Article

PEFR, FEF_{25-75} and MVV In Type-1 Diabetic Male And Their Relationships With HbA_{1c}

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Abstract

Background: Diabetes mellitus is a chronic and debilitating disease. Its complications give rise to microvascular, macrovascular and neuropathic diseases which affect eyes, kidneys, heart, blood vessels and also lungs. So, there may be a relationship between type-1 diabetes and reduced lung function. **Objectives:** To observe PEFR, FEF_{25-75} and MVV and their relationship with HbA_{1c} in type-1 diabetic male in Bangladesh. **Methods:** This cross-sectional study was carried out in the Department of Physiology, Sir Salimullah Medical College, Dhaka between 1st January and 31st December 2009. A total 30 type-1 diabetic male subjects, age 18-30 years were taken as study group. Another 30 apparently healthy age, sex, BMI and socioeconomic status matched non-diabetic persons were also included as control. For assessment of lung function PEFR, FEF_{25-75} and MVV of all the subjects were measured by a digital spirometer. Again, to observe glycemic control serum blood glucose and glycosylated hemoglobin (HbA_{1c}) levels of diabetic patients were also measured by usual laboratory technique. Data were analyzed by unpaired't' test and Pearson's correlation coefficient test. **Results:** PEFR ($p<0.001$), FEF_{25-75} ($p<0.001$), and MVV ($p<0.001$) were significantly lower in type-1 diabetic patients in comparison to those of apparently healthy non-diabetic male. Again, their PEFR ($p < 0.05$), FEF_{25-75} ($p>0.05$), and MVV ($p<0.05$) were negatively correlated with HbA_{1c}. **Conclusion:** The lung functions were lower in type-1 diabetic male in comparison to those of non-diabetic counterpart and this reduction is mainly due to poor glycemic control.

Key words: Type-I diabetes mellitus, Lung function parameters, Glycosylated hemoglobin.

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Introduction

Diabetes mellitus is a clinical syndrome characterized by hyperglycemia due to absolute or relative deficiency of insulin[1]. The incidence and prevalence of diabetes mellitus and its complications are increasing surprisingly throughout the world particularly in Indian subcontinent [1,2]. Several distinct types of diabetes mellitus exist and are caused by a complex interaction of genetics and environmental factors[3].

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Type-1 diabetes mellitus caused by autoimmune destruction of beta cells in pancreas, resulting in total lack of insulin secretion. It is always symptomatic and shows classical features of hyperglycemia[4]. Although it can occur at any age but usually found in young people specially who are thin[3]. It is a serious, progressive multi-factorial disease associated with a number of chronic complications, which include cardiovascular disease, nephropathy, neuropathy, retinopathy and lung damage[5].

Several pathological changes may occur in the lungs of type-1 diabetic patients. Chronic hyperglycemia may cause reduction of diffusing capacity of lung due to thickening of alveolar epithelium and pulmonary capillary basal laminae because of microangiopathic process and nonenzymatic glycosylation of tissue proteins[6]. Similarly, because of structural changes, the volumes and elastic recoil of lung may also reduce in type-1 diabetic patients[7]. However, like other systemic disorders impairment of lung functions considered as a potential risk factor for type-1 diabetic patients[8].

For assessment of lung functions PEFR, FEF_{25-75} and MVV are usually measured[9]. In addition, glycosylated haemoglobin (HbA_{1c}%) can be estimated for the assessment of long term control of diabetes over the last 8 to 12 weeks and may increase in diabetic patients with pumonary complications[2, 9].

Peak expiratory flow rate (PEFR) is a better indicator of respiratory muscle strength, may decrease in type-1 diabetic patients. In a study some researchers found that patients with HbA_{1c}>10% showed a significant reduction in PEFR in type-1 diabetes mellitus. They also found that significant reduction was associated with diabetic nephropathy and neuropathy[10].

Along with other lung function parameters, FEF_{25-75} decreases in patients with diabetes mellitus. Some investigators in a study found that FEF_{25-75} decreases in type-1 diabetes mellitus and it correlates with duration of disease, metabolic control and various complications of disease[10]. Moreover, Maximum Voluntary Ventilation (MVV) is a spirometric test, for measuring working capacity of respiratory muscle. This MVV may be decreased in diabetic patients due to impairment of respiratory muscle endurance[11].

Type-1 diabetes mellitus is likely to account for over 10% of the total diabetic cases[12] and the incidence is increasing globally[13]. It is an incurable life long disease, it involves multiple systems with wide ranging and devastating complications including lung damage[2]. Many studies of pulmonary functions on type-2 diabetic patients had been done by different researcher of different countries[2, 9] and also in our country[14]. However, no study has yet been done on lung function in type-1 diabetic patients in our country. Therefore, the present study was designed to observe PEFR, FEF_{25-75} and MVV and their relationship with HbA_{1c} in type-1 diabetic male in Bangladesh. This study may help to create awareness among the physicians and the type-1 diabetic patients in Bangladesh regarding the damaging effect of diabetes on lung function. This may help earlier diagnosis and proper management of pulmonary complications in this group of patients.

Methods

This cross sectional study was done in the Department of Physiology, Sir Salimullah Medical College (SSMC) between 1st January 2009 and 31st December 2009. A total 30 type-1 diabetic male subjects, age 18-30 years were taken as study group (Group B). They were selected from out patient department of BIRDEM hospital. Another 30 apparently healthy age, sex, BMI and socioeconomic status matched non-diabetic persons were also included as control (Group A). They were selected from slum area of Kallyanpur, Dhaka City. All the subjects were belonged to lower socio- economic status. Subjects having history of asthma, any acute or chronic lung infection, heart disease, renal insufficiency (serum creatinine>1.5 mg/dl)[15],or having any structural chest deformity were excluded from the study. Ethical permission was taken from the Institutional Ethics Committee (IEC) of SSMC.

Height and weight of the subjects were measured for calculation of BMI. After 8 to 14 hours of over night fasting, 5 ml of venous blood was collected at 8 am from every patient for estimation of fasting glucose, serum creatinine and HbA_{1c} level in the blood. A second blood sample was taken 2 hours after breakfast for estimation of blood glucose level. For the assessment of lung function PEFR, FEF_{25-75} and MVV of all the subjects were measured. All of theses tests were done by spirometric method by using a digital Spirometer (Spriobank G). Data were analyzed by Independent-Samples "t" test and Pearson's correlation coefficient test as applicable.

Results

The anthropometric data of the study subjects are presented in Table I. Both the groups were matched for age and BMI.Serum creatinine and blood glucose levels are presented in Table II. All the subjects were with normal renal function.

Again, mean percentage of predicted values of PEFR, FEF_{25-75} and MVV were significantly ($p<.001$) lower in group B, than those of group A. (Table III).

HbA_{1c} was negatively correlated with PEFR ($p<0.05$), FEF_{25-75} ($0>0.05$) and MVV ($p<0;05$). Fig 1,2,3.

Table I: Age and BMI in both groups (n=60)

Parameters	Group A (n=30)	Group B (n=30)	P value
Age (years)	23.43+3.41	23.63+3.38	0.820^{ns}
BMI (kg/m^2)	17.02+1.64	17.80+1.95	0.100^{ns}

Data are expressed as Mean ± SD. Statistical analysis was done by Independent-Samples "t" test.
Group A: Apparently healthy non-diabetic male
Group B: Type-I diabetic male
ns = not significant
n= Total number of Subjects

Table II : Serum creatinine, fasting blood glucose and blood glucose 2hr ABF in both groups (n=60)

Parameters	Group A (n=30)	Group B (n=30)	P value
Serum creatinine (mg/dl)	0.86 ± 0.14	1.19 ± 0.22	0.000***
Fasting blood glucose (mmol/L)	4.84 ± 0.51	11.11 ± 3.21	0.000***
2hr ABF (mmol/L)	7.14 ± 0.32	16.38 ± 4.54	0.000***

Data are expressed as Mean+SD. Statistical analysis was done by Independent-Samples " t" test..
Group A: Apparently healthy non-diabetic male
n = Total number of subjects.
Group B: Type-I diabetic male
*** = $p<0.001$.

Table III: Percentage of predicted values of PEFR, FEF_{25-75} and MVV in both groups (n=60)

Parameters	Group A (n=30)	Group B (n=30)	P value
PEFR %	93.07 ± 9.50	41.17 ± 20.39	0.000***
FEF_{25-75} %	98.07 ± 16.80	45.69 ± 22.58	0.000***
MVV %	86.00 ± 10.76	44.50 ± 15.25	0.000***

Data are expressed as Mean+SD. Statistical analysis was done by Independent-Samples " t" test.
Group A: Apparently healthy non-diabetic male
ns = Not significant
Group B: Type-I diabetic male
*** = $p<0.001$
n=Total number of Subjects

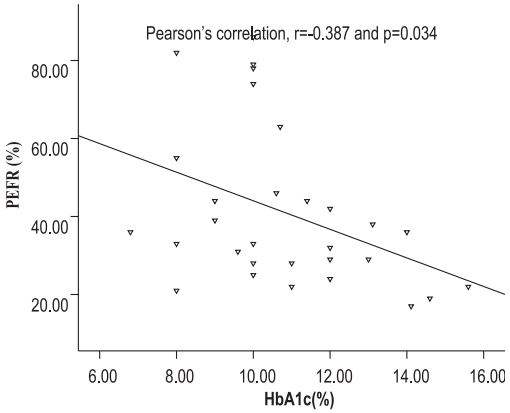

Figure 1: Correlation of percentage predicted value of PEFR with HbA_{1c} in type-1 diabetic male (n=30)

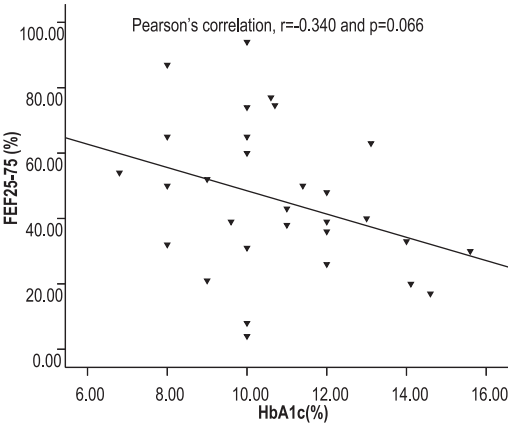

Figure 2: Correlation of percentage predicted value of FEF_{25-75} with HbA_{1c} in type-1 diabetic male (n=30)

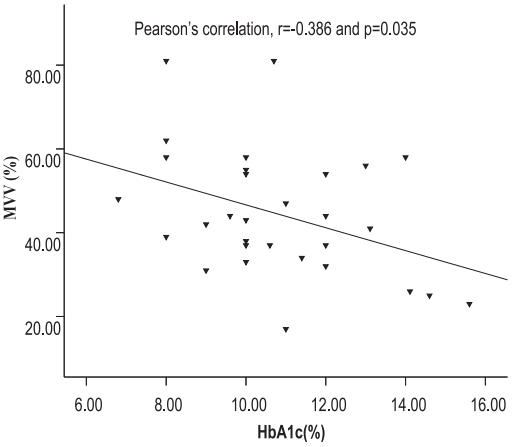

Figure 3: Correlation of percentage predicted value of MVV with HbA_{1c} in type-1 diabetic male (n=30)

Discussion

In the present study, the lung function parameters in healthy subjects were almost similar to the findings reported by the various investigators from different countries[10, 16] as well as in our country[14]. No abnormal findings of pulmonary function tests were detected in them.

In this study, mean percentage of predicted values of PEFR, FEF_{25-75} and MVV were significantly ($p<.001$) lower in type 1 diabetic male than those of non-diabetic subjects. These findings are in consistent with those of some other researchers [17].

Again, in this study HbA_1C was negatively correlated with PEFR ($p<0.05$), FEF_{25-75} ($p<0.05$) and MVV ($p>0.05$) in type-1 diabetic male. This observation is also similar to that of some other investigators[9].

Impairment of pulmonary function parameters have been found in type-1 diabetic male. Again, close association of HbA_1c with detoriation of some of the pulmonary function parameters have been demonstrated in this group of subjects. However there are some postulated mechanisms, suggested by various investigators of different countries, which may imply the probable mechanism of these changes in lung functions in type-1 diabetic patients.

Chronic hyperglycemia may cause thickening of alveolar epithelium and pulmonary capillary basal laminae[18], formation of fibrous tissue in lungs and chest wall[19], autonomic as well as somatic neuropathy[18], decreased production of NO[5]. These changes in lung tissue cause reduction of elastic recoil tendency of the alveoli and also reduction of lung volume[19]. In addition, 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[11].

In this coss-sectional study, the decrement of lung function parameters such as PEFR, FEF_{25-75} and MVV in type-1 diabetic subjects is most

likely due to chronic hyperglycemia as the observed blood glucose level of them were higher. Again, negative correlation of lung function parameters with HbA_1c in the study group are also in favor of this finding. Chronic hyperglycemia causes microangiopathy which may causes glycation of bronchial tissue protein. It may also cause reduction of muscular strength and decrease relaxation of bronchial smooth muscle due to decreased production of NO. But the exact mechanism cannot be elicited from this type of study as histopathological examination of lung tissue and NO levels are not observed in this study.

Conclusion:

From this study, it may be concluded that lung function parameters like PEFR, FEF_{25-75} and MVV decrease in type-1 diabetic male and the reduction is mainly due to poor glycemic control.

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