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Original Research Article

STUDY OF PULMONARY FUNCTION TEST IN TYPE 2 DIABETES MELLITUS PATIENTS

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Abstract

Diabetes mellitus (DM) has been broadly recognized as the syndrome of hyperglycemia leading to various macro- and microvascular complications. The different physiological systems that have been identified as a target of these injurious effects of hyperglycemia are the excretory system, ocular system, central nervous system, and cardiovascular system. To date, not much focus has been given to the respiratory system as a possible target for the deleterious effect of hyperglycemia. Objective of study was to assess the pulmonary functions in subjects with type 2 diabetes mellitus (T2DM)**.** 25 subjects of type 2 diabetes Mellitus of either sex in the age group of 35-65 years and 25 healhty control subjects were included in study.PFT was done in both groups. Our study shows Pulmonary function tests values in Diabetic and control subjects. FVC , $FEF_{25-75,}$ PEFR(L/s), FEV1(L) were low in diabetic subjects as compared to control subjects and this difference was significant. FEV1/FVC(%) was low in diabetic subjects as compared to control subjects and this difference was highly significant. We found that pulmonary function parameters in diabetic subjects were consistently lower than in healthy controls. This reduction in lung function is probably a chronic complication of type 2 diabetes mellitus.

Key words : Pulmonary Function Tests, Type 2 Diabetes Mellitus patients.

INTRODUCTION

Diabetes mellitus is a systemic disease that causes secondary pathophysiological changes in multiple organ systems and the complications affecting these systems is responsible for the majority of morbidity and mortality associated with the disease. [1,2] Diabetes mellitus is accompanied by wide spread biochemical, morphological and functional abnormalities which may precipitate certain complications that affect the neural, cardiovascular, renal systems and also organs and tissues like skin, liver, collagen and elastic fibers. These biochemical processes result in impaired collagen and elastin cross linkage with a reduction in the strength and elasticity of connective tissue [1, 3] which can cause both vascular and non-vascular complications. Vascular complications can further be subdivided into micro-vascular and

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macrovascular complications. The common microvascular complications include retinopathy, nephropathy and neuropathy. These complications are routinely screened for in all diabetic patients. [1]Diabetes mellitus (DM) is a lifestyle disease causing a huge health problem throughout the world. The recently published national study – the Indian Council of Medical Research – India diabetes (ICMR) study has shown an alarming rise in diabetes cases in our country.[4] Type 2 diabetes is the more common form and is associated with long-term damage to various organs. Its complications may be due to macro- or micro- vascular changes. Abnormal respiratory functions have found to be associated with diabetes, yet the significance of this association is not convincingly proven.[5,6] Respiratory parameters are also important risk factor for pulmonary morbidity as well as mortality in diabetes, although it has not been clearly categorized. Lung disorders are not part of the complications of diabetes by the International Diabetes Federation and American Diabetes Association.[7,8] Alveolar capillaries have a high chance to be affected in diabetic microangiopathy. Glycosylation of collagen and elastin of lung is seen in chronic hyperglycemia which may remain undiagnosed clinically. It was reported by researchers that respiratory parameters are reduced in diabetes, and duration of disease plays a very key role in its pathogenesis.[9,10]

Lungs and airways have a rich blood supply that contributes to approximately ten percent of the entire circulatory system of the human body. It is also known that chronic hyperglycemia causes non-enzymatic glycosylation of proteins such as collagen, elastin etc., which leads to thickening of basement membrane and microangiopathy. Since diabetes mellitus has been proved to have detrimental effects on microvasculature, it is quite probable that pulmonary functions may be affected in diabetes mellitus [11,12]. Although several studies have been conducted in the recent past to assess the deleterious effects of T2DM on lung functions, nothing has been strongly established so far and related literature in India is limited. Hence this study was conducted to determine the effect of type 2 DM on pulmonary function tests.

Material and Methods

A cross sectional study was conducted on subjects of type 2 diabetes mellitus. After ensuring that all inclusion criteria were met, 25 subjects of type 2 diabetes Mellitus of either sex in the age group of 35-65 years with duration of diabetes > 1 year were randomly selected from the out-patient department (OPD) . Approximately same number of age and sex matched healthy individuals were selected as control group. Informed consent was taken from each subject for the study. Subjects with a history of smoking, acute or chronic respiratory disease, history of occupational exposure to respiratory deterrents, neuromuscular or cardiovascular diseases or any physical disability that may affect lung function like kypho-scoliosis and inability to perform pulmonary function tests were excluded from the study. After providing the relevant information of the study, the subjects were asked to fill the pre-prepared questionnaire that contained relevant personal, socio-demographic and medical history. Pulmonary Function Tests were performed using a computerized Spirometer, self-calibrating, which fulfilled the criteria for standardized pulmonary function tests. All tests were done according to American Thoracic Society/ European Respiratory Society (ATS/ERS) guidelines in a quiet room in sitting position by trained personnel [13]. After taking detailed history and relevant clinical examination, informed written consent was taken. Then anthropometric parameters like height and weight were measured and recorded. Each subject was instructed to visit the laboratory with 6 hours of fasting on a specific date; the blood samples (3 ml volume) was drawn for estimation of fasting blood sugar. After explaining and demonstrating the technique for carrying out lung function tests, subjects were made to undergo lung function tests using digital

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spirometer 3 times at 15 minutes interval. The forced vital capacity (FVC), forced expiratory volume in 1 second (FEV1), and peak expiratory flow rate (PEFR), FEV1/FVC, FEF 25-75% were recorded. The subject was instructed to give a blood sample for post prandial estimation of blood sugar 2 hours after the meal.

Statistical analysis was carried out by statistical package of social sciences (SPSS) . Mean and standard deviation were computed for all continuous variables and comparison was done using Student's t-test . p value was calculated. $p<0.05$ was considered significant and $p<0.001$was considered highly significant.

Results

Table 1: Age, weight, height in Diabetes and control subjects

	Diabetics n=25 Mean±SD	**Controls n=25 Mean±SD**	**P value**
Age (years)	59.24±8.2	57.32±7.4	<0.05
Height (Meters)	1.64±0.06	1.67±0.12	<0.05
Weight(Kg)	70.24±7.24	67.32±6.8	<0.05

Table 2: Pulmonary function tests values in Diabetic and control subjects.

PFT parameters	**Diabetics n=25Mean±SD**	**Controls n=25 Mean±SD**	**P value**
FVC(L)	2.08±0.68	2.52±0.64	<0.05
FEF_{25-75} (L/s)	2.06±0.38	2.51±1.06	<0.05
PEFR(L/s)	3.83±0.42	5.24±0.23	<0.05
FEV1(L)	1.46±0.48	2.06±0.41	<0.05
FEV1/FVC(%)	70.24±8.92	85.12±11.26	<0.001

*Forced vital capacity (FVC), forced expiratory volume in 1 s (FEV1), peak expiratory flow rate (PEFR), FEV1/FVC, Forced expiratory flow (FEF).

Table 1 shows mean age, height, weight of diabetic and control subjects. Table 2 shows Pulmonary function tests values in Diabetic and control subjects. FVC , $FEF_{25-75,}$ PEFR(L/s), FEV1(L) were low in diabetic subjects as compared to control subjects and this difference was significant. FEV1/FVC(%) was low in diabetic subjects as compared to control subjects and this difference was highly significant.

Discussion

Our study aims to show reduced pulmonary functions in diabetics in comparison to their age- and sex-matched controls. There are many studies which show reduced pulmonary functions in diabetics.[14] The exact cause of the changes in pulmonary parameters in diabetics is not known, but there are several theories explaining reduced pulmonary parameters in DM. These are – diabetes-induced thickening of the basal lamina of the lung,[15] microangiopathy of pulmonary capillaries and arteriole,[16] glycosylation of collagen, leading to loss of lung elasticity, neuropathy of lung muscles, and mild inflammation of lung tissues.[17] There are studies which show that neuropathy is the causative factor for respiratory muscle dysfunction in diabetes causing reduction of pulmonary volumes.[18] A study done by Aparna showed that FVC, FEV1, and PEFR were significantly reduced diabetics and the FEV1/FVC % was increased in type 2 diabetics which was similar to our study, except FEV1/FVC% was decreased in our study.[19,20]Our study shows Pulmonary function tests values in Diabetic

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and control subjects. FVC , $FEF_{25-75,}$ PEFR(L/s), FEV1(L) were low in diabetic subjects as compared to control subjects and this difference was significant. FEV1/FVC(%) was low in diabetic subjects as compared to control subjects and this difference was highly significant. The pathophysiological correlation of diabetes mellitus with deteriorated pulmonary function may be multifactorial. The lung volume comprises parenchyma which includes a large number of alveoli and nonparenchymal structures comprised of pulmonary vessels and bronchial tree [21]. Proper functioning of both these components is required for optimal lung function. Airways, blood vessels, and the interstitium of the lung parenchyma are rich in various types of collagens and elastin. The non-enzymatic glycosylation of these structural proteins leads to alteration in functions of lung connective tissue and stiffening of the chest wall which may be the potential mechanism for mechanical lung dysfunction in diabetes mellitus [22]. Thickening of the basal lamina of capillaries is seen in patients with diabetes mellitus and has also been documented by some human postmortem studies [23]. This may result in a redistribution of vascular flow with reduced perfusion in well-ventilated areas leading to a decline in lung function. Patients of diabetes mellitus also had neuropathy leading to neuromuscular dysfunction which adversely affects pulmonary function [24]. Low-grade inflammation in diabetics adds to the deleterious effects of the disease on lung function. The potential mechanism of decreased lung function can also be non-enzymatic glycosylation of proteins, such as collagen in the lungs and chest wall. This glycosylation leads to irreversible collagen cross-linking, rendering to decreased proteolysis and accumulation of collagen in lung connective tissue.[25] The glycosylation process occurs in the early stages of diabetes, when hyperglycemia is most pronounced until new equilibrium is reached at lower turnover rate of collagen. the chest wall and bronchial tree protein by non-enzymatic glycation. This may cause reduced compliance of the lungs.[26] Diabetes mellitus is also associated with poor skeletal muscle strength due to increased protein catabolism. Thus, respiratory muscle endurance decreases in diabetes mellitus. The patients with diabetes complicated by autonomic neuropathy may have decreased lung function due to impaired control of bronchomotor tone. Resting vagal tone is depressed which explains the depressed bronchoconstrictory response to both cholinergic stimuli and hyperventilation with cold air. Thus, there is a complex alteration of both control of ventilation and bronchomotor tone in diabetic patients with automatic neuropathy. Monitoring periodic lung function (FEV1 and FVC) has been advocated as a general measure of overall health status as well as a prognostic indicator of premature death from all causes, including cardiovascular disease, chronic obstructive pulmonary disease, and lung cancer.[27] Patients with DM admitted with pneumonia have increased risk of complications and mortality.[28] Diabetes mellitus (DM) is accompanied by wide spread biochemical, morphological, and functional abnormalities which may precipitate certain complications that affect the neural, cardiovascular, renal systems, and also organs and tissues like skin, liver, collagen, and elastic fibers. It is indeed a multi-system disorder that affect many organs of the body.[29,30] The complications related to diabetes pose a significant healthcare burden and disrupt the overall quality of life.

Conclusion

Our study shows significant changes of FEV1, FVC%, and FEV1/FVC% in Type II diabetes patients . The above pattern of changes are possibly due to hyperglycemia induced non enzymatic glycosylation of tissue proteins and chronic diabetic microangiopathy causing basement membrane thickening (capillaries and endothelium) leading to reduction in strength and elasticity of connective tissues. The pulmonary parameters are effected in patients of diabetes, and PFT should be essentially done in these patients for better management. PFT if

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done in patients presenting with diabetes as a routine OPD procedure will not only help to delay the onset of various respiratory ailments but also help the patient to comply with the various diabetic complications in due course of time.

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