobacco use was 30.89 ± 6.80 pack years. In study by Gupta S, Khastgiret al[26] 87.25% were smoker. Hurst JR et al[27] showed 88.67% patients were smoker in his study. The incidence of non-smoker COPD in the study was 9.80 % (10 patients).This was lower than that reported by Behrendt[28] who stated non-smoker COPD to account for about 23-25% of cases in developed nations. This higher proportion reported by Behrendt could be due to the fact that it included former smokers with < 5 pack years. Pulmonary hypertension was observed in 38 (37.25%) patients. 13 patients (34.21%) had mild PHTN.15 patients (39.47%) had moderate PHTN. Severe PHTN was observed in 10 (26.32%) subjects. The level of PHTN has a prognostic value in COPD. This has been demonstrated by several studies. In one of the study[29], the 5-year survival rates were 50% in mild PHTN, 30% in those with moderate to severe PHTN, and 8% in very severe PHTN. Thus a high degree of PHTN bears poor prognosis. The incidence of PHTN in moderate, severe and very severe COPD was 27.27%, 47.22% and 57.69% respectively. Gupta et al[30] showed an overall incidence of PHTN in 42.5% patients and frequencies in mild, moderate, severe and very severe COPD was 11%, 9%, 40% and 33.3% respectively. In the present study none of the patients with mild COPD had PHTN. This supports the notion that the incidence of PHTN increases with advanced COPD[31]. The incidence of corpulmonale was 19.60% (20 patients) in our study as evidence by RV dilatation (more than 2.6 cm.) whereas Gupta N K et al[30] reported corpulmonale in 17.5% of patients.

V. **Conclusion**:

The present study has concluded that cardiovascular co-morbidities are common in COPD patients and Echo-Cardiography is useful for accurate assessment of cardiac status in COPD patients.

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