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RESEARCH ARTICLE

Role of spirometric lung functions and body mass index in patients with bronchial asthma

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ABSTRACT

Background: Bronchial asthma is an inflammatory disease also characterized by airflow limitation with a reduced peak expiratory flow (PEF), FEV1, and a low FEV1/forced vital capacity (FVC). In contrast with chronic obstructive pulmonary disease, the airflow limitation is highly reversible either spontaneously or with therapy. Repeated lung function measurements using portable peak flow meters have resulted in improved outcomes. In developing countries, there is a rising prevalence associated with increasing urbanization. The consistent finding of asthmatic airways correlates broadly with the severity of the disease, bronchial hyperreactivity, and reduced lung function. The purpose of our research was to perform spirometric lung function tests and grade the severity of airway obstruction. **Aims and Objectives:** This study aimed: (1) To perform spirometric lung function tests and grade the severity of airway obstruction in bronchial asthma and (2) distribution of asthma patients according to body mass index (BMI). **Materials and Methods:** The study comprises a total number of 50 bronchial asthma patients of both sexes between the age groups of 13 and 65 years. BMI was calculated in all patients, and spirometric lung function tests were recorded by means of a Helios computerized spirometer. The study variables include FVC, forced expiratory volume in 1 s (FEV1), FEV1/FVC ratio, PEF rate, and forced expiratory flow (25–75%) were analyzed in all patients. Based on severity predicted by FEV1%, asthma patients were classified into mild, moderate, and severe asthmatics. **Results:** The mild group has FEV1% predicted test value of 101.43 ± 12.43 (mean ± standard deviation) compared with the severe group having 45.3 ± 12.6 while the moderate group has 70.5 ± 5.14. Majority of the cases (74%) were in normal BMI category. **Conclusion:** FEV1% is important indicator of bronchial asthma severity. The symptoms of asthma have, at their core, obstructive lung impairment, which is detected by lung function tests using spirometry.

KEY WORDS: Bronchial Asthma; Computerized Spirometry; Body Mass Index; FEV1%

INTRODUCTION

Bronchial asthma is a condition with airflow limitation that varies over short periods, either spontaneously or in response to treatment, and is associated with inflammation in the airways. It presents as an obstructive type of ventilatory defect which is usually diagnosed from a reduced FEV1% (FEV1/forced vital capacity [FVC]) or a reduced peak expiratory flow (PEF) associated with reduced airway caliber, hence the lower expiratory flow and also with premature closure of airways during expiration.[1]

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The prevalence of asthma has risen in affluent countries over the past 30 years but now appears to have stabilized, with approximately 10–12% of adults and 15% of children affected by the disease. The epidemiologic observation suggests that there is a maximum number of individuals who are affected by asthma due to genetic predisposition.[2] The hallmarks of the disease are increased airway responsiveness to a variety of stimuli resulting in episodic bronchoconstriction, inflammation of the bronchial walls, and increased mucus secretion. Frequent flow determination is recommended in the routine management of asthma. Treatment with anti-inflammatory agents and close monitoring of lung function should help decrease the morbidity and mortality associated with asthma.[3] The relationship between asthma and obesity is well known for reduced lung functions.

Major risk factors for asthma are poorly controlled disease with frequent use of bronchodilator inhalers, lack of corticosteroid therapy, and previous admissions to hospital with near-fatal asthma.[2] Absolute eosinophil count and FEV1% are important indicators of bronchial asthma severity and can even be used to predict disease progression.[4] Expert consensus has recommended that spirometric testing be completed at the initial assessment after treatment is initiated and symptoms have stabilized, and at least every 1–2 years. The use of forced expiratory flow (FEF) in 1 s (FEV1) is necessary for the diagnosis. The measurement of PEF rates (PEFR) is recommended for monitoring the patient who has received a diagnosis of moderate to severe asthma. The use of PEF seems appropriate in as much as the disease is largely reversible, and the spontaneous or treatment-induced variations are reflected by changes in expiratory flow. In addition, patients with the most severe asthma tend to underestimate their symptoms and may present with very severe obstruction with little perception of any clinical change.[3]

MATERIALS AND METHODS

This is a cross-sectional study which was carried out in the Department of Physiology and Department of Respiratory Medicine from May 2011 to June 2012, Regional Institute of Medical Sciences (RIMS), Imphal. Written informed consent was taken from all the patients. Approval of the Institutional Ethical Committee was taken.

A total number of 50 patients were included in the study. Asthma patients of both sexes (male and female) between the ages of 13 and 65 who were attending the respiratory medicine outpatient department (OPD) and respiratory medicine ward of RIMS, Imphal were included in the study. All asthma patients between ages 13 and 65 years were included in the study irrespective of their sex. Patients with associated diseases such as worm infestations, allergic diseases, smokers, respiratory tract infections, and steroid therapy were excluded from the study.

Based on severity, the present study classifies the asthmatic patients according to the FEV1% predicted into mild (>80%), moderate (60–80%), and severe (<60%) asthmatic cases in line with Global Initiative for Asthma (GINA) 2008 updated classification. Spirometric lung function tests including FEV1% recorded by means of a Helios computerized spirometer model number 701 of the Recorders and Medicare system, Chandigarh, in the respiratory physiology laboratory of the Department of Physiology, RIMS, Imphal. The procedure was explained to the patient followed by a demonstration. They were instructed to inhale completely and then exhale with maximum force, for at least 2 s. Three consecutive tests were taken with a rest of 5–10 min, the best result among the three was considered. The study variables which include FVC, forced expiratory volume in 1 s (FEV1), FEV1/FVC ratio, PEFR, and (FEF 25–75%) were recorded in all patients using computerized spirometry.

The results were compared with the predicted values for the same age, sex, height, and weight. The Helios software contains a set of prediction equations both for adults and for children. The logic built into the Helios evaluates the patient as an adult or a child, male or female and selects the suitable set of equations for the computation of predicted parameter values.

Body mass index (BMI) was calculated in all patients as weight (kgs) divided by height^2 (meters) and divided into four classes according to the WHO criteria: Underweight <18, normal weight 18.5–24.9, overweight 25–30, and obesity >30 kg/m^2.

Statistics

The results were analyzed by Student's *t*-test using standard software SPSS version 16.

RESULTS

Table 1 shows the classification of the participants with respect to their BMI. BMI was calculated and divided into four classes according to the WHO criteria. From the above distribution, we see that the maximum number of patients 37 out of 50 have BMI between 18.5 and 24.9 while there are no patients from the obese group corresponding to BMI >30 kg/m^2.

Table 2 shows the comparison of test and predicted values along with standard deviations of FVC_L, $FEV1_{L/s}$, FEV1/FVC (%), $PEFR_L$, and $FEF_{25–75\ L}$. We find significant decrease in FVC_L, $FEV1_{L/s}$, $PEFR_{L/min}$, and $FEF_{25–75\ L}$ among the test values when compared with the predicted values ($P < 0.001$) which strongly points to the obstructive nature of the lung impairment among the cases studied.

Table 3 shows the classification of asthma according to the GINA guidelines updated 2008 into mild, moderate, and severe asthma. We find that the maximum number of cases are in the mild group, i.e., 28 (56%) with FEV1% predicted 101.43 ± 12.43 while moderate group has 12 cases (24%) with FEV1% predicted at 70.5 ± 5.14 while the least number of cases is the severe group with 10 (20%) with FEV1% predicted at 45.3 ±

Table 1: Distribution of bronchial asthma patients according to the BMI

Classification	No. of cases (%)
<18	4 (8)
18.5–24.9	37 (74)
25–30	9 (18)
>30	0 (0)
Total	50 (100)

BMI: Body mass index

Table 2: Comparison of test and predicted mean FVC_L, $FEV1_{L/s}$, FEV1/FVC(%), $PEFR_L$, and $FEF_{25-75\,L}$ among asthma patients

Parameters	Predicted value±SD	Test value±SD	*P*-value
FVC_L	2.82±0.67	2.09±0.741	<0.001
$FEV1_{L/s}$	2.29±0.67	1.87±0.74	<0.001
FEV1/FVC(%)	81.55±4.51	89.85±11.93	>0.001
$PEFR_{L/min}$	416.86±111	268.10±127.2	<0.001
$FEF_{25-75\,L}$	3.6±1.09	2.34±1.4	<0.001

FVC: Forced vital capacity

Table 3: Classification of bronchial asthma patients according to the severity predicted by FEV1%

Severity predicted by FEV1%	No. of cases (%)	Mean±SD FEV1% predicted (test)
>80 (mild asthma)	28 (56)	101.43±12.43
60–80 (moderate asthma)	12 (24)	70.5±5.14
<60 (severe asthma)	10 (20)	45.3±12.6
Total	50 (100)	

SD: Standard deviation,

12.6. A maximum number of patients 28 (56%) have >80% of their predicted FEV1% while the number of patients with <60% of their predicted FEV1% is 10 (20%).

DISCUSSION

The present study is based on the primary data collected from 50 bronchial asthma patients consisting 44% males against 56% females. Asthmatic patients according to their FEV1% predicted were classified into mild (>80%), moderate (60–80%), and severe (<60%) asthmatic cases in line with GINA 2008 updated classification (Global Initiative for Asthma). We found a significant decrease in FVC_L, $FEV1_{L/s}$, $PEFR_{L/min}$, and $FEF_{25-75\,L}$ among the test values when compared with the predicted values. The mild group has FEV1 % predicted test value of 101.43 ± 12.43 compared with the severe group having 45.3 ± 12.6 while the moderate has 70.5 ± 5.14. All asthma patients were classified according to their BMI as per guidelines given by the WHO. The BMI was calculated using the formula: Weight (kgs)/height^2 (m). It was revealed that the majority of the cases (74%) are in the normal BMI category, which is between 18.5 and 25 while there are no patients in the obese category (>30). Therefore, the majority of the cases have normal BMI in the present study population [Table 1]. The relationship between asthma and obesity is well known. Scott *et al*. in his study documented that obese asthmatics had more severe asthma symptoms, reduced lung function, and poorer asthma-related quality of life, compared to asthmatics of a healthy weight.[5] A study by Beuther *et al*. stated that although the precise relationship between obesity and asthma remains to be determined, modifications of atopy, lung development, Th1–Th2 balance, immune responsiveness, and airway smooth muscle have been hypothesized to be mechanisms by which obesity might increase asthma risk or modify asthma phenotype.[6]

The present study also highlights the different test values (in L) of FVC_L, $FEV1_{L/s}$, FEV1/FVC%, $PEFR_{L/min}$, and FEF_{25-75} comparing them with the predicted values of the same. Ukena *et al*. stated that airway obstruction is measured objectively with pulmonary function tests where the most important such test is spirometry, which measures the FEV1 and the FVC.[7] It is revealed in the present study that the $FEV1_L$ of the test values are significantly lower ($2.09_{L/s}$ ± 0.741; $P < 0.001$) than the predicted values ($2.82_{L/s}$ ± 0.67) [Table 2]. This is in accordance with the findings of Smith *et al*. who compared conventional methods like spirometry with other methods like exhaled nitric oxide (FE_{NO}) for the diagnosis of asthma.[8] He found that there was a significant reduction ($P < 0.001$) in the $FEV1_{L/s}$ ($2.71_{L/s}$) of the asthma patients when compared to the controls ($3.18_{L/s}$). Bai *et al*. also found a significant decrease in the $FEV1_{L/s}$ among the asthmatics ($2.37_{L/s}$ ± 0.81) as compared to the control group ($3.01_{L/s}$ ± 0.90).[9] Furthermore, Kumar *et al*. while analyzing the autonomic nervous system in asthmatics found a significant decrease ($P < 0.01$) in FEV $1_{L/s}$ in asthmatics ($2.26_{L/s}$ ± 0.50) when compared to the control population ($3.45_{L/s}$ ± 0.58).[10] The present study also found a significant decrease ($P < 0.001$) in FVC_L among the test (2.09_L ± 0.74) when compared to the predicted values (2.82_L ± 0.67) [Table 2]. This finding is consistent with the findings of Bai *et al*. where the FVC_L in asthmatics was 4.11_L ± 1.07 compared to 4.53_L ± 1.12 in the control group.[9] Kumar *et al*. also found that the FVC_L of asthmatics was significantly decreased ($P < 0.001$) in asthmatics (3.84_L ± 0.68).[10] The present study also found a significant decrease in the $PEFR_{L/min}$ in the test ($268.10_{L/min}$ ± 127.2) as compared to the predicted value ($416.86_{L/min}$ ± 111) [Table 2], which is consistent with the findings of Kumar *et al*.[10] ($326_{L/min}$ ± 46.42 in asthmatics; $512.5_{L/min}$ ± 45.87 in controls). We find that there is a marked difference in the FEV1% predicted between the severe and mild asthmatic groups with the moderate asthmatic group in between the two. The mild group has FEV1% predicted test value of 101.43 ± 12.43 (mean ± Standard deviation [SD]) compared with the severe group having 45.3 ± 12.6 (mean ± SD) while the moderate has 70.5 ± 5.14 (mean ± SD) [Table 3]. This is consistent with the findings of Bai *et al*. where the asthma patients were divided into infrequent and frequent exacerbators. There was a significant difference between the two groups with frequent exacerbators having FEV1% predicted 66 ± 19 (mean ± SD) while the infrequent exacerbators have 78 ± 17 (mean ± SD).[9] Nakamura *et al*.[11] conducted a study to determine the eotaxin levels in asthma patients wherein he found that the FEV1% predicted in asthmatics was 57 ± 12 (mean ± SD) while in the control group, it was 101 ± 11 (mean ± SD) which is similar to the findings of the present study. Jatakanon *et al*. classified asthmatics into mild, moderate, and severe in his study. The FEV1% predicted in mild asthmatics was 91 ($P < 0.001$), for moderate it was 88 ($P < 0.05$) while for severe, it was 61 ($P < 0.05$).[12] These values are in line with the findings of the present study.

We have seen a significant rise in the number of asthma patients in India due to increase in air pollution and allergens, in this regard all patients with asthma should be periodically followed up with pulmonary function tests to assess disease progression which will help in clinical management.

Limitation

This study would have been done on a larger sample size, age, and duration of disease were not correlated.

CONCLUSION

Spirometric lung function tests were significantly decreased in asthma patients. FEV1% predicted test value was within normal limits among mild asthmatics. We found a significant decrease in FEV1% predicted in severe asthma cases and an only a modest decrease in FEV1% predicted in moderate asthmatics. FEV1% is important indicator of bronchial asthma severity. In the majority of cases, BMI was normal in our study.

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