ORIGINAL RESEARCH

Pulmonary function tests in type 2 diabetes mellitus and their association with glycemic control and duration of the disease

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ABSTRACT

Background: This study was conducted to evaluate Pulmonary function tests in type 2 diabetes mellitus and their association with glycemic control and duration of the disease. **Material and methods**:This study comprised 100 subjects. 50 subjects had diabetes mellitus while the remaining 50 were controls.Participants with cardio-respiratory, musculoskeletal, or endocrine problems were excluded from the study. To rule out type 2 diabetes, blood glucose levels were tested fasting and postprandially using the glucose oxidase method.Both patients and controls provided informed written consent. All patients were given a questionnaire that included a full personal and medical background.All data were collected using a data collecting form and uploaded to an Excel sheet by two separate data entry operators. Discrepancies in values were rectified by reviewing the data collection form. The clean data was then evaluated statistically. **Results**:In this study, there were 30 males in diabetic group and 20 males in control group whereas there were 20 females in diabetic group and 30 females in control group. The mean age of the subjects was 52.1±8 and 53.6±7 in diabetic as well as control group, respectively. The mean HbA1c was 6.69±2.5 and the mean duration of diabetes was 5 years. It was discovered that no significant connection ($P > 0.05$) between the FVC and FEV1 and the length of sickness and HbA1c. **Conclusion**:Diabetes is a systemic disease that affects the lungs, generating restrictive ventilatory alterations that are most likely caused by glycosylation of connective tissues, diminished pulmonary elastic recoil, and inflammatory changes. It was discovered that glucose levels and disease duration are unlikely to be the primary predictors of lung pathology, necessitating additional investigation.

Keywords: Diabetes, Pulmonary function test, FVC, FEV1, HbA1c

INTRODUCTION

Diabetes is a group of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both. The chronic hyperglycemia of diabetes is associated with long-term damage, dysfunction, and failure of differentorgans, especially the eyes, kidneys, nerves, heart, and blood vessels.Several pathogenic processes are involved in the development of diabetes. These range fromautoimmune destruction of the β-cells of the pancreas with consequent insulin deficiency to abnormalities that result in resistance to insulin action. The basis of the abnormalities in carbohydrate, fat, and protein metabolism in diabetes is deficient action of insulin on target tissues. Deficient insulin action results from inadequate insulin secretion and/or diminished tissue responses to insulin at one or more points in the complex pathways of hormone action. Impairment of insulin secretion and defects in insulin action frequently coexist in the same patient, and it is often unclear which abnormality, if either alone, is the primary cause of the hyperglycemia.[1]

The metabolic disorder is a risk factor precipitating microvascular pathologies leading to autonomic neuropathy, nephropathy, retinopathy, and macrovascular pathologies leading to coronary artery diseases, cerebrovascular accidents, and peripheral vascular diseases. The microvascular complications appear early, within 5 to 10 years and macrovascular complications appear within 15 to 20 years from the onset of diabetes.[2]Among all, pulmonary dysfunction has been reported in patients of diabetes but with plausible pathophysiological mechanism. In fact, it is of debate whether or not spirometry is required in patients of diabetes.

The respiratory diseases associated with diabetes may result in changes in pulmonary volumes, diffusion, and elastic properties of lungs as well as the performance of respiratory muscles.[3,4]Several histopathological changes are also seen in diabetics.

Some researchers like Ljubic et al., showed that diabetes could lead to the development of pulmonary complications due to collagen and elastin changes.[5] While others suggest that increased non-enzymatic glycation of proteins and peptides of the extracellular matrix at chronic high circulating glucose levels may also have an important role in the pathological changes of the lungs in DM patients.[6] Autonomic neuropathy involving respiratory muscles may occur in these patients.[7]

Hence, this study was conducted to evaluate Pulmonary function tests in type 2 diabetes mellitus and their association with glycemic control and duration of the disease.

MATERIAL AND METHODS

This study comprised 100 subjects. 50 subjects had diabetes mellitus while the remaining 50 were controls.Participants with cardio-respiratory, musculoskeletal, or endocrine problems were excluded from the study. To rule out type 2 diabetes, blood glucose levels were tested fasting and postprandially using the glucose oxidase method.Both patients and controls provided informed written consent. All patients were given a questionnaire that included a full personal and medical background.All data were collected using a data collecting form and uploaded to an Excel sheet by two separate data entry operators. Discrepancies in values were rectified by reviewing the data collection form. The clean data was then evaluated statistically.

RESULTS

Table 1: Physical characteristics of subjects

Parameters	Diabetic subjects (n=50)	Controls (n=50)
Gender		
Males	30	20
Females	20	30
Mean Age (years)	52.1±8	53.6±7
Mean HbA1c (%)	6.69±2.5	-
Duration of diabetes (years)	5	-

In this study, there were 30 males in diabetic group and 20 males in control group whereas there were 20 females in diabetic group and 30 females in control group. The mean age of the subjects was 52.1±8 and 53.6±7 in diabetic as well as control group, respectively. The mean HbA1c was 6.69±2.5 and the mean duration of diabetes was 5 years.

Table 2: Correlation of HbA1c and duration of DM with PFTs

Parameters	R^2	P-value
FVC with HbA1c	0.016	0.182
FEV1 with HbA1c	0.005	0.399
FVC with duration	7.796e-0.008	0.8845
FEV1 with duration	0.005	0.414

PFTs: Pulmonary Function Tests

It was discovered that no significant connection ($P > 0.05$) between the FVC and FEV1 and the length of sickness and HbA1c.

DISCUSSION

Type 2 Diabetes Mellitus (T2DM) is a metabolic disorder that is characterized by high blood glucose in the context of insulin resistance and relative insulin deficiency.[8] This is typically a multi-organ chronic disease and is associated with a ten-year-shorter life expectancy due to its complications. Measurement of glycated haemoglobin (HbA1c) is the standard method for the assessment of long-term glycemic control. HbA1c is a form of haemoglobin that is measured primarily to identify the average plasma glucose concentration over prolonged periods.[9]

Pulmonary complications of Diabetes Mellitus (DM) have been poorly characterized with conflicting results. The alveolar-capillary network in the lung is a large micro-vascular unit and may be affected by microangiopathy. There are histopathological changes seen in the lungs of diabetics such as thickened alveolar epithelial and pulmonary capillary basal lamina leading to reduced pulmonary elastic recoil and lung volume. There is impaired diffusion due to reduced pulmonary capillary blood volume and thickening of the basement membrane.[10]

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Shah SH et al[11]analyzed the pulmonary function parameters in diabetic patients and compare them with age and gender matched healthy subjects. We

correlated forced vital capacity (FVC) and forced expiratory volume in 1 second (FEV1) in diabetic patients with duration of the disease and glycosylated hemoglobin (HbA1c).Pulmonary function tests (PFTs) were recorded in 60 type 2 diabetic male patients and 60 normal healthy male controls aged 40-60 years by using Helios 702 spirometer. The PFTs recorded were - FVC, FEV1, FEV1/FVC, FEF25, FEF50, FEF75, FEF25–75, FEF0.2–1.2, and peak expiratory flow rate (PEFR). HbA1c of all the patients was estimated by ion exchange resin method, which is a very standard method of estimation. PFTs of diabetic patients and controls were compared by applying Student′s unpaired t test. Associations between FVC and FEV1 and HbA1c and duration of illness in diabetic patients were analyzed by applying Pearson′s coefficient.The PFTs were significantly decreased in diabetic patients compared with the healthy controls except FEV1/FVC. There was no correlation found between FVC and FEV1 and duration of illness as well as HbA1c.DM being a systemic disease, which also affects lungs causing restrictive type of ventilatory changes probably because of glycosylation of connective tissues, reduced pulmonary elastic recoil and inflammatory changes in lungs. They found glycemic levels and duration of disease are probably not the major determinants of lung pathology, which requires further research.

Gupta M et al[12]evaluated the pulmonary function tests in type 2 Diabetes Mellitus (DM) patients and to determine the corelation of the HbA1c and duration of the disease with PFTs in type 2 DM patients.The basic parameters of the subjects like age, sex, weight in kg, and height in cm were recorded. Each subject was instructed to visit the biochemistry laboratory with 6 hrs of fasting on a specific date. The FBS and HbA1c were estimated using standardized methods. Spirometry was performed to assess pulmonary functions. The results were analyzed using SPSS version 10.0 software. Using this software, frequencies, range, mean, standard deviation, and 'p' were calculated through Student 't' test, One-way ANOVA, Pearson Correlation, and Chi-square test. The p-value of <0.05 was considered significant.The highest number of patients was recorded in the age group of 61-70 years. The mean age of the cases was 59.38 years while in the control group the mean age was recorded as 55.84 years. Sex distribution of the patients showed males and females were in the ratio of 66:34 while in the control group males were 64% and females were 36%. HbA1c was recorded significantly higher in cases (8.23) as compared to the control group (5.02). Type 2 Diabetes Mellitus (DM) patients had a mean of 67.96 with a range of 48.19-87.73 compared to controls having a mean of 102.24 with a range of 82.13-122.35. Type 2 DM patients had a mean of 109.28 with a range of 93.81-124.75 compared to controls having a mean of 101.70 with a range of 91.56-111.28. Age distribution and HbA1c showed significant association. The highest HbA1c was recorded in the age group of more than 70 years (10.73) which was followed by 51-60 years (7.92) while the lowest HbA1c was recorded in the age group of fewer than 40 years (4.33).FVC and FEV1 were decreased in Type-2 diabetes mellitus compared to controls, whereas the ratio of the two (FEV1/ FVC%) was increased. There was a negative correlation between the duration of diabetes mellitus and pulmonary functions FEV1% Pred, FVC% Pred. A linear relationship exists between increasing duration and FEV1/ FVC%, which is indicative of restrictive disorder of the lung. As the HbA1c level increases, the spirometry values FVC and FEV1 were consistently decreased. Patients with type 2 diabetes mellitus should undergo pulmonary function tests intermittently to detect pulmonary complications.

CONCLUSION

Diabetes is a systemic disease that affects the lungs, generating restrictive ventilatory alterations that are most likely caused by glycosylation of connective tissues, diminished pulmonary elastic recoil, and inflammatory changes. It was discovered that glucose levels and disease duration are unlikely to be the primary predictors of lung pathology, necessitating additional investigation.

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