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Assessment of Pulmonary Function in Type II Diabetes Patients

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Abstract

Various metabolic and clinical disorders are associated with diabetes mellitus, the most prominent being vascular disease. There may be a relationship between diabetes and reduced lung function, so this study was designed to evaluate the impairment of lung function on spirometry among diabetic patients. The study included 50 type II diabetic patients and 50 healthy persons, confirmed by normal blood glucose levels, as control group. There was a significant reduction in spirometric pulmonary function tests (FEV1 and FVC) of a restrictive pattern in type 2 diabetic patients compared to control subjects. Since the diabetes affects the pulmonary vasculature and the connective tissue, therefore it can cause reduction in the pulmonary function tests. So, it is recommended that simple tests like spirometry may be performed in patients of type II diabetes as early as possible or be used as a preventive measure.

Keywords: *Diabetes mellitus Pulmonary function FEV1 FVC*

Introduction

Various metabolic and clinical disorders are associated with diabetes mellitus, the most prominent being vascular disease. It is generally agreed that hyperglycemic patients have a higher incidence of pulmonary infections may lead to develop tuberculosis, emphysema, asthma, fibrosis and mucormycosis during course of disease [1-6]. All these respiratory disorders cause altered pulmonary function tests [7]. Among others peripheral airflow obstruction increase significantly with age in diabetics as compared to healthy subjects which is obvious against environmental challenges e.g. smoking or minor airway infection. Deterioration of the pulmonary function is proportional to the degree of hyperglycemia [8,9]. Its complications give rise to micro and macrovascular diseases which affect eyes, kidneys, heart, blood vessels, nerves and also lungs. There may be a relationship between diabetes and reduced lung function, so this study was designed to evaluate the impairment of lung function on spirometry among diabetic patients.

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Material and Method

The present study was a case control hospital based study conducted in the Department of Physiology in collaboration with the Department of Internal Medicine and Department of TB and Chest in Santosh Medical College and Hospital, Ghaziabad. The study included 50 type II diabetic patients and 50 healthy persons, confirmed by normal blood glucose levels, as control group. Control group were matched to the patients by age, BMI and WC. The patients were collected randomly from the outpatient department of internal medicine, Santosh Medical College and Hospital. Pulmonary function test was conducted in collaboration with the department of TB and Chest in Santosh Medical College and Hospital.

Selection of subjects

Diabetic patients on oral medication and/or insulin administration for last 5 years of age group of 40- 60 yrs were included in the study. An informed consent was taken. Patients who had a history of smoking, chewing tobacco, chronic obstructive pulmonary disease, Asthma , Interstitial lung disease, Acute respiratory tract infection, occupational diseases like pneumoconiosis, neuromuscular diseases, chest surgeries or other major surgeries were excluded from the study.

Method

A detailed medical history was taken from patients. The patients for participation in the study were divided into two Groups:

Group 1: Type II diabetic patients on oral and/or insulin administration (50 subjects)

Group 2: apparently healthy subjects, matched for age, BMI and waist circumference (50 subjects)

General physical examination was performed on all the subjects.

Pulmonary function tests of these patients were performed with the help of SPIROSCOUT LF 8 (Ganshorn medizin electronic). The subjects were made comfortable in sitting position for at least 5 minutes for a steady state. The following protocol was used for measurement of the spirometric indices [10]. The patient was explained the purpose of the test and demonstrated the correct technique before inviting the patient to use a spirometer. The patient's sex, age and height, was recorded as this is needed to compare FVC and FEV1 with the predicted normal values. A clean, disposable, one-way mouthpiece is attached to the spirometer. The patient is asked to wear a nose clip. He is asked to breathe in as deeply as possible (full inspiration) then to blow the breath out, forcibly, as hard and as fast as possible, until there is nothing left to expel. The procedure is repeated three times and the best reading is chosen.

All tests were carried out at a fixed time of the day (10.00- 14.00 hours) to minimise diurnal variation. After all the tests were performed, the necessary flow and volume data was plotted as parameter table.

For FVC Test: The subjects were asked to exhale through mouthpiece with full force after forceful inspiration. Results are usually given in both raw data (litres per second) and percent predicted- the test result as a percent of the 'predicted values' for the patients of similar characteristics (height, age, sex and weight). Generally speaking, results nearest to 100% predicted are the most normal and results over 80% are often considered normal. After the completion of the maneuver, four most important parameters i.e. FVC, FEV1, FEV3 and PEFR were recorded.

Biochemical Parameters

Estimation of blood glucose levels was done by Glucometer (Optium Xceed, Abbot, Alameda, USA) Statistical analysis was performed using Computer Software Microsoft Excel and SPSS version 21(IBM Inc.). Chi squared test was used to compare nominal data and student t test was used for the comparison of other types of data. A p value of < 0.05 was taken as significant.

Observations and Results

Comparison of percentage of the predicted FVC and FEV1 between diabetic patients and control group Table1,2,3. According to percentage of the predicted value of the spirometry, out of 50 patients in the diabetic group, 36 patients (71.5%) had percentage of the predicted FVC of < 80%, and 27 patients (54%) had percentage of the predicted FEV1 of < 80%. Out of 50 subjects in the control group, 9 subjects (18%) had percentage of the predicted FVC of < 80%, and 5 subjects (10%) had percentage of the predicted FEV1 of < 80%. On the other hand, all members of diabetic and control groups had FEV1% more than 70%. There was a significant reduction in the percentage of the predicted FVC and FEV1 in diabetic patients compared to the control group. According to the definition of restrictive and obstructive spirometric values, 27 patients (54%) of the diabetic group, and 5 subjects (10%) of the control group had a restrictive spirometric pattern. However, none of the participants had an obstructive spirometric pattern.

Table 1: The percentage of the predicted Spirometric indices in diabetics & control group

Spirometric indices		Diabetic group (n=50)	Control group (n=50)
FVC (% predict)	≥80%	14(28%)	41(82%)
	<80%	36(72%)	9(18%)
FEV 1 (% predict)	≥80%	23(46%)	45(90%)
	<80%	27(54%)	5(10%)
FEV 1 %	>70%	50(100%)	50(100%)
	≤70%	---	---

*p<0.0001

*p<0.0001

*p<0.0001

Discussion

Diabetes is a slowly progressive disease that deteriorates the normal functioning of lung as can also be observed from the findings. There is growing evidence regarding the deleterious effect of DM on pulmonary function as reflected by spirometric measurement. The current study, which involved 50 type 2 diabetic patients, reveals a significant reduction of spirometric indices (FVC and FEV1), with FEV1 ratio (normal or high) suggestive of restrictive pattern, compared to a matched normal subjects. The results are in agreement with results of Davis *et al.* [11] who reported that the Forced Vital Capacity (FVC), Forced Expiratory Volume in 1 sec (FEV1), and Vital Capacity (VC) were reduced in diabetic patients compared to control group. Walter *et al.* [12] conducted a cross sectional study to assess the association between glycemic state and lung function, and reported that the FVC and FEV1 were significantly reduced in patients with diabetes, with FEV1% suggestive of restrictive ventilatory disorder. Rosenecker *et al.* [13] demonstrated that in patients with diabetes, FVC and FEV1 declined significantly over the five year study period, whereas patients without diabetes did not show a significant decline during this period. Meo *et al.* [14] reported that lung function parameters; Forced Vital Capacity (FVC) and Forced Expiratory Volume in 1 sec (FEV1), and Peak Expiratory Flow (PEF) in type 1 and type 2 diabetic patients were impaired, as compared to their matched controls. Bram *et al.* [15] meta-analysis shows that diabetes, in the absence of overt pulmonary disease, is associated with a modest, albeit statistically significant, impaired pulmonary function in a restrictive pattern. The results were irrespective of BMI, smoking, diabetes duration, and HbA1c levels. In sub analyses, the association seemed to be more pronounced in type 2 diabetes than in type 1 diabetes. There are different hypotheses that explain the reduced spirometric measurements in diabetic patients. Preliminary reports of histopathologic changes in the lungs of diabetic patients, reveal basal lamina thickening and fibrosis[16]. Other possible contributory factors include glycation of chest wall/bronchial tree proteins[17], autonomic and/ or phrenic neuropathy causing alterations in bronchial reactivity and respiratory muscle function[18], and an increased propensity to, and severity of, respiratory infections [19]. In both human and animal studies, diabetic lungs have demonstrated diabetic microangiopathy of the alveolar septal capillaries, with a thickened epithelial and capillary basement membrane, and increased extracellular matrix and connective tissue [20]. The strength and stability of the connective tissue is provided by the cross-link formation of both collagen and elastin components and the stocking mesh arrangement of these fibers[21]. In diabetic patients, chronic hyperglycemia can bring about a rise in collagen molecule synthesis and cross-linking via the acceleration of advanced glycation end-products, which can also negatively influence lung function [22]. Arnalich *et al.*[23] observed a reduction in serum markers of inflammation with the treatment of diabetes, which suggests that diabetes may itself be a cause of systemic inflammation. In addition, expression of the transmembrane receptor for advanced glycation end-points is seen in the lung, preferentially localized to the basal face of type I pneumocytes [24]. Defects in the bronchiolar surfactant layer, which is involved in maintaining airway stability and diameter, may be also considered a contributing factor to the impairment of calibre regulation in type 2 diabetes. When the alveolocapillary barrier is damaged, surfactant proteins leak into the bloodstream. A recent population-based random sample has described how increased circulating levels of surfactant protein A, the major surfactant-associated protein, were associated with altered glucose tolerance and insulin resistance. Therefore, surfactant defects in diabetic individuals may also lead to an increase in airway resistance and to a reduction in FEV1 and FEV1/ FVC ratio [25]. The proinflammatory effects of advanced glycation end-products (AGEs), which result from interaction between intracellular proteins and decomposing saccharides and polysaccharides, can alter matrix proteins, affect the expression of cytokines, alter expression of inflammatory mediators by endothelial cells and induce apoptosis [26]. Limited joint mobility that occurs as a consequence of changes in structural proteins of the joints of the chest and elastin, collagen abnormalities of the pulmonary capillaries and smooth muscles of airways may be the reason for reduced total lung capacity and the disordered lung mechanisms[27]. A reduction of inspiratory capacity is due to reduced capacity of the muscles. [28, 29, 30] However, a concomitant reduction in MVV among diabetics was seen only in subjects with severe obesity (Weight/ Height greater than 1.1 kg/cm) [31, 32, 33]

Conclusions

There was a significant reduction in spirometric pulmonary function tests (FEV1 and FVC) of a restrictive pattern in type 2 diabetic patients compared to control

subjects. Since the diabetes affects the pulmonary vasculature and the connective tissue, therefore it can cause reduction in the pulmonary function tests. So, it is recommended that simple tests like spirometry may be performed in patients of type II diabetes as early as possible or be used as a preventive measure.

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Source of Funding- Self

Conflict of Interest - nil

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