Degree of Pulmonary Hypertension in Patients of COPD Attending a Tertiary Care Hospital

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Abstract

Introduction: Chronic obstructive pulmonary disease (COPD) is a major cause of morbidity and mortality in India. The development of pulmonary hypertension (PH) in COPD adversely affects survival and exercise capacity and is associated with an increased risk of severe acute exacerbation. Aims and Objectives: Present study aimed to describe the distribution of echocardiographically assessed pulmonary artery systolic pressure in the COPD patients attending pulmonary medicine OPD, to estimate the proportion of PH among such patients and to identify associated factors. Methodology: This Cross sectional study was done on 145 patients of COPD fulfilling the inclusion criteria were included in this study. These patients were evaluated for the presence of PH using chest X-ray, 2D-Echocardiography and electrocardiogram. Results: Pulmonary hypertension was present in 17 (29.8%) patients with moderate, 36 (60%) with severe and 36 (52.4%) with very severe COPD. Mild PH was seen in 52(73%), moderate in 11(15.4%) and severe in 18(11.2%) patients. Patient exposed to both smoking and biomass fuel smoke had more frequent occurrence of PH (56.8%) as compared to exposure to single risk factor of either tobacco smoke (47.1%) or biomass fuel (52.4%). Thus overall proportion of PH among reported cases of COPD patients was 48.6% in our study. Conclusion: With the increase in severity of COPD the proportion of PH rises. This study emphasizes the early detection of COPD and the importance of screening for PH through clinical assessment and non-invasive techniques 2-D Echocardiography.

Keywords: Chronic obstructive pulmonary disease, pulmonary hypertension, echocardiography.

Introduction

COPD is the fourth leading cause of death and is projected to be the 3rd leading cause by 2020 [1]. The prevalence of PH in stable COPD patients varies from 10-30% [2]. PH is defined as a mean pulmonary artery pressure of ≥ 25 mmHg at rest [3,4]. The ideal method to diagnose PH is right heart catherization. However in the absence of this facility, transthoracic Doppler echocardiography is a non-invasive screening test for detection of PH which fairly correlates the catherization findings.

The development of PH in COPD adversely affects survival and exercise capacity and is associated with an increased risk of severe acute exacerbation; therefore its early detection is mandatory to prevent heart failure [5].

Aims and Objectives

This study aimed to describe the distribution of echocardiographically assessed pulmonary artery systolic pressure in the COPD patients attending pulmonary medicine OPD, to estimate the proportion of PH among such patients and to identify associated factors.

Methodology

145 patients of COPD proven by spirometry as per latest GOLD Guidelines [6] attending the outpatient department of pulmonary medicine, were evaluated for presence of PH using chest X-ray, 2D-Echocardiography and electrocardiogram.

We included patients with age more than 40 years and with history of smoking with pack years of more than 20 and exposure to biomass fuel smoke. A significant biomass exposure was defined as a subject with more than 80 hours/year with a minimum exposure of 10 years. For patients with dual exposure of biomass and smoking, biomass fuel smoke exposure of ≥80 hours/years with a minimum exposure of 10 years with a pack years of ≥20 is considered significant dual exposure.

We excluded patients below 40 years of age, patients with other pulmonary diseases like tuberculosis, bronchiectasis, interstitial pulmonary disease and bronchial asthma, patients with unstable cardio respiratory status defined as occurrence of respiratory failure, broncho pulmonary infection or congestive cardiac failure in previous two months, structural diseases of heart e.g. valvular heart disease, congenital heart disease and cardiomyopathy, ischemic heart disease like typical angina pectoris.
or prior myocardial infarction, patients with primary pulmonary hypertension and hepatic and renal insufficiency.

The parameters noted on echocardiography with the use of 2-D, Color Doppler and M mode were size of right atrium and ventricle, Grade of PH, presence or absence of tricuspid regurgitation signifying severity of PH and pulmonary artery pressure estimation.

Pulmonary artery pressure was estimated based on peak tricuspid regurgitation velocity (TRV) and right atrial pressure (RAP) as per Bernoulli Equation

\[
\text{Pulmonary artery pressure} = \text{Right Ventricular Systolic Pressure} (\text{RVSP})
\]

\[
\text{RVSP} = 4v^2 + \text{RAP}
\]

Table 1:  

| Peak tricuspid regurgitation velocity (m/s) | Presence of other echo PH signs | Echocardiographic probability of pulmonary hypertension |
|--------------------------------------------|--------------------------------|----------------------------------------------------------|
| 2.9-3.4                                    | Yes                            | High                                                     |
| > 3.4                                      |                                |                                                          |
| ≤ 2.8 or not measurable                    | Yes                            | Intermediate                                             |
| 2.9-3.4                                    | No                             |                                                          |
| ≤ 2.8 or not measurable                    | No                             | Low                                                      |

Grading of PH was done according to American heart association guidelines [9]. 36-50 mmHg was considered as mild, 51-60 mmHg was considered as moderate and >60 mmHg was considered as severe.

Results

Out of 145 subjects included in our study, the variables which were observed are listed in table 2

Table 2

| Variables studied                        | No of cases | %    |
|------------------------------------------|-------------|------|
| Male                                     | 76          | 53%  |
| Female                                   | 69          | 47%  |
| Age group 40-55yrs                       | 22          | 15%  |
| Age group 56-70 yrs                      | 77          | 53%  |
| Age group 70 yrs                         | 46          | 32%  |
| Tobacco smokers                          | 104         | 72%  |
| Biomass fuel smoke exposure              | 42          | 28%  |
| Dual exposure to tobacco and biomass smoke | 37          | 25%  |

Table 3: The association between pulmonary hypertension and severity of COPD

| Severity of COPD       | Presence of PH (n) | Total number of cases (N) | %    | p' value |
|------------------------|--------------------|---------------------------|------|----------|
| Mild COPD              | 0                  | 3                         | 0%   | 0.078    |
| Moderate COPD          | 17                 | 57                        | 29.8%| <0.001   |
| Severe COPD            | 36                 | 60                        | 60%  | 0.022    |
| Very severe COPD       | 18                 | 25                        | 72%  | 0.017    |

It was observed that as severity of COPD increased the proportion of cases with pulmonary hypertension also increased. These findings were statistically significant as shown in table 3 (p value <0.05).

Table 4: The association between grades of COPD and severity of pulmonary hypertension

| Severity of COPD         | Mild PH n / total no of COPD cases (n%) | Moderate PH n /total no of cases (n%) | Severe PH n /total no of cases (n%) | p' value |
|--------------------------|----------------------------------------|-------------------------------------|-----------------------------------|----------|
| Moderate COPD            | 14 / 57 (24%)                          | 2 / 57 (3%)                         | 1 / 57 (1.7%)                    | <0.001   |
| Severe COPD              | 31 / 60 (51.6%)                        | 1 / 60 (1.6%)                       | 4 / 60 (6%)                      |          |
| Very Severe COPD         | 7 / 25 (28%)                           | 8 / 25 (32%)                        | 3 / 25 (12%)                    |          |
| Total no of cases of PH  | 52                                      | 11                                  | 8                                |          |
Most of the moderate to severe COPD cases had mild degree of PH, whereas most of the patients with very severe COPD had moderate degree of PH. It was thus observed that severity of pulmonary hypertension increased with increasing severity of COPD, which was statistically significant (p value 0.001) as shown in table 4.

| Risk factors | PH present (n) | Total number of cases (N) | % | ‘P’ value |
|--------------|---------------|--------------------------|---|----------|
| Biomass fuel smoke exposure | 22 | 42 | 52.4% | 0.564 |
| Tobacco Smoker | 49 | 104 | 47.1% | 0.564 |
| Combined Smokers and biomass fuel smoke exposure | 21 | 37 | 56.8% | 0.252 |

It was observed that patients having dual exposure to smoking and biomass fuel had more incidence of pulmonary hypertension (56.8%) as compared to single risk factor of either biomass fuel (52.4%) or tobacco smoking (47.1%) alone. However these results were statistically not significant.

**Discussion**

Pulmonary Hypertension (PH) is defined as an increase in mean pulmonary arterial pressure (PAPm) is ≥25 mmHg at rest assessed by right heart catheterization (RHC) [2]. PH in COPD affects survival and exercise capacity and is associated with increased risk of acute exacerbation. The pulmonary pressure increases during exercise, REM sleep and exacerbations which, eventually leads to right heart failure

In present study, out of 145 patients, 3 (0.2%) had mild, 57 (39%) had moderate, 60 (41.3%) had severe and 25 (17%) had very severe COPD. Pulmonary hypertension was present in 17 (29.8%) patients with moderate, 36 (60%) with severe and 18 (72%) with very severe COPD patients. Pulmonary hypertension was not seen in our patients with mild COPD. Thus overall prevalence of PH among reported cases of COPD patients in our study was 48.6%. These results were statistically significant (p value <0.05). A similar study done by Shruthi Reddy et al [10] found that the prevalence of PH among COPD patient was 50%. In a study by Gupta NK et al [11], the prevalence of PH in mild, moderate and very severe COPD were 16.67%, 54.55%, 60% and 83.33%. Approximately 25% patients with COPD eventually develop cor pulmonale [12].

Out of 71 total cases of PH, we had 52(73%) cases with mild,11(15.4%) with moderate and 8 (11.2%)with severe PH. A similar study done observed mild PH in 50.2%, moderate in 9.8%, severe in 3.7% cases of COPD [13]. Hyperinflation in COPD, compresses the alveolar vessels resulting in pulmonary vasoconstriction, destruction of vascular bed, vascular remodeling and polycythemia thus increasing the pulmonary vascular resistance, ultimately resulting in the development of PH [14]. Thus the incidence of PH is directly proportional to severity of airflow limitation.

As per the smoking status our keen observation was that patients exposed to both smoking and biomass fuel smoke had more frequent occurrence of PH (56.8%) as compared to exposure to single risk factor of either tobacco smoke (47.1%) or biomass fuel (52.4%). However these results were statistically not significant. Biomass is composed of mixture of gases and particles that penetrate deeply into the lung and cause morphologic and biochemical changes and are risk factors for COPD [15,16]. In a study by Rivera et al vascular changes were prominent in both groups, but more severe in the biomass exposed group which could explain why pulmonary hypertension is seen more in biomass exposed group [17]. The pathophysiology of the development of PH in COPD patients is due to chronic exposure of airways to noxious particles like tobacco smoke and biomass fuel smoke. Hence combined exposure to smoking and biomass increases the risk of PH. A similar study done by bunyamin et al showed that frequency of PH is higher in patients exposed to biomass fuel than tobacco smoke [18].

**Conclusion**

Pulmonary Hypertension is one of the most common complication of COPD. COPD associated PH is recognized as a poor prognostic marker. It is associated with increased risk of exacerbation, worsened exercise capacity, poor oxygenation and increased mortality. As severity of COPD increases the proportion of cases with increased severity of PH increases. Severe PH increases the right ventricular afterload and eventually leads to heart failure. This study emphasizes the early screening of patients of COPD for PH through clinical assessment and non invasive testing like 2-D Echocardiography.

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**Conflict of interest**

None

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