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Original Research Article

Study of pulmonary function tests in patients of chronic obstructive pulmonary disease

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Abstract: COPD is defined as a disease state characterized by airflow limitation that is not fully reversible. Our study aimed at studying pulmonary function tests in patients of chronic obstructive pulmonary disease (COPD) using spirometry with the objectives of assessing their degree of airway obstruction & post-bronchodilator reversibility using spirometry. In method a total of 100 patients clinically diagnosed as COPD visiting OPD or admitted in wards of our hospital were included in the study. After careful history taking, clinical examination and routine investigations they were subjected to pre & post bronchodilator spirometry tests using computerized spirometer Helios 401. In Results Out of the 100 patients studied all had obstructive pattern of spirometry tests (FEV_1/FVC <.7). 15 patients were in Global Initiative for Obstructive Lung Disease (GOLD) Stage I, 34 patients were in Stage II, 36 patients were in stage III whereas 15 patients were in stage IV of airway obstruction. In Conclusion the degree of airway obstruction in patients of COPD was easily accessed by spirometry. Most of the patients had airway obstruction in stage 2 & 3 of GOLD .There was no significant post-bronchodilator reversibility.
Keywords: spirometry, bronchodilator, GOLD

INTRODUCTION

Chronic Obstructive Pulmonary disease (COPD) is a clinical diagnosis that should be based on careful history taking, the presence of symptoms and assessment of airway obstruction (also called airflow limitation)[1]. Worldwide, COPD affects 329 million people or nearly 5% of the population [2]. In 2013, it resulted in 2.9 million deaths up from 2.4 million deaths in 1990 [3]. The number of deaths is projected to increase due to higher smoking rates and an aging population in many countries [4].

The hallmark of COPD is airflow obstruction which is typically described by spirometry. The GOLD international COPD guidelines, [5] as well as national guidelines, [6] advise spirometry as the gold standard for accurate and repeatable measurement of lung function. The spirometry involves forced expiratory maneuvers after the subject has inhaled to total lung capacity. Key parameters obtained from spirometry include forced expiratory volume in one second (FEV_1) and the total volume of air exhaled during the entire spirometer maneuver [forced vital capacity (FVC)]. In patients of COPD, pulmonary function testing shows airflow obstruction with a reduction in FEV_1 and FEV_1/FVC [7, 8].

Evidence is emerging that when spirometry confirms a COPD diagnosis, doctors initiate more appropriate treatment. Early detection of COPD by spirometry could make a major impact on the disease progression in many patients as spirometry may detect the presence of mild airflow obstruction 5-10 years before the disease starts to cause symptoms.

METHODOLOGY

This cross-sectional observational study aimed at studying pulmonary function tests in patients of COPD using spirometry with the objectives of studying their clinical profile, assessing their degree of airway obstruction & post-bronchodilator reversibility, included 100 patients of either gender irrespective of age who fulfilled the inclusion criteria. An informed consent was obtained from each patient before inclusion in the study.

The study included patients clinically diagnosed as COPD and were attending our OPD or

admitted to our wards and having symptoms of COPD. Patients who were known to have tuberculosis, bronchiectasis, ongoing respiratory tract infection, hemoptysis, pneumothorax, lung cancer, interstitial lung diseases, respiratory failure, severe cardiovascular disease or clinically unstable were excluded from study.

Detailed history of all patients was taken that included severity & duration of symptoms and clinical examination with examination of respiratory system was done thoroughly in all patients. Routine blood investigations were done.

Those patients who were already on bronchodilators were asked to withhold it for one day prior to spirometry tests. Pre and post bronchodilator (400 µg salbutamol through metered dose inhaler) spirometry using computerized spirometer Helios 401 of all the patients was done at interval of 20 minutes after bronchodilator administration. Patients with post-bronchodilator significant reversibility (improvement of 12% and 200 ml of FEV_1) were excluded. Patients without significant reversibility were selected and their pre & post-bronchodilator FEV_1% predicted and FEV_1/FVC were observed. They were classified to GOLD staging in stage 1 (post bronchodilator $FEV_1 \geq 80\%$), stage 2 (post bronchodilator $FEV_1 \geq 50\%$ and $< 80\%$), stage 3 (post bronchodilator $FEV_1 \geq 30$ and $< 50\%$), and stage 4 (post bronchodilator $FEV_1 < 30\%$). Data was analyzed by computer software Statistical Package for the Social Sciences (SPSS version 20.0 for windows).

RESULTS

In our study majority of the patients were in age group 50-60 yrs. Mean age of study population was 57.12 (SD ± 9.20) years. Out 100 patients studied 85 were males whereas 15 patients were females. Out of 85 males 82 were smokers where as none of the females gave history of smoking however history of exposure to domestic fuels were present in all the females. We also found different co-morbidities in our patients (Table 1).

Table- 1: Baseline characteristics of patients

Age (years)	57.12 (±9.20)
Male	85 (85%)
Females	15 (15%)
Diabetes Mellitus	27 (27%)
Hypertension	32 (32%)
Diabetes & Hypertension	15 (15%)
Congestive Cardiac Failure	3 (3%)

Spirometry results (Table 2) showed that mean pre-bronchodilator FEV_1 % predicted of the group was 50.11 (SD ± 17.61). Mean pre-bronchodilator FEV1/FVC ratio of the group was 0.406 (SD ± .142). Mean post-bronchodilator FEV_1 % predicted of the group was 53.43 (SD ± 18.78). Mean post-bronchodilator FEV1/FVC ratio of the group was 0.429 (SD ± .152).

Table- 2: Spirometry Results

Mean pre-bronchodilator FEV_1 % predicted	50.11 (SD±17.61).
Mean post-bronchodilator FEV_1 % predicted	53.43 (SD±18.78)
Mean pre-bronchodilator FEV1/FVC ratio	0.406 (SD± .142)
Mean post-bronchodilator FEV1/FVC ratio	0.429 (SD± .152)
Mean post-bronchodilator reversibility in FEV_1 (in percentage)	6.81 (± 2.75)

Mean post-bronchodilator reversibility in FEV_1 (in percentage) of the group was 6.81 (SD ± 2.75). The COPD patients were classified by their post-bronchodilator FEV_1% predicted in four stages according to GOLD (Table 3). Among 100 study population, 15 (15%) patients were in stage 1, 34 (34%) in stage 2, 36 (36%) in stage 3, and 15 (15%) in stage 4.

Table- 3: Distribution of patents according to severity of airway obstruction (GOLD Staging)

Gold Stage	Post-bronchodilator FEV1,FEV1/FVC	Number Of Patients	%
I: Mild	FEV1/FVC < .7 FEV1 ≥ 80% predicted	15	15
II: Moderate	FEV1/FVC < .7 50% ≤ FEV1 < 80 % predicted	34	34
III: Severe	FEV1/FVC < .7 30% ≤ FEV1 < 50 % predicted	36	36
IV: Very Severe	FEV1/FVC < .7 FEV1 < 30% predicted	15	15

In our study we found the mean ages of the study population in different stages of COPD were different. The mean ages of the patients in four stages of COPD were shown in Table 4. The mean age of stage 1 was 46.4 (SD ± 4.70) years, stage 2 was 53.6 (SD ± 6.36) years, stage 3 was 60.9 (SD ± 6.94) years, and stage 4 was 67.9 (SD ± 6.56) years. From the above table and by applying one-way ANOVA, it was found that severity of obstruction increases with age of the patients which was statistically significant (P < 0.05).

Table- 4: Mean ages of patients in different stages (GOLD) of airway obstruction.

Gold Stage	FEV1,FEV1/FVC	Mean Age (years)
I: Mild	FEV1/FVC < .7 FEV1 ≥ 80% predicted	46.4 ± 4.70
II: Moderate	FEV1/FVC < .7 50% ≤ FEV1 < 80 % predicted	53.6 ± 6.36
III: Severe	FEV1/FVC < .7 30% ≤ FEV1 < 50 % predicted	60.9 ± 6.94
IV: Very Severe	FEV1/FVC < .7 FEV1 < 30% predicted*	67.9 ± 6.56
P Value	.000*	

DISSCUSSION

Our study was an effort to study clinical profile of COPD patients and perform spirometry on them in order to confirm their airway obstruction and assess their degree of airway obstruction & post-bronchodilator reversibility.

The mean age of study population was 57.12 (SD ± 9.20) years and maximum number of the patients were more than 50 years of age, which was consistent with the previous literatures as the disease has highest prevalence in 5th and 6th decades of life [9, 10]. Majority of the patients in our study were males which was consistent with other previous studies done on COPD patients [11-14]. History of smoking was present in almost all males (82 out of 85) while none of the females were smokers but all of them had history of exposure to domestic fuels. Similar findings were found by Mohan A *et al.;* [11] in their study.

Mean post-bronchodilator FEV_1 % predicted of the group was 53.43 (SD ± 18.78). In a study conducted by Jain NK *et al.;* [12] on COPD patients mean post- bronchodilator FEV_1% predicted of the patients was 46.93 (SD ± 14.32) whereas in the study conducted by Jenkins CR *et al.;* [15] mean post-bronchodilator FEV_1% was 44.3 (SD ± 13.4). The difference between findings in our study and above mentioned studies may be due smaller sample size of our study and due to fact that in our study we took only clinically stable COPD patients as our subjects whereas in the above mentioned studies patients were taken as subjects during the exacerbation of their existing COPD.

On comparison the difference between pre & post-bronchodilator FEV_1 % predicted (applying student t-test) was not found to be statistically significant (P=.199>0.05). Neither the difference between pre & post-bronchodilator FEV_1/ FVC ratio (applying student t-test) was found to be statistically significant (P=.270>0.05). So our study using spirometry confirmed the fact that COPD characterized by airflow limitation that is not fully reversible [1] and this non-reversibility is the hallmark of COPD confirmed by spirometry.

In our study 15 (15%) patients were in Stage 1, 34 (34%) patients were in Stage 2, 36 (36%) patients were in Stage 3 &15 (15%) patients were in Stage 4 of GOLD. Almost similar distribution of patients in different stages of GOLD was found by Mitra M et al[13] & Jenkins CR *et al.;* [15] in their studies.

Mitra M *et al.;* [13] & Kohansal R *et al.;* [16] in their studies showed that severity of airflow obstruction increases more with age. The study was consistent to our study as we showed that with increase severity of GOLD staging average age of the patients were also increasing.

Moreover, our study was cross-sectional study and we believe longitudinal study is also required to study clinical profile of COPD patients and assess their severity of airway obstruction & reversibility using spirometry.

CONCLUSION

COPD is mostly prevalent in 5^{th} & 6^{th} decade of life. Majority of patients are males and smokers. Spirometry is important tool in confirming and assessing severity of airway obstruction in COPD patients. There is no significant reversibility by bronchodilator in airway obstruction in COPD confirmed by spirometry. Majority of COPD patients were in stage 2 & 3 (GOLD) of airway obstruction confirmed by spirometry. Severity of airway obstruction confirmed by spirometry increases with increasing age of patients.

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