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Pulmonary Function Test In Type 2 Diabetes Mellitus: A Cross Sectional Observational Study

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Abstract

Background: Diabetes Mellitus is a hyperglycemic disorder where altered metabolism of lipids, carbohydrates and proteins is seen. It is associated with chronic tissue damage which further leads to multiple organ failure. Cardiac, renal and retinal tissue is mainly damaged in Type 2 DM but it is seen that lungs are also affected by long term illness.

Aim: To assess the effects of chronic hyperglycemia on lung functions which focused on mechanical aspects of lung dysfunction, pulmonary function tests like FVC, FEV1, FEV1/FVC to be specific.

Material and Methods: A cross sectional observational study was conducted in total 100 cases of Type 2 Diabetes Mellitus admitted in medicine ward at tertiary care centre during December 2018 - 2020. Age >20 years and <60 years were included in the study whereas patients with history smoking; acute or chronic respiratory disease or cardiorespiratory disease; restrictive lung disease like kyphosis, scoliosis; occupational respiratory disorder like silicosis, asbestosis; history of abdominal or chest surgery were excluded from the study.

Results: The age of participants range from 29 to 59 years.FEV1 in 26% of cases were compromised while 74% of cases had normal value. PEFR were decreased i.e. < 80% of predicted value in 32% of cases while PEFR were increased i.e. > 80% of predicted value in 68% of cases. on spirometry 30% had restriction, 20% had obstruction and 50% were normal. ***Conclusion*:** Patients having longer duration of disease have abnormal PFT, mainly restrictive pattern was seen. Thus, duration and lung damage shows direct relation.

Keywords: Pulmonary function test, Type 2 DM, Lung Damage

Introduction

Diabetes Mellitus is an endocrine disorder. Type 2 diabetes mellitus is nothing but a persistent hyperglycemia and altered metabolism of lipids, carbohydrates and proteins. Several distinct types of diabetes mellitus are caused by complex interactions between genetics and environmental factors. These are the result from impaired insulin secretion and insulin resistance or combination of both of these mechanisms. [1,2] Type 2 diabetes mellitus is associated with chronic tissue damage, reduction in function, failure of multiple organs and its complications are preferably caused by macrovascular and microvascular damages and all are due to the metabolic dysregulation of the diabetes mellitus. [3] Though great attention was centered on the diabetic complications which had cardiovascular nature, nephropathy, retinopathy and neuropathy, the pulmonary complications of type2 diabetes mellitus have been poorly characterized. Of late the concept of the lung as a target organ for diabetic microangiopathy is receiving continuing attention.[4] Diabetic patients show abnormal lung function in the peripheral airways which increased with age and gas

transfer is also affected by diabetic microangiopathy as well as the duration of diabetes. Diabetes causes changes in pulmonary volumes, diffusion, and elastic properties of lungs as well as the performance of respiratory muscles. Diabetes also causes several histopathological changes. Diabetes may lead to the development of pulmonary complications due to collagen and elastin changes. It may also lead to increased non-enzymatic glycation of proteins and peptides of the extracellular matrix at chronic high circulating glucose levels.[5]

The aim of the study was to assess the effects of chronic hyperglycemia on lung functions, which focused on mechanical aspects of lung dysfunction, maximal forced spirometric pulmonary function tests like FVC, FEV1, FEV1/FVC to be specific. [6,7] The complications affected the lungs silently and may produce increased morbidity because of lung dysfunction. [8]

For all pulmonary complications the mechanism of damage is chronic hyperglycemia. So many lung disorders have been noted in patient with type 2 diabetes mellitus of which we are going to see mainly the mechanical complication of lung due to diabetes. Relatively few studies have been done on pulmonary mechanical function. Our study mainly concentrating on mechanical dysfunction of lungs due to diabetes mellitus mainly maximal forced spirometric PFTs to be specific.

Methods

After obtaining Institutional Ethical Committee approval and written informed consent from all the participants, this cross sectional observational study was conducted in total 100 cases of Type 2 Diabetes Mellitus admitted in medicine ward at tertiary care centre during period of December 2018 to December 2020. Diagnosed Type 2 Diabetes Mellitus patients with age >20 years and <60 years were included in the study whereas patients with history smoking; acute or chronic respiratory disease or cardiorespiratory disease; restrictive lung disease like kyphosis, scoliosis; occupational respiratory disorder like silicosis, asbestosis; history of abdominal or chest surgery were excluded from the study. Detailed history were taken and relevant clinical examination were done, an informed consent was taken. After demonstrating the technique for carrying out pulmonary function tests, subjects were made to undergo pulmonary function tests, using medspiror, for 3 times at every 15 min interval and best of 3 were taken into account.

The forced vital capacity [FVC], forced expiratory volume in 1 second [FEV1], peak expiratory flow rate [PEFR], FEV1/FVC, RV, TV were recorded. The subjects were asked to give blood sample for fasting blood sugar and post prandial estimation of blood sugar 2 hours after the breakfast on the next day. Anthropometric, Clinical and relevant Lab investigations are recorded the study. All the study participants are undergone Chest X-ray and Pulmonary Function Tests.

Statistical Analysis

Data was analyzed using software open epi version 2.3.1. Results were presented in the form of charts and graphs. Association between various factors like and dependent factor. Chi square test was used for qualitative variables and Unpaired T test was used to compare mean values of quantitative variables. P value less than 0.05 was considered for significance

Results

Total 100 cases of Type 2 Diabetes Mellitus admitted in medicine ward at tertiary care centre were enrolled in the study. The age of participants range from 29 to 59 years. The maximum number of cases were in age group of 40-50 years i.e [48%]. Mean age of the cases at time of presentation was 41.18 ± 6.95 years. Males [54%] were outnumbering females [46%] showing male to female ratio of 1.7:1.

Majority of the cases i.e 54% had sedentary lifestyle, 27% were heavy workers and only 19% were moderate workers. Maximum cases i.e. 54% were in normal BMI range, 22% were pre obese and 16% were obese whereas, 8% were undernourished. Mean BMI was 23.66+5.67kg/m2. Maximum cases 56% were non hypertensive, only 44% had hypertension. Among those 24 were males and 20 were females

Fasting and Postprandial blood sugar levels were more than 126 mg and 200 mg in maximum cases so HbA1c levels were done and showed that maximum cases were having poorly controlled diabetes with treatment i.e., 47% of cases had HbA1c between 7-10 %, 30% of cases had >10% were as only 23% of cases had <7% i.e. controlled diabetes with treatment. It was observed that 88% of cases were on oral

Volume 5, Issue 3; May-June 2022; Page No 635-641

hypoglycemic agents, 8% of cases were on insulin and 4% of cases were taking both oral hypoglycemic agents as well as insulin. As concerned with duration 62% of cases had duration more than 120 months, followed by 16% of cases had duration of 25 to 60 months , 12% of cases had duration of 61 to 120 months and only 10% of cases had duration of <24 months. Mean duration was 99.4+44.76 months.

GRAPH 1: Distribution of cases as per HbA1C

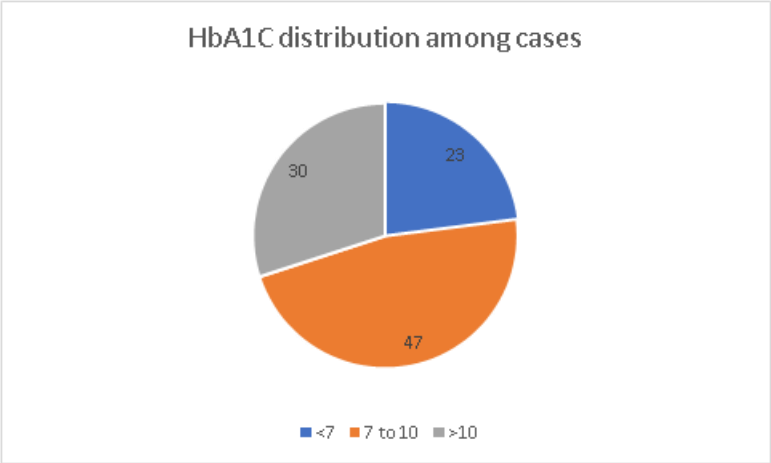


TABLE 1: Distribution of cases as per FEV1

FEV1 [% of predicted value	Males [%]	Females [%]	Total [%]
>80	40	34	74
<80	14	12	26
Total	54	46	100

FEV1 in 26% of cases were compromised while 74% of cases had normal value. Applying chi square test, p = 0.98, shows no statistical significance.

TABLE 2: Distribution of cases as per FVC

FVC [% of predicted value]	Males [%]	Females [%]	Total [%]
>80	38	18	56
<80	16	28	44

Volume 5, Issue 3; May-June 2022; Page No 635-641

Total	54	46	100

FVC were decreased i.e. < 80 % of predicted value in 44% of cases while FVC were normal or increased i.e. > 80 % of predicted value in 56% of cases. Applying chi square test, p =0.0008, as p <0.05, shows statistical significance.

TABLE 3: Distribution of cases as per FEV1/ FVC

FEV1/FVC [% of predicted value]	Males [%]	Females [%]	Total [%]
<70	8	12	20
>70	46	34	80
Total	54	46	100

FEV1/FVC were decreased i.e. <70% of predicted value in 20% of cases while FEV1/FVC were normal or increased i.e. >70% of predicted value in 80% of cases. Applying chi square test, p =0.08, as p >0.05, shows no statistical significance.

TABLE 4: Distribution of cases as per PEFR

PEFR [% of predicted value]	Males [%]	Females [%]	Total [%]
>80	40	28	68
<80	14	18	32
Total	54	46	100

PEFR weredecreased i.e. < 80% of predicted value in 32% of cases while PEFR were increased i.e. > 80% of predicted value in 68% of cases. Applying chi square test, p =0.07, as p >0.05, shows no statistical significance.

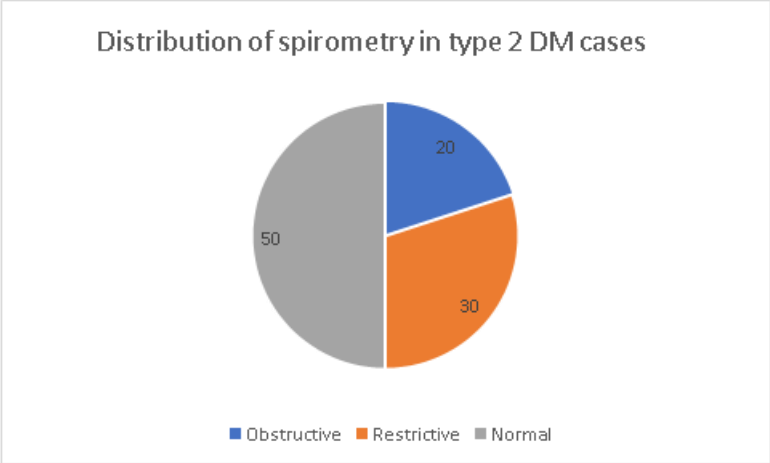
TABLE 5: Distribution of cases as per spirometry findings

SPIROMETRY	Total	Percentage
Obstructive	20	20
Restrictive	30	30
Normal	50	50

Volume 5, Issue 3; May-June 2022; Page No 635-641

Total	100	100

GRAPH 2: Distribution of spirometry in type 2 DM cases



Spirometry findings showed that 30% of cases had restrictive pattern, 20% of cases had obstructive pattern and and 50% of cases had normal pattern

Discussion

Spirometry is a widely used and readily available pulmonary function test, ideally describing the effects of obstruction or restriction on lung function. There is non enzymatic glycolysation of proteins in lung and chest wall which makes collagen less susceptible to proteolysis and leads to its accumulation in lung connective tissue. Non-enzymatically glycosylated collagen seen in diabetic is considerably more resistant to digestion by pepsin and collagenase than non-diabetics. This is the likely explanation for chronic hyperglycemia causing glycosylation of lung collagen and hence less compliant lung parenchyma leading to restrictive changes in lungs. [9] The study by David. A Kaminsky in 2004 speculates that abnormal lung function may precede the diagnosis of diabetes, suggesting that lung may contribute to or at least be commonly affected by factors involved in the pathogenesis of diabetes [10]

Male : female ratio was 1.7:1. Similar findings were seen by Maroti K et al [11] and reverse was seen in a study by OO Adeyeye et al [12] . Maximum cases were in age group of 40 to 50 years followed by 30 to 40 years and mean age was 41.28+6.95 years which was similar age composition was found in a study by Maroti K et al [11]

Mean BMI was 23.66+5.67kg/m2 in our study which was comparable with findings of Karande et al [13] with mean BMI of 24.7±2.4 kg/m2. The effect of BMI in reducing lung function may be due to reduced chest wall compliance and increased airway resistance.[14]

The finding of fasting and postprandial blood sugar level were similar to the study done by OO Adeyeye et al [12]

Also the finding of HbA1c of cases in our study was similar to study done by Shah SH et al [15]

Majority of cases i.e. 62% had duration more than 120 months, followed by 16% with 25 to 60 months of duration and mean duration was 99.4+44.76 months. Similar findings were seen by Shah SH et al [15] and Sheela Kurian V et al [16].

A study conducted by Walter. E. Robert, Alexa Beiser, Rachel J, Givelber, George T, OíConnor, et al. on “Association between glycemic state and lung function” concluded that a higher levels of FBS were associated with lower pulmonary function[17] . In a similar study done by Davis Timothy M. E, Matthew Knuiman, Peter Kendell, Hien Vu, Wendy A.Davis et al, it was found that pulmonary function is reduced in type 2 DM and diabetes duration has more influence on pulmonary function than the glycemic control [18]

Volume 5, Issue 3; May-June 2022; Page No 635-641

It was seen that on spirometry 30% had restriction, 20% had obstruction and 50% were normal.

OO Adeyeye et al [12] showed that 43% were normal, 38% had restriction, 11% had obstruction and 8% had mixed findings. Shah SH et al [15] found that have mentioned that acceleration of aging process in connective tissue cross links and presence of nonenzymatic glycosylation and modification of alveolar surfactant action causes reduction in PFTs.

SK Rajan et al [19] conducted a study on spirometric evaluation of type 1 DM, and study shows normal findings in 10 patients [33%], & abnormal findings in 20 patients [67%]. Among these 20 patients [67%] with abnormal findings, obstructive pattern was present in 12 patients [60%], restrictive pattern was present in 6 patients [30%] and mixed pattern was observed in 2 patients [10%].

Muhammad Irfan, Abdul Jabbar et al concluded in their study that diabetic patients showed impaired lung function independent of smoking. This reduced lung function is likely to be a chronic complication of diabetes mellitus [20]

Simran Kaur and Nandini Agarwal et al [21] also observed a significant change in lung function in diabetic patients with microangiopathy.

Two groups of studies [22][23] reported a thickening of pulmonary basal laminae. In addition, Kodolova et al [23] reported the existence of microembolization in the pulmonary arteries and some degree of emphysema

Conclusion

Most of the patients with longer duration of diabetes had the abnormality in the pulmonary function tests mainly the restrictive pattern of the lung disease. There is relation between the chronicity of diabetes mellitus and damage of the lungs. Most of the patients with the elevated levels had the abnormality in the pulmonary function tests mainly the restrictive pattern of the lung disease. There is a relation between the chronic uncontrolled diabetes mellitus and damage of the lungs.

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Volume 5, Issue 3; May-June 2022; Page No 635-641

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Volume 5, Issue 3; May-June 2022; Page No 635-641