ASIAN PACIFIC JOURNAL OF ALLERGY AND IMMUNOLOGY (2001) 19: 79-83

Relationship between Symptoms and Objective Measures of Airway Obstruction in Asthmatic Patients

Chong-Kin Liam, Chong-Tien Goh, Marzuki Isahak, Kim-Hatt Lim and Catherine Mee-Ming Wong

SUMMARY The objective of this study was to determine the relationship between asthma symptoms and the degree of airway obstruction as measured by the forced expiratory volume in one second (FEV_1) and peak expiratory flow rate (PEFR) in a group of 64 asthmatic patients with clinically stable disease attending a university-based urban asthma clinic. Asthma symptoms did not correlate with the degree of airway obstruction as measured by prebronchodilator PEFR (total asthma symptom score *vs* PEFR: $r = -0.214$, $p = 0.104$, $n = 59$) and only correlated poorly with prebronchodilator FEV_1 (total asthma symptom score *vs* FEV_1: $r = -0.256$, $p = 0.041$, $n = 64$). These results lend support to the recommendation that airway obstruction should be measured objectively when assessing patients with chronic persistent asthma.

Asthma is a chronic disease which affects the daily activities of many individuals. Clinical practice guidelines emphasize the need to objectively measure asthma severity when evaluating and treating patients with chronic asthma.[1,2] The current recommendation for asthma treatment is measuring peak expiratory flow rate (PEFR) in the clinic, the emergency room and as part of self-monitoring at home for some patients.[1] These recommendations are partly due to the fact that clinical studies have shown a poor correlation between asthma symptoms as perceived by the patient and the degree of bronchial obstruction measured objectively by determining PEFR and forced expiratory volume in one second (FEV_1).[2-6] Asthma patients often underestimate their level of airway obstruction.[3,4,6] Therefore, asthma treatment based on patient-reported symptoms alone may result in undertreatment of the condition.

We are not aware of any study on the relationship between asthma symptoms and the objective measurements of asthma severity in Asian asthmatic patients. We therefore sought to determine such a relationship in a group of Malaysian asthmatic patients attending the University of Malaya Medical Centre asthma clinic.

PATIENTS AND METHODS

Consecutive patients with clinically stable chronic persistent asthma attending the university-based urban asthma clinic of the University of Malaya Medical Centre during a 4-week period in May 2000 were interviewed using a questionnaire standardized for this study. The patients were requested to (a) grade their asthma symptoms by giving an arbitrary score of 0 to 6 (0 being least affected and 6 being most affected) on the various effects that asthma symptoms had on their daily lives for the 2 weeks prior to the clinic visit (questions 1 to 4 in Table 1), (b) state the number of days with asthma attacks, and (c) state the number of nights they were awoken by asthma symptoms. The possible total symptom score of each patient could have been 0 to 52.

The patients' airway obstruction was objectively assessed

From the Department of Medicine, Faculty of Medicine, University of Malaya, 50603 Kuala Lumpur, Malaysia
Correspondence: Chong-Kin Liam

by measuring their FEV_1 and PEFR in standing position using a Vitalograph spirometer (Vitalograph Ltd., Buckingham, England) and the mini-Wright peak flow meter (Clement Clarke International Ltd., London, England), respectively, before and 15 minutes following 200 μg of salbutamol inhalation. The best of three spirometric and PEF values were recorded. From the patients' gender, age and height, their predicted values of FEV_1 and PEFR were obtained from the Fukuda Sangyo Manual (Spiro-analyse ST-95). The predicted FEV_1 and PEFR values in this manual were derived from the formulae shown in Table 2.[7-10] Values for the percent of predicted prebronchodilator FEV_1, percent of predicted prebronchodilator PEFR, percent of predicted postbronchodilator FEV_1, percent of predicted postbronchodilator PEFR, percent increase in FEV_1 and percent increase in PEFR following bronchodilator were calculated. Results were expressed as mean (± SD) percent. Linear regression analysis was used to examine the relationship between the total symptom scores and each of the lung function test values. Kwikstat statistical software (Kwikstat 4.1, Cedar Hill, Texas: TexaSoft, 1995) was used for all statistical analyses. A p value of less than 0.05 was considered significant.

Table 1 Questionnaire on asthma symptoms over the last 2 weeks before clinic visit

Daytime symptoms	
1. How often did you experience asthma symptoms over the last 2 weeks?	0 1 2 3 4 5 6 None ... All the time
2. How much did your asthma symptoms bother you over the last 2 weeks?	0 1 2 3 4 5 6 Not at all ... Severely
3. How much activity could you do over the last 2 weeks?	0 1 2 3 4 5 6 More than usual ... Less than usual
4. How often did your asthma affect your activities over the last 2 weeks?	0 1 2 3 4 5 6 None ... All the time
5. Have you experience any asthma attacks over the last 2 weeks?	Yes/No If yes: ....days
Night time symptoms	
6. Have you woken up with asthma symptoms over the last 2 weeks?	Yes/No If yes: ....nights

Table 2 Prediction equations for forced expiratory volume in one second (FEV_1) and peak expiratory flow rate (PEFR)

Parameter	Sex and age (years)	Formula	Units	Reference
FEV_1	Male, 18 and above	$0.0344 \times H - 0.033 \times A - 1.00$	L	7
	Female, 18 and above	$0.0267 \times H - 0.027 \times A - 0.54$	L	7
	Male, 7 to 17	$0.782H^3 \times 10^{-6} - 0.011$	L	8
	Female, 7 to 17	$0.683 \times H^3 \times 10^{-6} + 0.221$	L	8
PEFR	Male, 15 and above	$(0.05666 \times H - 0.02403 \times A + 0.22544) \times 60$	L/min	9
	Female, 15 and above	$(0.03594 \times H - 0.01776 \times A + 1.13160) \times 60$	L/min	9
	Male and female, 12 to 15		L/min	10

H = height in cm, A = age in years

RESULTS

A total of 64 patients were interviewed. The characteristics of the patients are presented in Table 3. All 64 patients performed prebronchodilator spirometry, only 59 patients performed prebronchodilator PEFR, 49 performed postbronchodilator spirometry and 46 performed postbronchodilator PEFR. Only 45 patients completed the whole set of objective lung assessment required of them.

Relationship between asthma symptoms and objective measurements of airway obstruction

As shown in Table 4, the total symptom score had a statistically significant, though weak negative correlation with percent-predicted prebronchodilator FEV_1 (r = -0.256, p = 0.041) and a weak correlation with percent increase in PEFR after salbutamol inhalation (r = 0.335, p = 0.023). However, there was no significant relationship between the total symptom score and the other objective measurements of airway obstruction.

Table 3 Patient characteristics

Characteristics	Mean (± SD)	Range
Age (year)	51.1 (± 16.0)	14 - 84
Gender, % female	73.4	
Duration of asthma (years)	18.6 (± 16.1)	1 - 77
Asthma symptom score	13.9 (± 8.6)	3 - 32
Objective measures of airway obstruction		
Prebronchodilator FEV_1 (% predicted) (n = 64)	57.2 (± 21.4)	22.9 - 137.6
Prebronchodilator PEFR (% predicted) (n = 59)	77.8 (± 23.5)	37.2 - 147.8
Postbronchodilator FEV_1 (% predicted) (n = 49)	62.6 (± 20.4)	24.9 - 137.6
Postbronchodilator PEFR (% predicted) (n = 46)	90.6 (± 22.9)	37.2 - 155.4
Percent increase in FEV_1 after bronchodilator (n = 49)	12.9 (± 16.4)	0 - 72.9
Percent increase in PEFR after bronchodilator (n = 46)	19.8 (± 22.0)	0 - 85

FEV_1 = forced expiratory volume in one second
PEFR = peak expiratory flow rate

Table 4 Correlation between asthma symptoms and objective measures of airway obstruction

Asthma symptom	Objective measure of airflow obstruction	n	Correlation coefficient (r)	*P* value
Total asthma symptom score	Percent predicted prebronchodilator FEV_1	64	- 0.256	0.041
	Percent predicted prebronchodilator PEFR	59	- 0.214	0.104
	Percent predicted postbronchodilator FEV_1	49	- 0.192	0.187
	Percent predicted postbronchodilator PEFR	46	- 0.017	0.913
	Percent increase in FEV_1 after bronchodilator	49	0.133	0.362
	Percent increase in PEFR after bronchodilator	46	0.335	0.023

FEV_1 = forced expiratory volume in one second
PEFR = peak expiratory flow rate

Table 5 Correlation between different objective measures of airway obstruction

Objective measures of airflow obstruction		**n**	**Correlation coefficient** (r)	***P* value**
Percent predicted prebronchodilator FEV_1	Percent predicted prebronchodilator PEFR	59	0.581	< 0.001
Percent predicted prebronchodilator FEV_1	Percent increase in FEV_1 after bronchodilator	49	- 0.215	0.138
Percent predicted postbronchodilator FEV_1	Percent predicted postbronchodilator PEFR	46	0.530	< 0.001
Percent predicted prebronchodilator PEFR	Percent increase in PEFR after bronchodilator	46	-0.402	0.006
Percent increase in FEV_1 after bronchodilator	Percent increase in PEFR after bronchodilator	46	0.093	0.537

FEV_1 = forced expiratory volume in one second
PEFR = peak expiratory flow rate

Relationship between objective measurements of airway obstruction

There was significant correlation between pre- and post-bronchodilator FEV_1 and pre- and postbronchodilator PEFR, respectively (Table 5). Although there was a significant negative correlation between the prebronchodilator PEFR and the percent increase in the PEFR following bronchodilator inhalation, such a relationship was not found for the prebronchodilator FEV_1 and the percent increase in FEV_1 after bronchodilator inhalation.

DISCUSSION

PEFR and FEV_1 are the most widely used objective measurements for bronchial obstruction in asthma. Previous studies have demonstrated a poor relationship between asthma symptoms and objective measurements of airway obstruction. Our study serves to extend these observations to the Malaysian population. Although in clinical studies, patients can be asked to measure PEFR or fill in a symptom questionnaire every day, this is often not the case in real life.

Ferguson[3] recorded daily symptom scores and PEF over eight consecutive 2-week intervals in a cohort of 20 asthmatic children. Although symptomatic periods were closely associated with low PEF values, asymptomatic intervals were associated with reduced PEF values 54% of the time. Sly *et al.*[4] demonstrated that there was no significant relationship between subjective symptom scores and FEV_1 in a group of 14 asthmatic children, both before and after a 4-week "training period" during which PEF was measured thrice daily. Rubinfeld and Pain[11] compared the subjective assessment and objective measurements of airway obstruction in 82 patients during methacholine-induced asthma. They discovered that 15% of the patients were unable to sense the presence of marked airway obstruction, indicating a poor perception of asthma severity. Kendrick *et al.*[6] demonstrated that 60% of 255 adult patients were poor discriminators of their underlying airway obstruction as determined by serial PEF measurements over a 2-week period.

Our findings agreed with those of Teeter and Bleecker,[5] which demonstrated that asthma symptoms did not correlate with the degree of airway obstruction as determined by the FEV_1 and only correlated poorly with PEF in a cohort of adult patients attending a university-based urban asthma clinic. We have found only one weak relationship, which was significant, i.e. that between total symptom score and pèrcent-predicted prebronchodilator FEV_1. There was no other significant relationship. The objective measurements of airway function such as FEV_1 and PEFR do not always reflect all the disease processes, such as hyperinflation and airway plugging, that occur in asthma.[12] The relationship between the perception of asthma symptoms and lung function measurements in asthmatic patients is not well understood.[13] There is a difference between asthma severity and asthma control. While the former is the severity of the underlying disease process, the latter is an estimate of treatment efficacy.[14]

Hence, these studies have emphasized the lack of sensitivity asthma symptoms have for identifying the presence of underlying airway obstruction. As this is the case, objective assessment of asthma severity is important for the prescription of adequate treatment. While symptom and pulmonary function measurements of asthma severity are used for severity classification in practice guidelines, objective measurements still provide the best information about the patient's asthma severity.[12]

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