Article

FVC, FEV_1 and FEV_1/FVC% in Type 2 Diabetes and Their Relationships with Duration of the Disease

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Abstract

Background: Diabetes mellitus is a chronic debilitating disease affecting various organs including lungs. The magnitude of the complications of this disease is related to its duration. **Objective**: To observe FVC, FEV_1 and FEV_1/FVC% in type 2 diabetic patients and their relationship with duration of the disease. **Methods:** This cross-sectional study was carried out in the Department of Physiology, BSMMU, Dhaka, from July 2007 to June 2008 on 60 type 2 diabetic male patients of age 40-60 years (Group B). For comparison, 30 age and BMI matched apparently healthy non diabetic subjects (Group A) were also studied. Patients were selected from the out patient department of Bangladesh Institute of research on diabetes, endocrine and metabolic diseases. Based on duration of diabetes, diabetic patients were divided into B_1 (5-10 years) and B_2 (10-20 years). FVC, FEV_1 and FEV_1/FVC% of all the subjects were measured by a digital microspirometer . Data were analyzed by One way ANOVA test, Unpaired Student's 't' test and Pearson's correlation coefficient test as applicable. **Results:** Mean of the percentage of the predicted values of FVC and FEV_1, were significantly ($p<0.001$) lower in both those of Gr. $B_1$and B_2 than that in A and were also significantly ($p<0.001$) lower in Gr. B_2 when compared with Gr. B_1. Again, FEV_1/FVC% was significantly ($p<0.01$)higher in Gr. B_2 than those in Gr. B_1 and A whereas this value was lower in Gr. B_1than those of group A but it was not statistically significant. However, FVC and FEV1 showed negative and FEV_1/FVC% showed positive correlations with duration of diabetes. All these correlations were statistically non significant. **Conclusion:** From the result of this study it can be concluded that the ventilatory function of lung may be reduced in type 2 diabetes which may be related to the duration of the disease.

Key words: FVC, FEV_1, diabetes mellitus

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Introduction

The term diabetes mellitus describes a metabolic disorder of multiple aetiology characterized by chronic hyperglycemia with disturbances of carbohydrate, protein and fat metabolism resulting from defects in insulin secretion or insulin action or both [1]. It is a leading public health problem with increasing incidence and long term complications of various organs such as kidney, neuron, eye, heart etc. These compli-cations are mainly a consequence of macro and micro vascular damages of the target organs[2].

Like other target organs lung is also affected in diabetes[3]. Hyperglycemia causes micro vascular changes such as thickening of basal lamina in the smaller vessels of the lungs, which causes reduction of its diffusing capacity of them. Hyperglycemia also causes some mechanical changes in the lungs. In this chronic disease, the susceptibility and severity of systemic inflammation increases which may cause peripheral airway obstruction [4] as well as fibrosis of lung tissue [5]. It was also observed that hyperglycemia affects the lung by non enzymatic glycation of chest wall and bronchial tree protein which prevents easy expansion [6].

The duration of DM is an important factor affecting the lungs. Chronic hyperglycemia is

strongly associated with progressive neurogenic damage. Its severity and extent increases with the duration of diabetes. In 2000, Davis et al. observed that some pulmonary functions were decreased in type 2 diabetes and the reduction was directly proportionate to the duration of the disease [6]. In 2007, MEO et al. also observed that some spirometric lung function parameters were decreased in this group of patients and the decline was more in patients with longer duration of diabetes [2].

The prevalence of diabetes is increasing day by day [7]. The number of diabetic patients in the world may be raised from 150 million to 220 million by the year 2010 [8]. In our country, the number of diabetic patients is also increasing day by day. In 1966, about 1% people were affected by diabetes. But in 2003, it was about 15% [9]. It is surprising that there is no age limitation for presentation of type 2 diabetes. Many of the patients are diagnosed after development of one or more complications including nephropathy, neuropathy, retinopathy, and cardiovascular diseases. They also suffer from pulmonary complications.

Many studies on pulmonary functions in type 2 diabetic patients have been done in other countries. With the best of our knowledge no data is available in Bangladesh. Therefore, the present study was conducted to observe some aspects of lung functions in type 2 diabetic male to evaluate their lung function status and its association with duration of the disease.

Methods

This cross-sectional study was carried out in the Department of Physiology, BSMMU, Dhaka, from July 2007 to June 2008 on 60 type 2 diabetic patients of 40-60 years old. For comparison, 30 age and BMI matched apparently healthy non diabetic subjects were (Group A) also studied. The patients were also matched with healthy subjects in terms of socioeconomic status. Based on duration of diabetes, diabetic patients were divided into B_1 (5-10 years) and B_2 (10-20 years). The study group was selected from the Out Patients Department of BIRDEM. Subjects with history of COPD, asthma, smoking, heart disease, renal insufficiency, obesity, chest deformity and lung infections were excluded from the study. After selection of the subjects the purpose of the study was explained to each subject with a cordial attitude giving emphasis on the benefits they would obtain from this study. They were encouraged for voluntary participation. They were also allowed to withdraw themselves as soon as they need. To avoid the diurnal variation all the subjects were requested to attend at Department of Physiology BSMMU within 9 a.m. (after taking breakfast at 7 a.m) on the day of examination. Before examination an informed written consent was taken from each subject. A detail personal, medical, family, socio economic, occupational and drug history were recorded in a preformed questionnaire. Thorough physical examinations were done. Height and weight of the subjects were measured for calculation of BMI. 5 ml of venous blood was collected at 9 am from every patient for estimation of serum glucose, serum creatinine and HbA_{1c} level in the blood as applicable. Then FVC, FEV_1, FEV_1/FVC% of all the subjects were measured by an electronic spirometer in the Respiratory Laboratory, Department of Physiology, BSMMU. Glycosylated hemoglobin (HbA_{1c}) of diabetic patients was estimated by ion-exchange high-performance liquid chromatography (HPLC) method. Data were analyzed by One way ANOVA test, Unpaired Student's't' test, and Pearson's correlation coefficient test as applicable.

Results

The demographic variables of the study subjects are presented in Table-I. The groups were matched for age and BMI. Mean Glycosylated hemoglobin (HbA_{1c}) levels in different duration of diabetes are shown in Figure 1. The mean (±SD) HbA_{1c} level was significantly higher ($p<0.01$)in group B_2 when compared to B_1.

Table I: Age and BMI in different groups (n=90)

Groups	n	Age (years)	BMI (kg/m^2)
A	30	49.56 ± 5.59 (40 - 60)	20.63 ± 1.42 (18.5-22.9)
B_1	30	51.70 ± 4.69 (42 - 60)	21.40 ± 1.70 (18.5 – 22.9)
B_2	30	51.90 ± 5.82 (40 - 60)	21.30 ± 1.60 (18.5 – 22.9)

Statistical analysis:

Groups	p value	p value
A vs B_1 vs B_2	0.184 ns	0.13 ns
A vs B_1	0.115 ns	0.06 ns
A vs B_2	0.119 ns	0.10 ns
B_1 vs B_2	0.884 ns	0.80 ns

Data are expressed as Mean ± SD. For test of significance, one way ANOVA were performed for comparison among the groups. Independent 't' test was done to compare between the groups..
Group A = Apparently healthy non diabetic male for control.
Group B_1 = Diabetic male with duration 5-10 years.
Group B_2 = Diabetic male with duration 10-20 years.
ns = Not significant. n = Number of subjects.

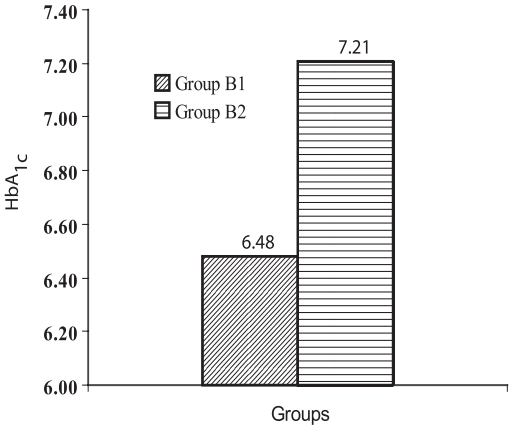

Figure 1: Mean Glycosylated Hb level in different duration of diabetes (n=60)

Group B_1 = Diabetic male with duration 5-10 years.
Group B_2 = Diabetic male with duration 10-20 years.
n = Number of subjects.

The results of FVC, FEV_1 and FEV_1/FVC (%) are shown in Table II.

Table II: Mean percentage predicted values of FVC, FEV_1 and FEV_1/FVC (%) in different groups (n=90)

Groups	n	FVC (litres)	FEV_1 (litres)	FEV_1/FVC (%)
A	30	112.86 ± 11.97	130.13 ± 12.84	116.06 ± 6.31
B_1	30	83.30 ± 7.69	101.30 ± 8.78	115.53 ± 6.77
B_2	30	75.10 ± 8.95	85.51 ± 9.84	121.60 ± 6.78
Statistical analysis:		p value		
Groups				
A vs B_1 vs B_2	0.000***	0.000***	0.001***	
A vs B_1	0.000***	0.000***	0.753 ns	
A vs B_2	0.000***	0.000***	0.001***	
B_1 vs B_2	0.000***	0.000***	0.001***	

Data are expressed as Mean ± SD. For test of significance, one way ANOVA were performed for comparison among the groups. Independent 't' test was done to compare between the groups.
Group A = Apparently healthy non diabetic male for control.
Group B_1 = Diabetic male with duration 5-10 years.
Group B_2 = Diabetic male with duration 10-20 years.
*** = $p < 0.001$., ns = nonsignificant, n = Number of subjects.

The mean percentage of predicted values of FVC and FEV_1 in group B_1 and B_2 were significantly ($p<0.001$) lower than those of group A, Similarly, the values of FVC and FEV_1 in group B_2 were significantly ($p<0.001$) lower than B_1. But the mean percentage of predicted values of FEV_1/FVC (%) were significantly higher ($p<0.001$) in group B_2 compared to B_1. No significant difference was found when this value was compared between group B_1 and group A.

Relationship of FVC, FEV_1 and FEV_1/FVC (%) with duration of diabetes in the study groups were observed. The results are shown in Figure 2, 3 and 4.

FVC and FEV_1 were negatively and FEV_1/FVC was positively correlated with duration of diabetes in both group B_1 and B_2. But these relationships were not statistically significant.

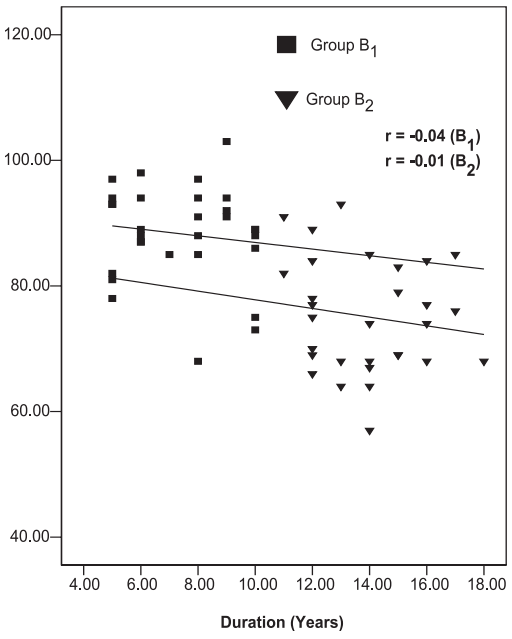

Figure 2: Correlation of percentage predicted value of FVC with duration of diabetes in study groups (n=60)

Group B_1 = Diabetic male with duration 5-10 years
Group B_2 = Diabetic male with duration 10-20 years

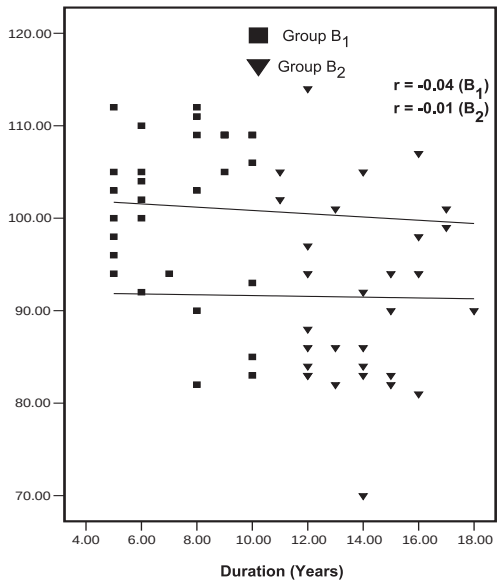

Figure 3: Correlation of percentage predicted values of FEV_1 with duration of diabetes in study Groups (n = 60)

Group B_1 = Diabetic male with duration 5-10 years
Group B_2 = Diabetic male with duration 10-20 years

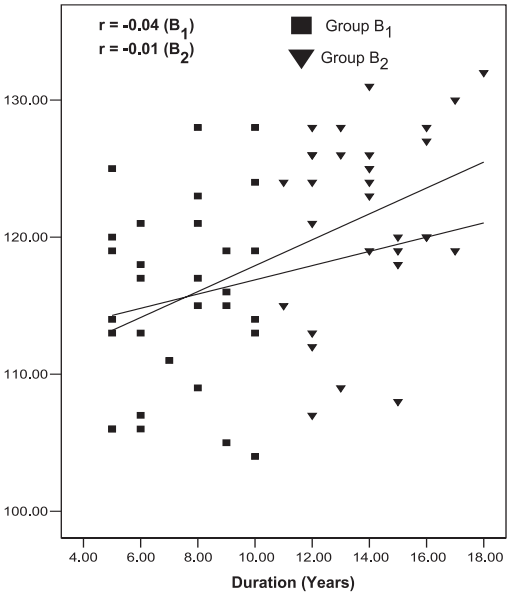

Figure 4: Correlation of percentage predicted value of FEV_1/FVC (%) with duration of diabetes in study groups (n = 60).

Group B_1 = Diabetic male with duration 5-10 years
Group B_2 = Diabetic male with duration 10-20 years
HbA_{1c} (%)

Discussion

The present study was undertaken to observe some of the spirometric lung function variables in type 2 diabetic male subjects. Most of the values of lung function parameters in non diabetic subjects were within normal range and almost similar to the findings reported by different investigators of other countries [10, 11] as well as in our country[12].

In this study, the mean of the percentage of predicted values of FVC and FEV_1 in type 2 diabetic patients of different duration were significantly lower than those of non diabetic subjects. These findings are consistent with findings of some investigators of different countries [2, 3, 11]. Again, these parameters in diabetic patients of 10-20 years duration was significantly lower when it was compared to that of 5-10 years duration of the disease. These findings are also in agreement with those of different investigators of other countries [2, 6, 13].

FEV_1/FVC (%) in the diabetic patients with 5-10 years duration was lower than that of the control group though the difference was not statistically significant. Sreeja et al. reported almost similar type of finding [14]. On the other hand, this parameter in the patients with 10-20 years of diabetes was significantly higher than those of the diabetic patients with 5-10 years duration and also the control group. However, almost similar type of finding was reported by different researchers although the differences were not statistically significant [11].

The data of our study showed that FVC and FEV_1 were negatively but FEV_1/FVC (%) was positively correlated with the duration of diabetes of both groups. All these relationships were statistically nonsignificant. These observations are in partial agreement with those of Meo et al. (2007). They found significant negative correlation with FVC and FEV_1[2]. On the other hand, Benbassat et al. observed no correlation between lung function parameters and duration of the disease or glycemic control subjects [15].

Various studies suggested that diabetes mellitus may cause irreversible collagen cross linking in thoracic as well as lung tissue In addition, chronic hyperglycemia causes fibrous tissue formation in the chest wall and bronchial tree protein (specially collagen) by non enzymatic glycation. This fibrous tissue may cause reduced compliance of lung and subsequent chronic airflow obstruction [16]. Long standing hyperglycemia may also cause autonomic as well as somatic (phrenic) neuropathy, which alters respiratory muscle function[17].

Moreover, hyperglycemia causes over production of mitochondrial super oxides and ultimately a secondary reduction in antioxidant defense of the lungs. So there is increased susceptibility to environmental oxidative insults and subsequent loss of respiratory function [18-19].

Diabetes mellitus is also associated with poor skeletal muscle strength due to increased protein catabolism [20]. For this reason respiratory muscle endurance also decreases in diabetes mellitus [21].

In this study, comparatively reduced FVC and FEV_1 in diabetic patients of both group and its subnormal value in patients with longer duration denotes decreased lung compliance and air flow obstruction. Again, the increased ratio of FEV_1/FVC (%) in diabetic patients of longer duration is due to disproportionate reduction of FVC and FEV_1, which indicate that long-standing hyperglycemia may cause predominantly restrictive type of lung disorder. All these changes may be due to glycation of the chest wall and bronchial tree protein. This is further supported by negative correlation of FVC and FEV_1 and positive correlation of FEV_1/FVC% with longer duration of diabetes. The negative correlation of FVC and FEV_1 with duration of diabetes indicate that long standing hyperglycemia may intensify the devastating effect of the disease.

Conclusion

From this study it may be concluded that lung functions decreases in type 2 diabetic male and

the reduction is directly proportionate to the duration of the disease.

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