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Original Article

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Abstract

Objectives: To assess the Pre-bronchodilator criteria and the Post-bronchodilator criteria of FEV1/FVC ratio in diagnosing Airflow obstruction.

Methods: An observational study was conducted from 1988 to 2006 at the Aga Khan University Hospital. Patients referred to the pulmonary function test laboratory for spirometry with bronchodilator reversibility at the hospital during the above said period were enrolled. Forced spirometry was performed according to ATS guidelines. All patients who had pre-bronchodilator criteria of airflow obstruction were analyzed and compared with the post bronchodilator criteria.

Results: A total of 4222 individuals underwent spirometry out of which 4072 individuals were studied.Using the pre bronchodilator criteria, 1375 (34%) patients had airflow obstruction. Applying the post bronchodilator criteria on the same patients, 1098 (27%) had evidence of airway obstruction. Out of these 1375 patients who had airflow obstruction by using pre-bronchodilator criteria, 277 (20%) patients had no airflow obstruction by using the post bronchodilator criteria. Out of these 277 patients, 52% had significant airways reversibility as evidenced by >12% increase in their FEV1 pre and post bronchodilator.

Conclusion: Pre bronchodilator criteria for detection of airflow obstruction overestimate the diagnosis of airflow obstruction and by using post bronchodilator criteria for airway obstruction on spirometry, decreases this over diagnosis of the condition

Keywords: Spirometric criteria, Airflow obstruction, COPD, Asthma (JPMA 61: 1172; 2011).

Introduction

Chronic Obstructive Pulmonary Disease (COPD) ranks among the top five causes of death in developed countries[1] and it continues to increase its effect on morbidity and mortality throughout the world.[2,3] For the diagnosis and assessment of COPD, spirometry is the gold standard as it is the most reproducible, standardized, and objective way of measuring airflow limitation. According to Global Initiative for Chronic Obstructive Lung Disease (GOLD) COPD is defined on spirometry as a post-bronchodilator ratio of forced expiratory volume in one second (FEV1) to forced vital capacity (FVC) < 0.7, and disease severity is categorized based on post-bronchodilator forced expiratory volume in one second (FEV1) in percent of predicted.[4]

The most important factor in the evaluation of patients with COPD is to determine ventilatory limitation accurately. Recent international guidelines have emphasized the importance of post-bronchodilator lung function measurements in the diagnosis and severity classification of chronic obstructive pulmonary disease (COPD).[4,5] The use of post-bronchodilator spirometry facilitates the distinction between fully reversible asthma and poorly reversible COPD, and may lead to a reduction in misclassification of individuals with reversible obstruction as COPD cases. The prevalence of COPD using pre-bronchodilator values gives an overestimation, especially among young adults.[6,7] Few studies have been published that have used post bronchodilator GOLD criteria for COPD prevalence and shows the overestimation rate of COPD using the pre-bronchodilator criteria.[8,9]

There are major differences in diagnosing airflow obstruction among expert groups[10] which leads to widely varying prevalence estimates of COPD.[11] Therefore it complicates the assessment of the burden of disease and creates a diagnostic confusion and also confounds the comparability of research studies.[12]

There had been different criteria used for the diagnosis/assessments of airflow obstruction[13] Viegi et al demonstrated that the measured prevalence of COPD is mainly dependent upon the criterion used to define airflow obstruction.[14]

Misdiagnosis or Misclassification of airflow obstruction potentially results not only in an individual patient being misinformed and incorrectly educated about their condition, but can also lead to incorrect management.

The objective of the study was to assess the Pre-bronchodilator criteria and the Post-bronchodilator criteria of FEV1/FVC ratio in diagnosing Airflow obstruction in our setting.

Patients and Methods

An observational study was conducted from 1988 to 2006 at the Aga Khan University Hospital, Karachi.

All patients referred to the pulmonary function laboratory for spirometry with bronchodilator reversibility were enrolled. Information regarding patient demographics and disease history, respiratory symptoms, occupational exposure to airborne agents, and smoking history were collected using a standardized Performa.

Standing height and weight of the patients were measured and body mass index (BMI) was categorized into four groups: <20kg/m^2, 20-24.9kg/m^2, 25-29.9kg/m^2 and >30kg/m^2.

Forced spirometry was performed according to guidelines issued by American Thoracic Society (ATS). Forced Vital Capacity (FVC) and Forced Expiratory Volume in one second (FEV1) were measured with a spirometer MedGraphics Profiler (Pulmonary diagnostic system by Medical graphic Corporation, USA) according to the American Thoracic Society (ATS) criteria.[15,16] Spirometry was performed before and 5 minutes after inhalation of 0.2 mg salbutamol inhaler (Made by GlaxoSmithKline) at room temperature ranging from 19 to 24°C, with a mean of 22 ± 0.5 . Highest value for FVC and the highest value for FEV1 were used in the ratio FEV1/FVC.

The subject breathed in from room air and then exhaled into the spirometer. The wedge opened as air was blown into the spirometer, and a marker moved accordingly along a sheet of paper for 6 seconds.

Analysis:

For all patients who had pre bronchodilator criteria of airflow obstruction FEV1/FVC of <0.7, values of FVC, FEV1 and FEV1/FVC ratios were analyzed (both in pre-bronchodilator and post-bronchodilators values were examined).

Results

A total of 4222 individuals underwent spirometry in the above said period. Of these 150 individuals failed to perform spirometry effectively and were excluded from the study, and remaining 4072 individuals were analyzed. The mean age of the study population was 53.5 ± 16.3 years (range 15-95). Mean BMI was 26.3 ± 5.73 kg/m^2. Symptomatically, 50% had cough and 70% had dyspnoea. The base line characteristics of the patients are given in Table-1.

Out of 4072 individuals who underwent spirometry with bronchodilator reversibility testing; using the pre bronchodilator criteria, 1374 (34%) had airflow obstruction. Applying the post bronchodilator criteria on

Table-1: Characteristics of study population.

	Women (%) (N=1569, 38.5%)	Men (%) (N=2503, 61.5%)	N (%) (4072, 100%)
Age (Years)			
15-29	183(12)	224(9)	407(10)
29-44	298(19)	446(18)	744(18)
45-59	559(36)	722(29)	1281(31)
60-74	431(27)	849(34)	1280(31)
>74	98(6)	262(10)	360(9)
Body mass Index (kg/m^2)			
<20	167(11)	318(13)	485(12)
20-24.9	377(24)	857(34)	1234(30)
25-29.9	531(34)	926(37)	1457(36)
>30	494(31)	402(16)	896(22)
Mean Height (cm)	153.3 ± 7.9	167.5 ± 44.5	162.0 ± 36.7
Mean Weight (Kg)	65.0 ± 16.3	71.70 ± 18.4	69.1 ± 17.9

FEV1/FVC < 70% after post bronchodilator spirometry while ATS/ERS guidelines set post bronchodilator values of FEV1/FVC < 5th percentile for diagnosing the COPD.[17] Before the establishment of GOLD guidelines several studies have reported airflow obstruction in COPD patients by using pre-bronchodilator testing.[18,19] The major flaw of using the pre-bronchodilator spirometry values for diagnosing the airflow obstruction was that the people with reversible airflow obstruction were not excluded. All the previous publications have shown that both prevalence and incidence of COPD in a general population decreased substantially when COPD was defined with post-bronchodilator rather than pre-bronchodilator lung function values,[7,9] likewise our study also showed the same findings that is 1375 (34% of all individuals) had air flow obstruction using the pre-bronchodilator spirometry which

Table-2: Airflow Obstruction (FEV1 /FVC <70%) defined before and after bronchodilation.

Variables	Numbers (n)	Pre-BD Airflow Obstruction	Post- BD Airflow Obstruction	Percentage of reduction in Airflow Obstruction
Total Patients	4072	1375	1098	20%
Sex				
Female	1569	366	252	31%
Male	2503	1009	846	16%
Age (years)				
15-29	407	79	40	49%
30-44	744	163	115	29%
45-59	1281	383	307	20%
60-74	1280	582	496	15%
>74	360	168	140	17%
BMI (kg/m^2)				
<20	485	217	192	12%
20-24.9	1234	509	419	18%
25-29.9	1457	448	349	22%
>30	896	201	138	31%

the same group of patients, 1098 (27%) had evidence of airway obstruction.

Out of these 1375 patients who had airflow obstruction by using pre-bronchodilator criteria, 277 (20%) had no airflow obstruction by using the post bronchodilator criteria. Out of these 277 patients, 52% had significant airways reversibility as evidenced by >12% increase in their FEV1 pre and post bronchodilator (Table-2).

Discussion

Several guidelines have been in use for diagnosing and finding the severity of the of airflow obstruction in COPD. The Global Initiative for Chronic Obstructive Lung Disease (GOLD) and American Thoracic Society (ATS)/European Respiratory Society (ERS) criteria for defining COPD are quite different in several aspects. GOLD committee defines airway obstruction as an

was significantly higher than 1098 (27% of all individuals) who had air flow obstruction using the post-bronchodilator spirometry i.e., a total of 277 (20% of individuals who had pre-bronchodilator airflow obstruction) were excluded from the category of airflow obstruction after bronchodilation.

Recently, a community study in Norway reported that the prevalence of airflow obstruction in subjects with bronchodilation was 27% lower than that defined without bronchodilation (7.7%)[7] as in our study in which bronchodilation lowered the prevalence of airflow limitation by 20% compared to the value without bronchodilation.

Similarly, a study on Korean population by Kim et al showed that COPD prevalence by post-bronchodilator GOLD criteria was 3.7%, which was much lower than that of pre-bronchodilator criteria.[9] These results imply that the

pre-bronchodilator COPD criteria overestimate the diagnosis of airflow obstruction and also, that many people may have been erroneously diagnosed as COPD and undergone unnecessary, inappropriate medical examinations and treatment.

Conclusion

The study concluded that the diagnosis of airflow obstruction depends on the criteria used for airway obstruction. Pre bronchodilator criteria for detection of airflow obstruction overestimate the diagnosis of airflow obstruction and by using post bronchodilator criteria for airway obstruction on spirometry decreases this over diagnosis of the condition.

Finally, it is recommended that more studies should be carried out to find out the predictive value of spirometry in the diagnosis of COPD and to establish both post-bronchodilator prediction equations and reversibility prediction equations and their implementation.

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