# PULMONARY FUNCTION IN SYMPTOM-FREE ASTHMATICS

I Yaacob, M Mohammad

*ABSTRACT*

***Seventy-five adult asthmatic patients with clinical remission underwent spirometry. Only 8.3% of the subjects demonstrated normal spirometry. The others had reduced vital capacity (VC), forced vital capacity (FVC), forced expiratory volume in one second ($FEV_1$), maximum mid-expiratory flow rate (MMF) and peak flow rate (PEFR). This study demonstrates that asthma can cause irreversible airflow obstruction and there is a poor relationship between symptoms in asthmatics and their respiratory function test results.***

*Keywords: asthma, remission, lung function, spirometry*

**SINGAPORE MED J 1993; Vol 34: 522-523**

## INTRODUCTION

Bronchial asthma is considered to be a reversible airway obstructive disease as indicated by complete remission of abnormal clinical features. However, evidence from several studies[1-6] suggests that chronic asthma may be associated with the development of irreversible airflow obstruction and pulmonary function during clinical remission from asthma is frequently abnormal. Many asthma patients have persistent airflow obstruction, which is not reversed even by intensive treatment including corticosteroids[7,8].

This paper describes a study of spirometric lung function in a group of symptom-free asthmatic subjects. The purpose of the study was to examine the frequency, severity and range of functional abnormalities during clinical remission of asthma.

## PATIENTS AND METHODS

Seventy-five adult asthma patients (37 males, 38 females) who were on regular follow-up at the Chest Clinic were included in this prospective study. All patients had never smoked and had a clinical history of asthma with paroxysmal dyspnoea and wheezing, reversibility of $FEV_1$ of at least 20% on previous occasions, symptomatic response to bronchodilators, intervals with complete remission of abnormal clinical features and absence of chronic disease (cough, sputum, dyspnoea) and absence of complications such as heart disease. They were on regular treatment with combination of inhaled steroids (68 patients), oral theophylline (55 patients), oral beta2 agonists (12 patients) and/or inhaled beta agonist. No patient was taking oral corticosteroid. They had been symptom-free for at least two months before and throughout the study period and not requiring more treatment than their regular drugs.

The mean age of the patients was 34±12.6 years (range 13 to 66 years) and their mean height was 156 cm (range 140 to 174 cm). Thirty-two patients had childhood-onset asthma while in 40 subjects the asthma developed after the age of 20 years. The mean duration of asthma was 10.9 years (range one to 37 years).

Spirometric measurements were made of the vital capacity (VC), forced vital capacity (FVC), forced expiratory volume in one second ($FEV_1$), $FEV_1$/FVC ratio, maximum mid-expiratory flow rate (MMF or FEF 25%-75%) and peak expiratory flow rate (PEFR), using an electronic spirometer (MICROSPRO HI-298; Chest Corporation, Japan). All of these measurements were made with the subjects seated and nose-clipped. Inhaled bronchodilators were withheld for at least 12 hours prior to the test but the patients continued to take other regular treatment. Based on the age, sex, and height of the patient, the spirometer automatically calculates the predicted and percentage of predicted value for all the parameters. The equations for normal predicted values used by the spirometer were based on works by European Community for Coal and Steel (ECCS)[9], Dickman et al[10], and Zapletal et al[11].

Spirometry was performed on four consecutive follow-up visits, one to four weeks apart. Two of the visits were in the morning (between 0830 hours and 1100 hours) and two visits in the afternoon (between 1430 to 1630 hours). At each visit three acceptable FVC manoeuvres were performed. The best FVC curve from the four visits was chosen for evaluation. The best test was defined as the one with the largest sum of FVC plus $FEV_1$ from a single tracing[12,13].

## RESULTS

Table I shows the best spirometry results over the three-month follow-up. Of the 72 subjects studied, only six patients (8.0%) had spirometric parameters within 25% of the predicted. 13.8% of patients had an $FEV_1$/FVC ratio of less than 60%. The mean PEFR and $FEV_1$ were about 50% and 70% of predicted respectively. The mean MMF was only 35% of predicted. After bronchodilator there was significant improvement of spirometric parameters.

Relationship between duration of asthma and the highest $FEV_1$ is shown in Fig 1. Regression analysis showed that there was no significant relation between the degree of airway obstruction ($FEV_1$) and sex, age of the patient, age of onset or the duration of asthma (R values for all parameters were about 0.1).

**Table I – The best spirometric parameter over a 3-month follow-up of 75 symptom-free adult asthmatics**

| | Before Bronchodilator | | After Bronchodilator | |
|---|---|---|---|---|
| | Measured Value | % Predicted | Measured Value | % improvement |
| VC (Litres) | 2.55±0.77 | 75.78±15.84 | – | – |
| FVC (Litres) | 2.58±0.77 | 78.36±17.16 | 2.81±0.76 | 13.5±15.9 |
| $FEV_1$ (Litres) | 1.98±0.67 | 70.32±21.00 | 2.16±0.57 | 20.8±19.3 |
| $FEV_1$/FVC (%) | 76.37±14.40 | — | 78.73±15.1 | 7.3±9.3 |
| PEFR (L/sec) | 3.67±1.56 | 54.80±22.75 | 4.27±1.32 | 25.3±26.8 |
| MMF (L/sec) | 1.45±0.80 | 36.59±19.67 | 1.69±0.79 | 28.6±24.3 |

VC: Vital capacity
FVC: Forced vital capacity
$FEV_1$: Forced expiratory volume in one second
PEFR: Peak expiratory flow rate
MMF: Maximum mid-expiratory flow rate

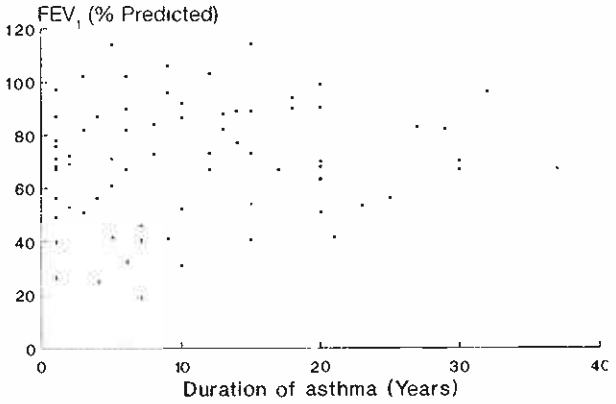
**Department of Medicine**
**School of Medical Sciences**
**Hospital Universiti Sains Malaysia**
**15990 Kubang Kerian**
**Kelantan**
**Malaysia**

I Yaacob, FRCPI
Lecturer

M Mohammad, MD (UKM)
Trainee Medical Officer

**Correspondence to:** Dr I Yaacob

**Fig 1 – Relationship between the duration of asthma and the $FEV_1$**




## DISCUSSION

Bronchial asthma has generally been regarded as an intermittent problem characterised by symptom-free intervals of variable length, and punctuated by exacerbations of variable severity. We have demonstrated that in the majority of patients there is evidence of mild to moderate impairment in the ventilatory capacity even when the patients were symptom-free. Sixty-one percent of patients had normal $FEV_1$/FVC ratio of more than 70% but their $FEV_1$ and FVC values were below the predicted values.

Several studies have shown that chronic asthma may be associated with the development of irreversible airflow obstruction[1-6]. First, pulmonary function is frequently abnormal during clinical remission from asthma. Secondly, the airways of patients with chronic asthma dying from non-respiratory causes show changes including mucous plugging, chronic inflammation with eosinophilic infiltration, basement membrane thickening and smooth muscle hypertrophy, all of which could contribute to persistent airway narrowing. Thirdly, many patients with asthma have persistent airflow obstruction in the symptom-free intervals, and this is not reversed by intensive treatment including corticosteroid[8]. In our patients the lung function improved after bronchodilator. It is possible that even though the patients were asymptomatic, their treatment was not optimal.

Factors which may contribute to the development of irreversible airflow obstruction in asthmatics include cigarette smoking and respiratory illness in childhood[11]. The results of our present study in lifelong non-smokers showed that the airway function abnormalities were not dependent on smoking.

Brown et al[6] found a good relationship between the degree of airflow obstruction and the duration of asthma. This was not supported by our study and others[12]. In agreement with Cade and Pain[1], we also found no correlation between sex, age or type of asthma and the lung function abnormalities.

In support of other previous studies therefore, our study confirmed that although asthma is generally regarded as a reversible airway obstruction, the extent of reversibility frequently appears to be incomplete. It is also of clinical importance to appreciate the poor relationship between the symptom of dyspnoea and the extent of functional abnormalities. Patients without any symptoms frequently have abnormal tests. The implication for the clinician is that in order to optimise treatment, lung function measurements are essential for the assessment of asthmatic subjects, regardless of presence of symptoms.

## REFERENCES


1. Cade JF, Pain MCF. Pulmonary function during clinical remission of asthma: How reversible is asthma? Aust N Z J Med 1973; 3:545-51.
2. Palmer KNV, Kelman GR. Pulmonary function in asthmatic patients in remission. Br Med J 1975; 1:485-6.
3. Sobol BJ, Emirgil C. Pulmonary function in ambulatory asthmatics. J Chron Dis 1976; 29:233-42.
4. McCarthy DS, Sigurdson M. Lung elastic recoil and reduced airflow in clinically stable asthma. Thorax 1980; 35:298-302.
5. Brown PJ, Greville HW, Finucane KE. Asthma and irreversible airflow obstruction. Thorax 1984; 39:131-6.
6. Ulrik CS, Backer V, Dirksen A. A 10-year follow-up of 180 adults with bronchial asthma: factors important for the decline in lung function. Thorax 1992; 47:14-8.
7. Loren ML, Leung PK, Cooley RL, Chan H, Bell TD, Buck VM. Irreversibility of obstructive changes in severe asthma in childhood. Chest 1978; 74:126-9.
8. Carmichael J, Paterson IC, Diaz P, Crompton GK, Kay AB, Grant IWB. Corticosteroid resistance in chronic asthma. Br Med J 1981; 282:1419-22.
9. European Community for Coal and Steel. In: Quanjer Ph H, ed. Report of the Working Party. Standardization of lung function testing. Bull Eur Physiopathol Respir 1983; 19 (suppl5):1-95.
10. Dickman ML, Schmidt CD, Gardner RM. Spirometric standards for normal children and adolescents. Am Rev Respir Dis 1971; 104:680-7.
11. Zapletal A, Motoyama EK, Van De Woestijne, KP. Maximum expiratory flow-volume curves and airway conductance in children and adults. J Appl Physiol 1969; 26:308-16.
12. American Thoracic Society. Lung function testing: selection of reference values and interpretative strategies. Am Rev Respir Dis 1991; 144:1202-18.
13. Sorenson JB, Morris AH, Crapo RO, Gardner RM. Selection of the best spirometric values for interpretation. Am Rev Respir Dis 1980; 122:802-4.
14. Burrows B, Knudson RJ, Lebowitz MD. The relationship of childhood respiratory illness to adult obstructive airway disease. Am Rev Respir Dis 1977; 115:751-60.