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Research Article

Evaluation of Respiratory Functions in Patients With Type II Diabetes Mellitus

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Abstract: Diabetes mellitus is a chronic metabolic disorder of carbohydrate, protein and fat metabolism affecting all the systems in our body. Present study is designed to reveal the effects of diabetes mellitus on the pulmonary functions. Spirometry is a feasible tool to detect pulmonary function abnormalities at very early stage. The aim of present study is to record and compare pulmonary function tests in Type-2 Diabetes mellitus patients and apparently healthy control group. 60 cases of diabetics who had history of Diabetes mellitus for 5 years were enrolled for the study. In this study, there were a larger number of females than males (66.2% vs. 33.8%). The probable cause for this discrepancy was the fact that many males were excluded on account of their smoking history, alcohol intake, irresponsible behavior, busy working schedule while female diabetics were mostly eligible on account of their being non-smokers and other favoring factors. 60 age and sex matched healthy subjects served as controls. Forced expiratory spirograms were recorded by RMS medspiror. Lung function parameters such as forced vital capacity (FVC), forced expiratory volume in 1st second (FEV1), the ratio of FEV1/FVC, forced expiratory flow in the middle half of FVC (FEF 25-75%), peak expiratory flow rate (PEFR) were studied in both cases and controls. Student's unpaired t-test was used to analyze the results obtained. Diabetic patients showed greater decline in FVC, FEV1, FEF 25-75%, PEFR and increase in FEV1/FVC ratio which is statistically significant, suggesting restrictive lung disorder..
Keywords: Pulmonary functions, Spirometer, type II diabetes mellitus.

INTRODUCTION

Diabetes mellitus [DM] is a syndrome of impaired carbohydrate, fat and protein metabolism, caused by either lack of insulin secretion or decreased sensitivity of the tissues to insulin. There are two general types of diabetes mellitus:

1. Type I diabetes or insulin-dependent diabetes mellitus (IDDM) which is caused due to deficiency of insulin secretion.
2. Type II diabetes or non-insulin-dependent diabetes mellitus (NIDDM), is initially caused by decreased sensitivity of target tissues to the metabolic effect of insulin. This reduced sensitivity to insulin is often called insulin resistance [1].

Diabetes mellitus type 2 (adult-onset diabetes) is a metabolic disorder characterized by hyperglycemia in the perspective of insulin resistance and relative lack of insulin. It is a multi-system disorder that affects renal, cardiovascular, nervous system as well as skin, liver, collagen and elastic fibers [2]. The incidence of this multi-system disorder has been increasing since years due to changes in the lifestyle, modernization, sedentary lifestyle, food habits, etc.

According to WHO, India will be known as the world diabetic capital in 2025 [3]. There is an alarming increase in the incidence and prevalence of diabetes mellitus in Asian Indians [4]. This metabolic disorder serves as a risk factor for precipitating microvascular pathologies leading to autonomic neuropathy, nephropathy, retinopathy, peripheral neuropathy and macro vascular pathologies leading to coronary artery disease, cerebrovascular accidents and peripheral vascular disease [3]. Diabetes mellitus causes biochemical, morphological and functional abnormalities mainly of collagen and elastin. The alterations in these scleroproteins in turn affect the mechanical behavior of the lungs manifesting in altered lung volumes measured by pulmonary function tests[5].

Diabetes has both microvascular and macrovascular complications involving many organs. It targets the alveolar capillary network in the lung which is a large microvascular unit to be affected by microangiopathy. The ultimate cause of the microvascular and macrovascular complications is chronic hyperglycemia. Intracellular hyperglycemia activates the enzyme aldose reductase which could lead to increased formation of sorbitol inside the cells;

Sorbitol in turn reduces cellular Na^+K^+ ATPase. Intracellular glucose can be converted to Amadori products that in turn form advanced glycosylation end products (AGEs) which cross link the matrix proteins. These advanced glycosylation end products interfere with vascular functions damaging the blood vessels [6]. Diabetic pulmonary angiopathy still remains poorly identified because of the enormous reserve of the lungs [4].

MATERIALS AND METHODS

This study was undertaken during the period January 2012 to April 2013 after obtaining ethical clearance from the institute. 60 cases of diabetics in the age group 40 -55 years, who had history of Diabetes mellitus for 5 years were enrolled for the study. In this study, there were a larger number of females than males (66.2% vs. 33.8%). The probable cause for this discrepancy was the fact that many males were excluded on account of their smoking history, alcohol intake, irresponsible behavior, busy working schedule while female diabetics were mostly eligible on account of their being non-smokers and other favoring factors.60 healthy volunteers of 40-55years age with no history of smoking, hypertension, respiratory and cardiovascular diseases as controls.

The procedure of lung function tests was explained to all the study and control subjects to remove any apprehension. We also told them about the complications of type 2 diabetes mellitus and the importance of early screening. Patients with occupational lung diseases, those exposed to excessive dust at their workplaces, tuberculosis, chest injuries, chronic obstructive lung disease cases and those who were smokers were excluded from the study. A thorough history was taken to meet the inclusion criteria. All the participants of the study gave informed consent. The pulmonary functions of all the subjects were done in the noon hours (between 12 pm to 1:30 pm) to avoid any diurnal variations, for convenience to the subject [lunch break] and to maintain uniformity. The physical characters such as height in centimeters and weight in kilograms of all the study subjects were recorded and the data were entered into the computer to get predicted values for pulmonary function tests.

A computerized spirometer loaded with software known as RMS MEDSPIROR, from Recorders and Medicare system, Chandigarh , was used for assessing the pulmonary functions of the diabetic patients and the control group.

All the subjects were motivated prior to the initiation of maneuver. We explained all the subjects in detail regarding the maneuver and demonstrated the maneuver until they got acquainted to it. The subject was than asked to perform the procedure to gain confidence to perform the maneuver before taking up the actual test.

The test was performed thrice and the best among the three readings was chosen. The data were statistically analyzed using students unpaired t test and the results for each parameter were compared between diabetics and the controls.

RESULTS

In Table 1, the formal statistical comparison of the matching variables (age, height and weight) is done as it was thought to be appropriated, as these variables are insignificant for the two groups hence, statistical confirmation of this fact is not discussed to avoid the repetition.60 cases and 60 controls underwent the pulmonary function testing after fulfilling the inclusion and exclusion criteria.

Table-1: Anthropometric Parameters Of Subjects

Basic characteristics	Cases (n = 60)	Controls (n = 60)	Significance	
			t-value	p-level
Age in years	48.2 ± 6.1	46.1 ± 7.8	1.68	0.10, NS
Height (cm)	161.4 ± 6.4	162.8 ± 0.9	0.90	0.37, NS
Weight (kg)	63.72 ± 6.26	61.52 ± 7.15	0.60	0.55, NS
BMI (kg/m^2)	23.33 ± 3.05	23.70 ± 2.63	0.65	0.52, NS

All values are expressed as Mean ± SD
Analysis of all parameters is done by unpaired t-test
NS -Not Significant

Table 3: Comparison of PFT Between Type II Diabetics [Cases] And Controls

Parameters	Cases	Controls	P value
FVC	2.41±0.24	3.25±0.42	P<0.001*
FEV1	2.54±0.14	3.82±0.45	P<0.001*
FEV1/FVC	76.2±12.6	63.8±5.9	P<0.001*
FEF25%-75%	3.85±1.45	4.84±1.03	P<0.001*
PEFR	5.78±2.02	7.24±1.62	P<0.001*

All values are expressed as Mean ± SD. * indicates highly significant value

DISCUSSION

Few countries have done similar studies on lung functions in diabetes. Their findings are similar to our study done in India. Our study is in agreement with Walter. E. Robert et al who studied the relationship between diabetes mellitus and pulmonary function and showed a decrease in FEV1 by 27ml in diabetes mellitus [7]. Davis M.E. Timothy studied the pulmonary function and its association with Type-2 diabetes mellitus and showed an average decrease of 9.5% in FEV1 of diabetics [8].

Davies et al carried out a community based study in Western Australia in type II diabetic patients and came with a conclusion that FVC, FEV1 and PEFR were reduced in the diabetic patients [9].

Pathophysiology for the deteriorated pulmonary capacity in diabetic patients is not fully understood. Few histopathological reports are in favor of basal lamina thickening [10] and fibrotic changes in the lung parenchyma [11].

Our study goes in hand with that of Irfan et al [12] which also shows significant reduction in FVC, FEV1 in diabetic patients as compared with controls. Our findings are in concordance with Meo et al who did their studies on Saudi diabetic patients and showed significant reduction in FVC, FEV1 and PEFR as compared to their matched controls [13].

A Study carried out in Japan by Asanuma also revealed similar findings. They found that FVC and FEV1 were reduced in Japanese diabetic patients compared to normal non-diabetic subjects [14].

CONCLUSION

To summarize, our study is in accordance with other studies which explained that diabetic patients showed impaired lung functions independent of smoking. There was a decrease in FVC, FEV1, FEF25%-75%, PEFR and increase in FEV1/FVC as compared to their controls. This reduced lung function is likely to be a chronic complication of diabetes mellitus which was of particularly restrictive pattern. Early screening of lung functions has to be undertaken to know the pathology setting in, at the earliest as prevention is always better than cure. Spirometry is a bedside tool to assess lung functions at an early stage. It is cost effective, non –invasive procedure with advantage of having a permanent record.

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