Spirometric Evaluation of Pulmonary Function Tests in Bronchial Asthma Patients

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Abstract

The present study was undertaken to assess the pulmonary function status of bronchial asthma patients. The results are based on a sample of 403 asthma patients and 347 healthy subjects (control group) in the age range of 20-70+ years. To study pulmonary functions of asthmatic patients, spirometric evaluation of FEV1, FVC, FEV1/FVC, have been recorded on each subject. The data have been subjected to statistical analysis viz. mean, standard deviation, standard error of mean and test of significance. All the pulmonary parameters in asthmatic patients showed significantly less observed values than the normal predicted values. The difference in the mean values of all the lung function parameters of bronchial asthma patients are lower as compared to normal healthy subjects with statistically significant differences in almost all the age groups.

Keywords: Pulmonary function test, bronchial asthma, spirometry

Introduction

Asthma is a complex, recurrent disease of the airways that causes shortness of breath, wheezing, and cough (particularly at night or early in the morning). Asthma is episodic in nature and usually reversible, either spontaneously or with treatment. However, chronic inflammation, associated with persistent symptoms, may contribute to airway remodeling that may not be completely reversible. Airflow limitation occurs as a result of varying degrees of airway hyperresponsiveness, airway edema, and bronchoconstriction

Pulmonary function test (PFT), is a non invasive test, used to detect air flow limitation and/or lung volume restriction. Assessment of ventilatory function is an important investigation because early detection of functional impairment and its appropriate treatment will help to reduce morbidity and mortality related to disease.

Long -term deterioration of lung function in asthmatic subjects has been described in various studies. For a long time it has been believed that asthma is characterized by totally reversible airway obstruction. Now it is established that prolonged airway inflammation regulated by a variety of inflammatory cells and mediators is the central mechanism in the pathogenesis of asthma. Inflammation leads to injuries and repair including regeneration and replacement by connective tissue. It has been hypothesized that chronic airway inflammation can lead to airway remodeling and in the long term to irreversible airway obstruction. The consequence of this process could be deterioration in pulmonary function.

Asthma is characterized by the presence of reversible airflow obstruction; however, irreversible airflow obstruction develops in some patients. Moreover, accelerated loss of lung function over time has been reported in groups of patients with asthma in longitudinal prospective and retrospective studies (*Lange et al, 1998, Peat et al, 1987, Sears et al, 2003, Covar et al, 2004*) *Pascual et al (2005)* reported that clinically, airflow

obstruction in asthma often is not fully reversible, and many asthmatic subjects experience an accelerated and progressive loss of lung function over time. *Lange et al (1998*) proved that adults with asthma have substantially greater declines in forced expiratory volume in 1s (FEV1) over time in comparison with healthy subjects. Accelerated decline in lung function does not occur in all patients. The risk factors identified for accelerated decline in lung function include young age, male gender *(Covar et al 2004),* duration of disease *(Lee et al, 2007)* more prominent eosinophilic airway inflammation *(Covar et al, 2004),* asthma exacerbations *(Bai et al, 2007),* and smoking *(Lee et al, 2007).*

Recent studies of patients with asthma selected from the general population have shown increased mortality in subjects with reduced ventilatory function and have thus underlined the importance of preservation of normal lung function. (*Silverstein, 1994; Lange, 1996; Huovinen, 1997*).

In the present investigation an attempt has been made to study pulmonary function of bronchial asthma patients. Little is known about lung function of bronchial asthma patients in this part of the region as patients are treated on the basis of clinical history and sign and symptoms and their lung function is rarely assessed.

Materials & Methods

The present cross sectional study has been conducted on bronchial asthma patients to study their pulmonary function status. 403 bronchial asthma patients and 347 normal healthy subjects have been studied in the age range of 20-70+ years. Data on patients have been collected from Civil Hospital, Hoshiarpur and Aggarwal Nursing Home and Chest Clinic, Hoshiarpur. Selected patients and normal subjects were explained the purpose of the study and need of cooperation was emphasized. All the subjects participated in the study voluntarily.

Pulmonary Function Tests (PFT): pulmonary function tests were done on all the subjects using Helios -401 *electronic spirometer***,** which is a precalibrated and computerized spirometer. Following spirometeric parameters were recorded for analysis.

1. Forced Vital Capacity (FVC)
2. FEV_1
3. FEV_1/FVC

In normal health subjects FVC & FEV_1 should be greater than or equal to 80% of predicted value. All PFT values have been expressed as percentage of predicted values. These have been compared age wise between patients and control group subjects. Lung function parameters have also been compared according to smoking status of asthma patients and control subjects.

Results & Discussion:

Table 1: Mean and standard deviation of forced vital capacity (FVC) in bronchial asthma and control subjects, classified as per age groups.

	PATIENT		CONTROL		
Age	**Mean**	**SD**	**Mean**	**SD**	**t**
			Males		
20-29	95.80	19.05	101.39	13.91	1.01
30-39	92.14	23.77	100.27	14.35	1.60
40-49	87.42	21.43	101.21	20.725	2.65‡
50-59	83.43	24.32	101.91	14.09	3.63‡
60-69	81.41	24.45	98.43	27.88	2.13†
70+	76.86	25.24	100.13	24.69	3.05‡
			Females		
20-29	93.97	21.90	109.65	13.56	3.36‡

30-39	93.58	22.24	102.97	15.44	2.11†
40-49	86.03	16.61	95.59	22.60	2.29†
50-59	82.80	25.53	100.54	27.76	2.61‡
60-69	71.85	22.37	92.73	19.18	3.72‡
70+	74.28	31.02	101.67	34.10	2.39†

† = p < 0.05 , ‡ = p < 0.01

Table 1 presents mean values and comparison of FVC of male and female patients and controls. In patients FVC values show a decreasing trend with increasing age. In control males and females, FVC mean values remained almost constant in all the age groups. It did not show any decreasing trend with increase in age. When FVC mean values were compared among patients and controls, the differences were found to be statistically significant ($p<0.01$) in all the age groups in both the sexes except in 20-29 and 30-39 years age groups in males.

*Forced expiratory volume in one second***:** Table 2 also depicts the mean values and comparison of FEV_1 in patients and controls. In patient males and females, there is a continuous decrease in the mean value of FEV_1 from the age group of 20-29 years to the age of 70+ years except that in females slight increase in FEV_1 at the age group of 70+years has been observed in control group both in males and females, FEV_1 values remained almost stable and above 90 %.

Table 2: Mean and standard deviation of forced expiratory volume in first second (FEV1) in bronchial asthma and control

PATIENT			CONTROL		
Age	**Mean**	**SD**	**Mean**	**SD**	**t**
Males					
20-29	78.13	26.09	91.67	15.10	1.86
30-39	70.72	31.36	94.67	12.95	3.83‡
40-49	61.21	27.22	96.39	19.84	6.00‡
50-59	57.47	23.87	91.09	16.31	6.43‡
60-69	54.41	26.04	53.57	23.24	5.66‡
70+	53.61	19.91	103.73	21.70	7.7‡
Females					
20-29	20-29	74.45	21.72	111.38	12.22
30-39	30-39	68.22	23.12	102.90	13.48
40-49	40-49	66.00	23.62	95.89	18.98
50-59	50-59	69.71	29.32	96.57	30.41
60-69	60-69	56.53	25.26	92.73	22.06
70+	70+	61.78	28.19	98.20	30.68

Statistically significant differences have been observed in the values of FEV1 in patient and control groups except in the age group of 20-29 and 30-39 years in the males and 70+ years in females

FEV_1/FVC

Table 3 shows changes in FEV1/FVC with age and comparison of FEV1/FVC in patient and control group. In patient males, FEV_1/FVC ratio decrease with increase in age. FEV_1/FVC mean value improved in 70+ years of age group. In patients' females, values of FEV_1/FVC show no decrease with increasing age as FVC values also decrease with increasing age and ratio improved in older age groups. In control males and females, no increasing or decreasing trend is seen and value remained above 90% in all the age groups. Comparison shows that patient males and females have lower values of FEV_1/FVC than control males and females and differences have been found to be statistically significant in all the age groups

Table 3: Mean and standard deviation of ratio of forced expiratory volume in first second to forced vital capacity (FEV_1/FVC) in bronchial asthma and control subjects, classified in age groups

	Patient		Control		
Age	Mean	SD	Mean	SD	t
Males					
20-29	82.00	22.35	91.16	14.43	1.45
30-39	72.48	16.77	118.97	13.87	1.92
40-49	67.61	18.57	96.88	13.89	7.25‡

50-59	66.93	22.03	90.00	15.27	4.76‡
60-69	66.75	22.33	97.79	15.52	6.33‡
70+	76.86	26.97	105.87	18.45	4.73‡
Females					
20-29	75.80	25.00	102.14	9.76	5.44‡
30-39	73.44	19.56	100.72	10.93	7.37‡
40-49	75.58	20.15	102.27	14.54	6.66‡
50-59	83.11	19.04	96.64	16.53	3.02‡
60-69	80.20	25.35	101.23	17.88	3.63‡
70+	85.89	25.56	99.47	18.74	1.76

† =p < 0.05 , ‡ = p < 0.01

Very few female smokers in both patient and control groups except 20-29 and 30-39 years of age groups in males and in 70+ years age group in females. Table 4 presents mean values and comparison of FVC, FEV1 and EV1/FVC, in patient and control group males according to their smoking status. In patient smokers, the mean value of all the lung function parameters are control subjects, the difference in lung function parameters between smokers and nonsmokers are statistically insignificant. This shows that smoking in asthma patients accelerates lung function decline in asthma patients.

Table 4: Lung function profile of male bronchial asthma and control subjects according to smoking status

Parameter	Patients		T	CONTROL		T
	Smokers Mean ±S.D.	Nonsmokers Mean ±S.D.		Smokers Mean ±S.D.	Nonsmokers Mean ±S.D.	
FVC	77.96 ±21.82	87.8 ±24.64	3.02**	98.63 ±17.42	101.67 ±18.28	0.96
FEV1	50.73 ±22.63	64.48 ±27.56	3.98**	92.00 ±17	95.41 ±17.82	1.11
FEV1/FVC	65.67 ±22.56	72.53 ±21.66	2.17*	94.79 ±17.52	101.82 ±74.91	0.94

***=p < 0.05 , ** =p < 0.01**

Discussion

Findings of the present study have shown that there is decline in all the lung normal healthy controls remained normal in all the age groups. The difference in all the lung function parameters in patients and control group subjects are statistically significant in almost all the age groups. Present findings are thus in line with the perception that asthma is a chronic inflammatory disease in which ongoing tissue injury and repair may result in irreversible fibrotic changes in the airways leading to decline in lung functions. Conflicting results have been reported regarding the influence of bronchial asthma on the rate of decline of lung function. The results of previous studies of the decline in FEV1 in people with asthma are generally consistent with the present findings *Fletcher and co workers (1976)* mean unadjusted decline in FEV1 of 22ml. per year greater in men with asthma than in men without asthma. More recent studies have evaluated FEV1 delin in large population samples *(Ulrik et al, 1992 and Lange et al, 1998)* and the results suggest that asthma as a significant impact on lung function decline. However, in the Tucson lung study *(Burrows et al, 1987)* declines in FEV_1 of less than 5 ml. per year were observed in adults with asthma. In a recent report of 25-year follow-up data on adults from a Dutch asthma clinic, more than 75 percent of the patients had FEV_1 values below 90 percent of the predicted values at the final examination *(Panhuysen et al, 1997).* In a study by *Zeiger et al (1999)*, the unadjusted annual decline was 80.1 ml. per year of asthma duration for FEV1 and 20.5 ml. per year for FVC in the whole study group. Also, *Peat et al (1987)* found a mean loss of FEV1 in male nonsmokers suffering from asthma of about 50 ml .year compared with 35 ml./year in normal subjects. Studies by *Silverstein et al (1994) Lange et al (1996) Huovinen et al (1997)* show that a reduction in ventilatory function leads to

an increased mortality among asthmatic subjects The preservation of normal lung function should be one of the aims of asthma therapy. Furthermore, in the present study findings, it is seen that smoking in asthma patients increases the severity and accelerates the decline in lung function. *Thomson and Spears (2005)* have reported that smoking and asthma are associated with poor symptom control and impaired therapeutic responses to anti asthma drugs. Higher levels of smoking are seen in patients with asthma who attend emergency departments with exacerbations *(Silverman et al, 2003)* Compared with asthmatic nonsmokers, smokers with asthma have worse symptom control *(Althuis et al, 1999),* an accelerated decline in lung function *(Lange et al, 1998),* and an increased mortality rate *(Marquette et al, 1992).* Asthmatic smokers have more severe asthmatic symptoms, greater need for rescue medications, and worse indices of health status in comparison with asthmatics who have never smoked *(Gallefoss and Bakke, 2003).* With regard to the influence of age on lung function decay in asthma, conflicting results have previously been reported. Peat et al did not find any influence of age on the functional decline over several years in asthma, Whereas Urlik et al.(1992) reported steeper decline in FEV1with ageing. *Cibella et al (2002)* suggested that in older asthmatics the rate of pulmonary function loss may slow down. Aging unlike the duration of disease, may lower the intensity of the events of remodeling that characterize chronic asthma and thus produce a slower rate of decline in lung function. Therefore it is clearly evident from present finding that asthma patients show lower values of all lung functions. In addition to this smoking further aggravates the decline in lung functions of asthma patients.

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