Original Research

Patterns of spirometry in asthmatic patients presenting with respiratory symptoms

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Abstract

Background: Asthmatic patients typically show obstructive patterns on spirometry with positive bronchodilator responses; however, other spirometric patterns were also reported.

Objective: to determine patterns of spirometry among asthmatic patients who attend the outpatient clinic with respiratory symptoms.

Materials and Methods: A cross-sectional study was conducted among 323 known asthmatic patients (59% females) who attended the outpatient clinic with respiratory complaints. A portable spirometer (All flow, Clement Clarke International, Harlow, UK) was used for lung function measurements. Measurements and reversibility tests were performed according to the American Thoracic Society (ATS) Guidelines for spirometry measurements.

Result: Normal spirometric pattern was found in only 21% of all participants, obstructive in 12%, mixed in 32%, and restrictive in 36%. The patterns had no relation with the gender or the body mass index of the participants. The majority had low FEF25 (88%), low FEF50 (83%), and low FEF25-75% (82%) indicating inflammation within the middle and small airways. Nearly half of those who showed positive FVC reversibility tests had a restrictive pattern on presentation ($p < 0.001$).

Conclusion: Our findings indicate poor lung function of asthmatic patients on presentation. The bronchodilator responses were positive in a considerable proportion of those who presented with non-obstructive patterns.

KEY WORDS: Asthma, Spirometry, Outpatient clinic

Introduction

Bronchial asthma is a major health problem that affects more than 300 million people worldwide. Its diagnosis depends on the clinical presentation and the objective evidence of a reversible airflow obstruction or airway hyperresponsiveness. Spirometry is a valuable tool for the diagnosis and follow-up.[1,2] The forced expiratory volume in the first second (FEV1), the forced vital capacity (FVC), and the FEV1/FVC ratio are the most commonly used parameters for spirometry interpretation. For each patient, these parameters should be compared with reference values based on his age, gender, height, and ethnicity. Spirometry results may suggest one of the following four types of spirometric patterns: normal, obstructive, restrictive, or mixed (obstructive and restrictive). Normal values of FVC (≥ 80% of predicted), FEV1 (≥ 80% of predicted), and FEV1/FVC (≥ 0.7) are suggestive of a normal spirometry. Low FEV1 (<80% of predicted) and low FEV1/FVC (< 0.7), with a normal FVC indicates obstructive pattern; whereas it indicates a mixed pattern when all the three parameters are decreased. The restrictive pattern is suggested by predominantly low FVC, low FEV1, and a normal or an increased FEV1/FVC.[2-4] The positive response to bronchodilators is diagnosed when the FEV1 or the FVC improves by >12% or 0.2 L following inhalation of 400 μg of salbutamol that is given via a metered dose inhaler with a spacer by 15 minutes. Evidence of obstruction within the middle and small airways of the lungs is suggested by low values of the forced expiratory flows (FEF25, FEF50, FEF75, or FEF25-75). The asthmatic patient typically presents with an obstructive pattern and a positive response to bronchodilators; however,

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atypical findings could be present.[5] A recent cross-sectional study showed that patients receiving asthma treatment have mixed patterns of physiological impairment.[6]

The primary goals of asthma management include control of asthma symptoms, prevention of exacerbation, and restoration of the patient's normal lung function. Refractory asthma that does not respond to conventional management can be encountered; however, some difficult cases could result from poor compliance to therapy, wrong technique of inhaler use, or inadequate therapy. On the other hand, there is an alarming evidence of inadequate hospital management and premature discharge of asthmatic patients.[7,8] In addition, it is noticed that spirometry is rarely used for assessment of asthma control and adequacy of therapy for asthmatic patients under home management. The evaluation of patients' lung function for characterization of their spirometric patterns when they attend the outpatient clinic with respiratory symptoms can be used as an objective indicator of their asthma control. The aim of this study is to determine the varieties of spirometric patterns among the asthmatic patients who attend the outpatient clinic with respiratory complaints.

Materials and Methods

A cross-sectional study was conducted among 323 asthmatic patients (59% females) who attended the outpatient clinic with the following respiratory symptoms (cough, wheezes, chest tightness, and shortness of breath). All the participants were known asthmatic for at least one year before their attendance. A portable All-flow spirometer (Clement Clarke International, Harlow, UK) was used for lung function measurements. All the measurements were performed according to the guidelines of the American Thoracic Society (ATS).[9] Reversibility tests were performed for the patients who did not take their medications for at least 6 hours (for short-acting bronchodilators), 12 hours (for long-acting bronchodilators), or 24 hours (for theophylline). The research conforms to the ethical principles of medical research developed by the World Medical Association Declaration of Helsinki.[10] Written consents were obtained from the patients before starting the spirometry measurements.

Statistics

Data obtained was analyzed using the Statistical Package for the Social Sciences (SPSS Inc. Chicago, IL, USA) version 20. Mean and standard deviations were used to describe the spirometric values. Categorical variables were compared using the chi-square test. Statistical significance was accepted when the *p*-value < 0.05.

Results

Table 1 shows general characteristics of the participants. Mean (SD) values of age and body mass index were 43.8 (16.2) years and 28.6 (6.6) respectively. Patterns of spirometry were Obstructive (12%), normal (21%), restrictive (36%), and mixed (32%). The relations of the patterns with the gender and the body mass index of the participants were statistically insignificant. A significant relation was found between the patterns and the age group, $p = 0.015$ (Table 1). Higher proportions of the older age group (≥ 40 y), compared to the younger age group (< 40 y), presented with restrictive patterns (40% Vs 32% respectively) and mixed patterns (36% Vs 27% respectively). Table 2 shows that the majority

Table 2: The percentage of patients who presented with low spirometric values

Parameter	Patients with low result *n* (%)
FVC (< 80% of predicted)	218 (67%)
FEV1 (< 80% of predicted)	245 (76%)
FEV1/FVC (< 70%)	140 (43%)
FEF25 (< 50% of predicted)	284 (88%)
FEF50 (< 50% of predicted)	268 (83%)
FEF75 (< 50% of predicted)	264 (82%)
PEFR (< 80% of predicted)	296 (92%)

Table 1: General characteristics of the participants

Patient's characteristic		Pattern				Total	*P*-value
		Mixed	Normal	Obstructive	Restrictive		
Gender	Male	43 (32%)	30 (23%)	15 (11%)	45 (34%)	133 (100%)	0.869
	Female	59 (31%)	37 (19%)	23 (12%)	71 (37%)	190 (100%)	
Age Group	< 40 y	41 (27%)	40 (26%)	23 (15%)	48 (32%)	152 (100%)	0.015
	≥ 40 y	61 (36%)	27 (16%)	15 (9%)	68 (40%)	171 (100%)	
BMI	< 25.00	29 (31%)	16 (17%)	14 (15%)	34 (37%)	93 (100%)	0.810
	25- 29.99	36 (33%)	24 (22%)	7 (6%)	41 (38%)	108 (100%)	
	≥ 30.00	37 (30%)	27 (22%)	17 (14%)	41 (34%)	122 (100%)	
Total		102 (32%)	67 (21%)	38 (12%)	116 (36%)	323 (100%)	

Table 3: Reversibility Test in Relation to Patterns of Spirometry in the Study Group

Type of reversibility test*		Pattern of spirometry				Total	*P*-value
		Normal	Restrictive	Obstructive	Mixed		
FVC	Positive	17 (14%)	54 (46%)	3 (3%)	44 (37%)	118 (100%)	0.000
	Negative	50 (24%)	62 (30%)	35 (17%)	58 (28%)	205 (100%)	
FEV1	Positive	2 (2%)	32 (36%)	7 (8%)	47 (53%)	088 (100%)	0.000
	Negative	65 (28%)	84 (36%)	31 (13%)	55 (23%)	235 (100%)	
FEF25-75	Positive	7 (9%)	20 (26%)	17 (22%)	33 (43%)	077 (100%)	0.000
	Negative	60 (24%)	96 (39%)	21 (9%)	69 (28%)	246 (100%)	

of the patients presented with low spirometric values. Those who presented with low FEV1 were 76% of all participants. Table 3 shows that the reversibility tests were positive in significant proportions of the participants, including those who presented with non-obstructive patterns ($p < 0.001$).

Discussion

Spirometry is a valuable tool in asthma management.[1,2] In the present study, the majority of the participants presented with poor spirometric results. Low values of FEV1 were found in 76%, obstructive patterns (obstructive or mixed) were found in 44% whereas more than half of the participants showed non-obstructive patterns. Although the mean body mass index (BMI) of the participants was high, no relation was found with the spirometric patterns. Evidence of restriction was higher in the older age group compared to the younger one. Our major finding is that a considerable proportion of those who showed non-obstructive pattern had positive reversibility tests.

The causes of the poor results of spirometry in these patients should be investigated. Patients' compliance with treatment, inhalation technique, frequency of follow-up visits, and elimination of the possible triggering factors should all be revised. The periodic use of spirometry for assessment of patients' lung function should also be questioned. It is worth noting that there is general underuse of spirometry in the outpatient clinic and during the follow-up visits, especially for those who showed profound improvement following a recent acute attack of asthma exacerbation.[11,12] Physicians who rely only on the patient's symptoms and signs for evaluation of asthma severity may overestimate the degree of asthma control.[13] This incorrect assessment could result in suboptimal management. On the other hand, the presentation with non-obstructive patterns (normal and restrictive) is a misleading presentation and might result in exclusion of an airway obstruction. As shown in our study, those who present with non-obstructive patterns (normal or restrictive) would still suffer from airway obstruction that can be demonstrated with the reversibility tests. Similar findings were recently reported.[14] The obstruction could be within the middle and the small airways, as indicated by the low values of the forced expiratory flows (FEF25, FEF50, FEF75, and FEF25-75). One of the possible explanations for the restrictive pattern is the high closing capacity in asthmatic patients that increases air trapping and decreases the overall volume of air that ventilates the lungs; thus reducing FEV1 and FVC values.[15] Obesity could be another explanation; however, the association in this study was statistically insignificant.

Our study suffers from many limitations that should be considered during interpretation of the results. The random selection of the participants could be associated with sampling bias. Results of investigations into other possible causes for the patients' symptoms were not considered. Static lung volumes that could confirm the presence of lung restriction were not measured. However, all spirometric measurements were carried out by the same investigator, according to the recommendations of the ATS.[9]

Conclusion

Our findings demonstrated varieties of spirometric patterns among asthmatic patients presenting with respiratory symptoms. Reversibility tests were positive in a considerable proportion of the patients who presented with non-obstructive patterns. The study suggests that in the symptomatic asthmatic patient, a bronchodilator study can be performed even if the spirometric pattern is not showing an evidence of obstruction

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