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Research Article

EVALUATION OF LUNG FUNCTION IN TYPE 2 DIABETES MELLITUS

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ABSTRACT

Background: Diabetes mellitus (DM) is a leading cause of morbidity and mortality in the world. According to WHO, India will be the Diabetic capital of the world by 2025, as every fifth diabetic in the world is an Indian. Though there are many studies centered towards the systemic complications of diabetes mellitus including coronary artery disease, nephropathy, retinopathy and neuropathy, the pulmonary complications of type 2 diabetes mellitus are rarely studied. So the present study focuses on lung functions which are attributable to type 2 diabetes mellitus.

Aim and Objective: To evaluate the pulmonary functions in type2 diabetic patients and to compare them with healthy subjects

Materials and Methods: This case control study was conducted in the Department of physiology, Chengelpet as Dharmapuri Medical College, Dharmapuri. Fifty type 2 diabetic patients on oral hypoglycemic treatment, of the age group 40 -60yrs, duration not less than 5yrs were randomly selected for study group from the Diabetes Outpatient Department. Age, gender and BMI matched fifty healthy individuals were selected for control group. Pulmonary function test parameters Forced vital capacity(FVC), Forced expiratory volume in first second (FEV1)and Forced expiratory volume in first second to Forced vital capacity (FEV1/FVC ratio)were recorded in percentage of predicted value using spirometry by following American Thoracic Society Guidelines.

Results: Analyzed statistically by using student's unpaired't'-test. It shows significant decrease of FVC and FEV1 in type 2 diabetic individuals compared to controls, whereas FEV1/FVC ratio was increased but not statistically significant.

Conclusion: Thus in our study restrictive pattern of respiratory abnormality is associated with type 2 diabetes mellitus. Hence periodical assessment of lung function in type 2 diabetics could be done to avert the respiratory complications.

INTRODUCTION

There is alarming increase in the incidence and prevalence of diabetes mellitus globally and in Asian Indians. Prevalence of diabetes mellitus in India is more than 62 million and is predicted that by 2030 it may be about 79.4 million.[1] In India, the development of diabetes is highly due to change in lifestyle, junk foods, environmental factors, genetic factors and stressful life. They all have impact on the glucose metabolism and insulin sensitivity. Diabetes mellitus is a metabolic disease characterized by chronic hyperglycemia resulting from impaired insulin secretion, insulin action or both. Type1 or Insulin-dependent diabetes mellitus (IDDM) is characterized by insulin deficiency resulting from autoimmune destruction of beta cells in the islets of pancreas. Type 2 or non-insulin-dependent diabetes mellitus (NIDDM) is due to insulin resistance and impaired insulin receptors. It usually develops after the age of 40 years and is the common type of diabetes mellitus.[2]

Diabetes mellitus is associated with various systemic complications which affect the eyes, kidneys, nerves, heart, blood vessels and lung.[3]Proposed theories how hyperglycemia leads to end organ damage includes advanced glycosylation end products(AGEs) formation, via sorbitol pathway glucose metabolism, protein kinase C activation and increased flux through hexosamine pathway. Diabetes mellitus is characterized by widespread biochemical, morphological and functional abnormalities which precipitate certain systemic complications. The biochemical process results in impaired cross linking of collagen and elastin with decrease in strength and elasticity of connective tissue leads to both vascular and non-vascular complications. The common microvascular and macrovascular complications include retinopathy, neuropathy,

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nephropathy, coronary artery disease, cerebrovascular accidents and peripheral vascular disease. [4]

Lung is also a "target organ" in diabetic patients due to an extensive microvascular network and an abundant connective tissue.[4,5]The gas exchange and normal lung mechanics are influenced by the integrity of microvasculature and pulmonary connective tissue, so any abnormalities in either of the two structural components lead to abnormal pulmonary function.[6] Microangiopathy and increased non-enzymatic glycosylation of proteins and peptides of the extracellular matrix of thorax and lung parenchyma may be the underlying mechanism for the pulmonary dysfunction in diabetic patients.[4,6]

Another theory suggested that the diabetes is associated with chronic low grade inflammation together with microangiopathy mayalter lung matrix proteins causing pulmonary function impairment.[2]Moreover, secondary reduction in antioxidant defense of the lung and increased susceptibility to environmental oxidative insults results in subsequent loss of lung function due to lung damage.[7] Impaired lung function in diabetes mellitus may also be due to increased sclerosis of bronchial arteries as a consequence of generalized arteriosclerosis.[8]Thereby these underlying mechanisms are associated with decrease pulmonary volume, pulmonary diffusion and elastic recoil and respiratory muscle performance.[9]

There are several studies about pulmonary function abnormalities in type 1 diabetes mellitus but only a few studies in type 2 diabetes mellitus. Hence it is important to study pulmonary function abnormalities in this group. Earlier studies have reported normal pulmonary functions and some have shown abnormal respiratory parameters in patients of type 2diabetes mellitus. So the aim of our study was to determine the varied effects of type 2 diabetes mellitus on lung function.

Aim: To evaluate the pulmonary functions in type 2 diabetic patients

Objectives

To compare the pulmonary function tests in type 2 diabetic and non-diabetic subjects

To analyze the pattern of lung dysfunction in type 2 diabetic subjects.

MATERIALS AND METHODS

This case control study was conducted in the research lab of Department of physiology at Chengelpet as Dharmapuri Medical College, Dharmapuri after getting institutional ethical committee approval. The total number of subjects participated in the study were hundred. Fifty type 2 diabetic patients on oral hypoglycemic treatment of age group 40-60yrs, both male and female, duration not less than 5yrs were randomly selected as subjects for study group from the Diabetes Outpatient Department.[6]Age, gender and BMI matched fifty healthy individuals were selected as subjects for control group. Person with H/O smoking, recent respiratory tract infections, chronic respiratory illness such as chronic obstructive pulmonary diseases, bronchial asthma e.t.c. H/O hypertension, cardiac disease, neuromuscular disease, connective tissue disorder, malignancy and any abdominal or chest surgeries were excluded from the study.

Subjects were explained about the procedure and informed written consent was obtained. Detailed history and clinical examination were carried out to rule out cardiac or pulmonary diseases. After taking anthropometric measurements height and weight, BMI was calculated. Pulmonary function test was performed by following American thoracic society guidelines. Procedure demonstrated to them and subjected to Kokolegend spirometry Version/Revision 9.A. Subjects nostrils were closed with the nose clip while doing the procedure and they were asked to hold the mouth piece with right hand. They were instructed to inhale atmospheric air deeply and then to blow out air as fast and as hard as possible for a minimum of 6 seconds in to the mouthpiece. Then immediately ask the subject to inhale deeply to form a loop. Minimum of 3 trials done with an interval of 5 minutes between each trial and best of 3 trials were taken for analysis. [10]Parameters FVC, FEV1 and FEV1/FVC ratio in percentage of predicted values were taken into account for result analysis.

RESULTS

Following observations were made from the study of pulmonary function tests in type 2 diabetics and non-diabetics individuals. Data collected were analyzed using SPSS version 17.0. Mean and Standard deviation were calculated for parameters like Age, Weight, Height, BMI, FVC, FEV1 and FEV1/FVC ratio. Statistical analysis was done using student's unpaired't'-test.

Table 1 shows descriptive characteristics of control and diabetics. They were expressed as Mean ± SD.

Table 2 shows Comparison of pulmonary function test parameters between control and diabetics. The mean value of FVC in control and diabetics were 89.06 ± 11.47 and 76.96 ± 12.28. The mean value of FEV1 in control and diabetics were 88.52 ± 9.85 and 79.52 ± 11.53. Thus FVC and FEV1 were reduced in diabetics compared to control with statistically significant ((p=0.0001**). The mean value of FEV1/FVC ratio in control and diabetics were 108.64 ± 8.2 and 111.56 ± 7.46 which was increased in diabetics compared to control but not statistically significant (p= 0.065).

Table 1 Comparison of Anthropometric Characteristics of the Subjects

Parameters	Control Subjects		Type2 DM Subjects		p value
	Mean	SD	Mean	SD	
Age (years)	48.44	6.89	49.14	7.05	0.617
Weight (kg)	62.98	7.58	64.16	8.48	0.465
Height (cm)	159.12	7.73	157.58	7.32	0.309
BMI(Kg/m^2)	24.78	3.22	25.7	3.28	0.160

*p<0.05 statistically significant,
**p<0.01statistically highly significant

Table 2 Comparison of Pulmonary Function Test In Control And Type 2 Diabetic Subjects

Parameters	Control Subjects		Type2 DM Subjects		p value
	Mean	SD	Mean	SD	
FVC (%) Predicted	89.06	11.47	76.96	12.28	0.0001**
FEV1 (%) Predicted	88.52	9.85	79.52	11.53	0.0001**
FEV1/FVC(%) Predicted	108.64	8.20	111.56	7.46	0.065

*p<0.05 statistically significant,
**p<0.01 statistically highly significant

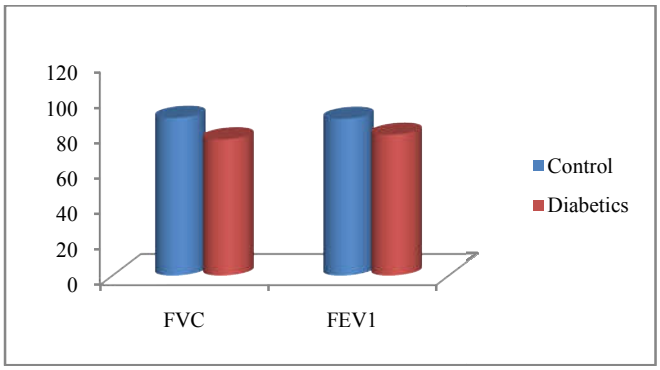

Figure 1 Comparison of FVC and Fev1 between Control and Diabetics

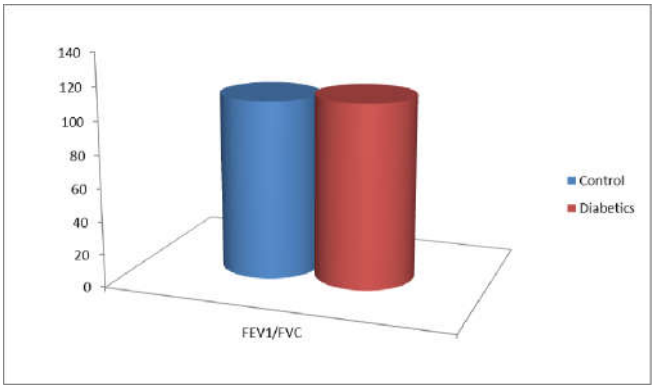

Figure 2 Comparisons of FEV1/ FVC between Control and Diabetics

DISCUSSION

Fifty age and sex matched type 2 diabetic patients were compared with control group. Pulmonary function parameters FVC, FEV1 and FEV1/FVC ratio were analyzed.FVC and FEV1 were reduced in type 2 diabetic group compared to control group which was stastically significant. The result was consistent with the study done by Aparna *et al*[11]who observed significant reduction of FVC and FEV1 in type 2 diabetics compared to non-diabetics in the age group 40-65 years in both sexes. Similar findings were also seen in type 2 diabetic individuals in the study conducted by Swati H. shah *et al* [6]in the age group 40- 60years in males and Muhammad Irfan *et al* [12] in the mean age 54 years in males. Sultan A. Meo *et al* [13]also observed significant difference of FVC and FEV1 between type 2 diabetics and non-diabetics, in the age group 24-73years in male gender. Further in the Framingham Heart Study of Robert Walter *et.al*, [14]there was a progressive decrease in mean FVC and mean FEV1 values as the duration of DM increased. Timothy studied the pulmonary function and its association with type-2 diabetes mellitus and showed an average reduction of FVC and FEV1 indiabetics. [15]

The present study also shows increaseFEV1/FVC ratio in type 2 diabetic group compared to control group though not statistically significant. These findings were in accordance with Swati H. shah *et al* [6], Muhammad Irfan *et al* [12]and Sultan A. Meo *et al*[13]. In the study by Anupriya Deshpande *et al*[16] significant increase ofFEV1/FVC ratio in type 2 diabetics compared to non-diabetics individuals in the age group of 40-55 years was noted. Similarly Kapoor D *et al*[17] reported significant increase in FEV1/FVC ratio among type 2 diabetics. But Srikanth Sajj *et al*[8] observed decrease FEV1/FVC ratio in diabetic subjects as compared to controls in both sexes in the age group 30-55yrs.

In the present study low FEV1, FVC value and high FEV1/FVC ratio was observed suggesting restrictive pattern of lung dysfunction among diabetics. In contrary Srikanth Sajja *et al*,[8]observed progressive decrement in residual FEV1/ FVC ratio with increasing level of blood sugar reporting obstructive pattern of lung dysfunction. Nikhil. G. Panpalia *et al* [4] reported mixed (obstructive and restrictive) pattern of lung involvement in diabetic group. According to Wendy A. Davis *et al*[18] also mixed pattern of lung involvement was seen in diabetic group. Simultaneously there was study by Benbass *et al*[19] that shows insignificant differences between diabetic patients and normal controls in spirometric lung function tests.

The mechanism for restrictive dysfunction of lung in diabetes in our study may be due to accumulation of AGEs by non-enzymatic glycosylation of collagenin the lung parenchyma. These AGEs increases cross-linkage formation between the polypeptides of collagen which leads to thickening of lung parenchyma. This alteration in the connective tissue of the lung, particularly collagen and elastin results in the restriction of lung volume and elastic recoiling. [20,21]Similarly non-enzymatic glycosylation also occurs in the chest wall and bronchial tree proteins which causes restriction of chest wall expansion, decrease in the lung volume and lung compliance.[11]Thus the basis for reduced FVC and FEV1 in diabetic patients is reduced elastic recoil of lung and stiffened thorax and lung parenchyma.[6, 22]

Other possible mechanism for restrictive ventilatory defect in chronic hyperglycemia is diabetic myopathy and diabetic autonomicneuropathy of the thoracic nerves causing weakness of the respiratory muscles. [2, 23]Lung function is also reduced due to the inflammatory mediators such as C-reactive protein and Interleukin-6 associated with diabetes causing some damage to the alveolar endothelium.[24, 25]

CONCLUSION

From the present study we conclude pulmonary function was significantly affected in type 2 diabetes mellitus and restrictive pattern of respiratory abnormality is seen. Pulmonary dysfunction is earlier and easily measurable alteration in diabetes mellitus. Pulmonary function test is a simple non-invasive tool can be carried out periodically to assess the lung function impairment in type 2 diabetic patients. Strict glycemic control and regular breathing exercises improves the lung function in diabetic patients. [23]

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