Original Article

Asthma-like peak flow variability in various lung diseases

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ABSTRACT

Background and Objectives: Bronchodilator reversibility and diurnal peak flow variability are considered characteristic of asthma patients. Patients with chronic obstructive pulmonary disease (COPD) show poor reversibility. But reversibility and variability in other pulmonary diseases manifesting with airflow obstruction in not known. Therefore, we assessed reversibility and peak flow variability in patients with various lung diseases to recognize the pattern. **Materials and Methods**: Seventy consecutive patients with a diagnosis of lung diseases manifesting with airflow obstruction were recruited in the study. These included 23 patients with asthma, 11 patients with bronchiectasis, 16 patients with post-tubercular lung disease (PTLD), and 20 patients with COPD. Ten healthy matched control subjects were also selected to pair with asthmatic patients. Bronchodilator reversibility test was done initially and peak expiratory flow rate (PEFR) was measured for a duration of 1 week by patients themselves on a chart that was given to them. The mean amplitude percentage of these records were analyzed. **Results**: The mean values of peak flow variability were 14.73% ± 6.1% in asthmatic patients, 11.98% ± 7.5% in patients with bronchiectasis, and 10.54% ± 5.3% in PTLD. The difference in the mean values of peak flow variability between asthma and bronchiectasis, that is, 14.73 (6.1) vs 11.98 (7.5) was not statistically significant ($P > 0.05$). Forced expiratory volume one second (FEV_1) reversibility values were 14.77% ± 26.93%, 11.24% ± 20.43%, 10.85% ± 13.02%, 16.83% ± 22.84%, and 5.47% ± 4.99% in asthma, COPD, PTLD, bronchiectasis, and healthy subjects, respectively. **Conclusion:** Both reversibility and diurnal peak flow variability were higher in patients with various lung diseases compared with normal healthy subjects. Although these are characteristic of asthma, some cases of bronchiectasis and PTLD patients may also manifest asthma-like PEFR variability and reversibility.

KEY WORDS: Asthma, bronchial hyper-reactivity, PEFR, respiratory tract diseases

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INTRODUCTION

Lung diseases with components of airflow obstruction, such as asthma, chronic obstructive pulmonary disease (COPD), and bronchiectasis are major causes of morbidity and mortality worldwide. Post-tubercular lung diseases (PTLDs) with or without bronchiectasis are also quite common in the developing countries. Bronchial hyperactivity has been demonstrated in many of these diseases by previous studies.[1-3] Bronchial challenge with histamine and methacholine has been used in these studies but diurnal peak expiratory flow rate (PEFR) variability may be a clinically more approximate marker of bronchial lability. Guidelines emphasize PEFR variability as one of the important diagnostic features of asthma. PEFR variability can differentiate between asthma and other lung diseases, such as COPD.[3] Although studies have evaluated PEFR variability in patients with asthma[4-6] and COPD,[7] not much literature is available about diseases, such as bronchiectasis and PTLD. Therefore, the present study was conducted to evaluate the presence of PEFR variability in various lung diseases having components of bronchial obstruction.

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MATERIALS AND METHODS

Seventy patients with various lung diseases manifesting with airflow obstruction were recruited in the study. Spirometry was done in all patients before the study and forced expiratory volume one second (FEV_1) and forced

Table 1: Clinical and spirometry findings among lung diseases

Parameter	Asthma	COPD	Bronchiectasis	PTLD	Control
Number of patients	23	20	11	16	10
Age (years) mean (SD)	26.8 (8.3)	58.9 (10.5)	59.9 (12.7)	37.4 (12.7)	28.1 (3.5)
Sex (M:F)	1.1:1	19:1	4.5:1	1.7:1	2.3:1
Height (cm) mean (SD)	162.7 (8.7)	168 (6.6)	163.4 (8.3)	165.1 (7)	170 (9.2)
Weight (cm) mean (SD)	55.4 (9.9)	59.3 (13.2)	52.6 (12)	53.6 (6.9)	58.8 (6.9)

COPD: Chronic obstructive pulmonary diseases, PTLD: Post-tubercular lung diseases

Table 2: Mean amplitude percentage mean values among various lung diseases

Groups	Mean	*P* values*
Asthma vs control	14.73 (6.1) 7.69 (3.9)	< 0.005
Bronchiectasis vs control	11.98 (7.5) 7.69 (3.9)	> .05
PTLD vs control	10.54 (5.4) 7.69 (3.9)	> .05
COPD vs control	10.20 (3.7) 7.69 (3.9)	> .05
Asthma vs Bronchiectasis	14.73 (6.1) 11.98 (7.5)	> .05
Asthma vs PTLD	14.73 (6.1) 10.54 (5.3)	< .05
Asthma vs COPD	14.73 (6.1) 10.20 (3.7)	< .005

*Student's *t* test, COPD: Chronic obstructive pulmonary diseases, PTLD: Post-tubercular lung diseases

vital capacity (FVC) values were obtained. All the patients had airflow obstruction with FEV_1/FVC ratio less than 70% the actual value in spirometry done in the preceding 1 year or at the time of recruitment.

Ten age- and gender-matched healthy control subjects were also included in the study. A written informed consent was obtained from all subjects before entering the study. The diagnosis of the patient was based on characteristic clinical, radiographic features and relevant investigations. High-resolution computed tomography was performed wherever necessary to confirm the diagnosis. The patients were in stable condition and the subjects with a history of respiratory tract infection or allergic manifestations within the last 4 weeks or with comorbid medical disease were not included in the study. All patients attended pulmonary laboratory on 2 days separated by a period of a week. At the first visit, a detailed clinical assessment along with routine investigations, including chest radiographs were recorded in patients Performa.

Spirometry with vitalograph (2120, CE, Herger Tellt in ENNIS, Ireland) was done in pulmonary laboratory. Best of 3 efforts was assessed for spirometric parameters. Reversibility was determined 20 min after administration of salbutamol nebulization. To record diurnal peak expiratory flow, the subjects were provided with a Mini Wright Peak Flow Meter (Clement Clarke International Ltd, London, UK). After training to use the peak flow meter they were asked to perform 3 attempts each of peak flow at home morning (6 am) and evening (6 pm). The subjects were given a chart to record the peak flow values for 7 successive days. Values of first 2 days were rejected to exclude the training errors. The mean values of next 5 days were taken for calculation of PEFR variability or amplitude percent mean as follows:

Amplitude percent mean = PEF max − PEF min/PEF mean × 100
PEF max = maximum peak expiratory flow of the day
PEF min = minimum peak expiratory flow of the days
PEF mean = Average of the 2 values of the day

Those who came with inadequate records were retrained and asked to repeat the same procedure for further 7 days.

Statistical Analysis

PEFR variability was recorded as mean and standard deviation (SD) in different disease groups. The differences were compared by Student's *t* test.

RESULTS

Demographic features of 80 subjects are given in Table 1. There was no significant difference between mean amplitude percent mean PEFR values of healthy control and some of the groups. Mean (SD) values of bronchiectasis, PTLD, and COPD were 11.98 (7.5), 10.54 (5.4), and 10.20 (3.7) as compared with the control group values of 7.69 (3.9) with a *P* value of > 0.05. However, the difference of mean amplitude percent mean values of PEFR in asthma versus control/PTLD/COPD was significant [Table 2]. Interestingly, difference between asthma and bronchiectasis, that is, 14.73 (6.1) versus 11.98 (7.5) was not statistically significant ($P > 0.05$).

FEV_1 reversibility values were 14.77% ± 26.93%, 11.24% ± 20.43%, 10.85% ± 13.02%, 16.83% ± 22.84%, and 5.47% ± 4.99% in asthma, COPD, PTLD, bronchiectasis, and healthy subjects, respectively. There was no correlation between bronchial obstruction and diurnal peak flow variability [Table 3].

All patients were on bronchodilator treatment. Asthma patients were mainly taking a combination of inhaled corticosteroids (ICS) and long-acting beta-agonists (LABA). Patients with COPD, bronchiectasis, and PTLD were also using ICS and LABA. But many patients in these groups were using ipratropium and theophylline. Some asthmatic patients were taking Montelukast [Table 4].

DISCUSSION

It was observed that both FEV_1 reversibility and PEFR variability were higher in all disease groups in comparison to normal population. This study shows the presence

Table 3: Baseline spirometric values of subjects in various groups

Groups	PEFR (Mean amp % Mean)	FEV_1 mean and SD				FVC mean and SD		
		Predicted normal values	Pre-bronchodilator	Post-bronchodilator	Reversibility	Predicted normal values	Pre-bronchodilator	Post-bronchodilator
Asthma	14.73 ± 6.10	3.48 ± 0.69	2.64 ± 0.94	2.88 ± 0.81	14.77 ± 26.93	2.98 ± 0.56	2.15 ± 0.73	2.40 ± 0.65
COPD	10.20 ± 3.74	3.34 ± 0.57	1.38 ± 0.62	1.52 ± 0.65	11.24 ± 20.43	2.71 ± 0.48	0.88 ± 0.46	0.96 ± 0.47
PTPL	10.54 ± 5.26	3.56 ± 0.64	2.31 ± 0.94	2.48 ± 0.92	10.85 ± 13.02	3.00 ± 0.53	1.80 ± 0.84	2.02 ± 0.94
Bronchiectasis	11.98 ± 7.53	3.13 ± 0.87	1.33 ± 1.15	1.54 ± 1.06	16.83 ± 22.84	2.57 ± 0.74	0.98 ± 0.89	1.07 ± 0.90
Healthy subjects	7.69 ± 3.94	3.98 ± 0.76	3.48 ± 0.43	3.67 ± 0.53	5.47 ± 4.99	3.37 ± 0.60	3.08 ± 0.59	3.17 ± 0.62

COPD: Chronic obstructive pulmonary disease; FEV_1: Forced expiratory volume one second; PTLD: Post-tubercular lung diseases.

Table 4: Medication used by patients in different groups

	Asthma (23)	COPD (20)	Bronchiectasis (11)	PTPD (16)
ICS	15	8	2	
SABA	23	3		5
Theophylline		7		3
Montelukast	5			
SAMA		6	4	5
LABA	12	11	4	2
LAMA		7	2	2

ICS: Inhaled corticosteroid, SABA: Short-acting beta-agonist, SAMA: Short-acting muscarinic antagonist, LABA: Long-acting beta-agonist, LAMA: Long-acting muscarinic antagonist

of diurnal PEFR variability most remarkably in asthma patients with high specificity (94.7%), although with low sensitivity (26%). This is consistent with previous studies,[8,9] which showed higher specificity and lower sensitivity of peak flow variability for diagnosis of asthma. In contrast, Leroyer *et al.*[10] demonstrated high sensitivity and specificity (73% and 100%) of peak flow measurements, which were better than post-bronchodilator reversibility of FEV_1 but slightly less than methacholine challenge test.[11]

PEFR variability was present in patients with bronchiectasis in our study and the overall mean amplitude percentage mean were not significantly different from asthma (asthma vs bronchiectasis; 14.73 (6.1) vs 11.98 (7.5), respectively, and a P value > 0.05). Bronchial hyper-response in bronchiectasis may be because of allergic component, bronchial obstruction, smoking, or bronchial Inflammation.[8] Our patients with bronchiectasis did not demonstrate any allergic features. Current smoking in these patients was significantly less than the patients with COPD (9% vs 25%). Thus, our study supports the most plausible explanation of bronchial reactivity by bronchial obstruction. Both bronchial obstruction and inflammation may contribute to the pathogenesis of bronchial changes in bronchiectasis.

PTLD group also showed the mean amplitude percentage values of 10.54 (5.3) as compared with 14.73 (6.1) in patients having asthma in our study. This group also showed features of bronchial obstruction on spirometry without significant reversibility. However, the mean amplitude percentage mean was significantly different from asthma patients ($P < 0.05$). Chronic lung function impairment has been described in PTLD patients[12] post-infectious obstructive bronchiolitis may be the causative factor for these lung function changes.[13]

COPD patients in the present study had mean amplitude percentage values that were not significantly different from those of the control subjects. Similar observations have been reported in previous studies, while some showed same variability as that of asthma.[14,15] Timing of measurements and the type of patients selected could bring about these conflicting results.

CONCLUSION

In conclusion, a significant peak flow variability was present in asthma, bronchiectasis, and PTLD in our study, although it remains the most important feature favoring the diagnosis of asthma. Some of the limitations of the present study are recruitment of patients based on obstruction in spirometry, which could have restricted the number of subjects with variability but obstruction is the only valid defining criteria of asthma and COPD. A relatively small sample size in the study could also have influenced the presence of variability and outcome of the study. Further larger studies are needed to resolve the pathogenetic issues in relation to genetic or molecular aspects of lung diseases with bronchial obstruction.

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Announcement

Indian Chest Society

SPIROMETRY TECHNICIAN TRAINING WORKSHOP

After successful completion of Workshop on Spirometry Technician Training Programme in year 2009, 2010 and 2011, Indian Chest Society announces 4th Workshop on Spirometry Technician Training in the month of January, February and March 2012. Details are given below.

Name of Course	-	Spirometry Technician Training Course
Duration	-	2 days (16 hours of training excluding lunch & tea break)
Eligibility for participant	-	10 + 2
Desirable	-	Work experience in the Pulmonary Function Laboratory in Chest Physician Clinic/Nursing Home/Hospital/Diagnostic centers
Course Fees	-	Rs.2000/- Draft in the name of Indian Chest Society payable at Varanasi
Course Centre	-	Chennai, Mumbai, Kolkata, Jaipur, Nagpur, Lucknow, Saifai Etawah (U.P.) and Indore
Course Director	-	Dr. Vijayalakshmi Thanasekaraan

Note: Please contact Course In-charge at following address:

1. **Dr. Vijayalakshmi Thanasekaraan, Chennai**
   Mobile: 09840112099
   E-mail: drvthanasekaraan@yahoo.com
   Date of Workshop: 17th & 18th February, 2012
2. **Dr. Rohini V. Chowgule, Mumbai**
   Dr. Mahesh Tawde, Dr. Niraj Chauhan
   E-mail: cmplbom@gmail.com
   Mobile: 09969580730, 09869275736
   Date of Workshop: 24th – 26th February, 2012
3. **Dr. Aloke Gopal Ghoshal, Kolkata**
   Mobile: 09830068023
   E-mail: agghosal@yahoo.com
   Date of Workshop: 10th & 11th March, 2012
4. **Dr. Ashish Malpani, Jaipur**
   Mobile: 09414454196
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   Date of Workshop: 16th – 18th March, 2012
5. **Dr. Rajesh Swarnakar, Nagpur**
   Mobile: 09822225130
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   Date of Workshop: 28th & 29th January, 2012
6. **Dr. Suryakant, Lucknow**
   Mobile: 09415016858
   E-mail: kant_skt@rediffmail.com
   Date of Workshop: 1st or 2nd Week February, 2012
7. **Dr. Rajendra Prasad, Saifai, Etawah**
   Mobile: 09415021590
   E-mail: rprasadkgmc@gmail.com
   Date of Workshop: 1st or 2nd Week February, 2012
8. **Dr. Salil Bhargava, Indore**
   Mobile: 094250 60403
   E-mail: bhargavasalil@hotmail.com
   Date of Workshop: Not yet decided

1. Boarding & lodging has to be arranged by candidate himself during the training course.
2. On the successful completion of Training Course a certificate of competence will be given by the Indian Chest Society. I request all the members to send interested persons for the training.

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