A COMPARATIVE STUDY ON PULMONARY FUNCTION TEST IN TYPE II DIABETICS AND NON-DIABETICS IN A TERTIARY CARE CENTRE - KANYAKUMARI

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ABSTRACT

BACKGROUND

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. The aim of the study was to assess the effects of chronic hyperglycaemia 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.

MATERIALS AND METHODS

This study is a cross sectional study conducted among 50 people with type 2 diabetes and 50 people with non-diabetes without having risk factors that affect the lung functions.

RESULTS

In our study correlation between HbA1C and Pulmonary function is statistically significant (p value is <0.0001). . Most of the patients with elevated levels of HbA1c had the abnormality in the pulmonary function tests mainly the restrictive pattern of the lung disease. The patients with diabetes have 14% normal and 80% with restrictive lung disease and 6% with obstructive lung disease of pulmonary function tests. In non-diabetics 78% having normal and 12% having restrictive pattern and 10 % having the obstructive pattern of lung disease. In our study both FEV1 and FVC are reduced in diabetics, in which FVC have reduced more than FEV 1 so that F EV1/FVC has increased, and the 'p' value is significant in all the parameters according to independent sample t test.

CONCLUSION

It is clearly shown that diabetes will affect the lungs too and mainly restrictive pattern of lung disease is common. Chronic uncontrolled diabetes is one of the leading cause of lung complications. So an intensive management will decrease the rate of death by an improved ventilatory function.

KEYWORDS

Diabetes, Pulmonary Function Test, Spirometry.

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BACKGROUND

Diabetes mellitus is characterized by chronic hyperglycaemia due to defects in insulin secretion, peripheral insulin action or both which leading to alteration in the fat, proteins and carbohydrate metabolism of the individuals. Several distinct types of diabetes mellitus are caused by complex interactions between genetics and environmental factors. Though great attention was centered on the diabetic complications which had cardiovascular nature, nephropathy, retinopathy and neuropathy, the pulmonary complications of type 2 diabetes mellitus have been poorly characterized. Of late the concept of the lung as a target organ for diabetic microangiopathy is receiving continuing attention.

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. Most of the studies were done on type 1 diabetics 3. The present study was done on type 2 diabetics.

Major consequences of hyperglycaemia are excessive non enzymatic glycosylation of various body proteins including albumin.[1,2,3,4] collagen and elastin. In type 2

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diabetics with uncontrolled disease there is decreased pulmonary functions. There may be increased cross linkage between polypeptides of collagen leading on to thickening and restriction of lung volume and alveolar gas transport, reduced membrane diffusion capacity and pulmonary capillary blood volume. [5,6,7] The possible explanations of restrictive type of lung disease are thickening of alveolar epithelium, pulmonary microangiopathy and centrilobular emphysema. So the net effect is due to collagen & elastin changes and microangiopathy.[1,8,9]

The lung complications of type 2 diabetes mellitus are mainly that affects the mechanical aspects of the organ and among that restrictive pattern of lung disease is the commonest one, these effects are reported by using the spirometry and measuring the forced vital capacity and forced expiratory volume in first second and ratio between these two.

Spirometry is a set of pulmonary function tests which read the mechanical lung function, which measures air that can be inhaled and exhaled. It is the recording of lung volumes and capacities by using spirometer. It is Simple, office-based, Measures flow, volumes, volume vs. Time. It is the most readily available most useful pulmonary function test. It takes 10 to 15 minutes and carries no risk. Spirometry is the most commonly used lung function screening study. It needs patients voluntary effort to inhale maximally beyond the tidal volume and exhale forcefully into the close circuit maneuver. Before doing the test the examiner must explain the complete procedure to reduce the faults.[10]

Can Determine

- Forced expiratory volume in first second (FEV_1)
- Forced vital capacity (FVC)
- FEV_1/FVC
- Forced Expiratory Flow 25%-75% $(FEF)_{25-75}$

Relative contraindications for spirometer includes recent heart disease, unstable angina, abdominal aorta aneurysm, recent eye surgery, recent surgeries in the past, haemoptysis of unknown origin haemoptysis of unknown origin, pneumothorax, cerebral artery aneurysm, syncopal attacks, thoracic aorta aneurysm.[11,12] Spirometer is used for only the single breath. Repeated breathing is not indicated in this spirometer because repeated breathing can cause the accumulation of carbon dioxide and other air and oxygen are cannot be provided to the patients.

Forced Vital Capacity is the Total volume of air that can be exhaled forcefully from Total lung capacity. The majority of FVC can be exhaled in <3 seconds in normal people, but often is much more prolonged in obstructive diseases measured in liters**.** Forced expiratory volume in the 1st second is the

Volume of air forcefully expired from full inflation (TLC) in the first second. Measured in liters (L). Normal people can exhale more than 75-80% of their FVC in the first second; thus the FEV1/FVC can be utilized to characterize lung disease.

MATERIALS AND METHODS

AIMS AND OBJECTIVES

1. To compare the pulmonary function test in type 2 diabetics and non-diabetics a comparative study.
2. To evaluate the effect of uncontrolled diabetes mellitus on lung functions and functional limitations of activities and pulmonary complications, in patients with type 2 diabetes.

STUDY POPULATION

This study is to be conducted among 50 people with type 2 diabetes and 50 people with non-diabetes without having risk factors that affect the lung functions.

Inclusion Criteria

1. People with type2 diabetes and non-diabetes in age group between 30 – 50 yrs.
2. Both male and female.

Exclusion Criteria

1. Patient refusal
2. Subjects with vertebral column or thoracic cavity anatomical abnormality
3. acute or chronic respiratory infections,
4. Neuro and muscular disease,
5. Known cancer patients
6. Cardiac disease
7. Patient underwent major chest or abdominal surgeries
8. Smokers of any duration, betel nut chewers, smoking in any form of preparation using
9. Those who are obese
10. Asthma and COPD

Data Collection

The following information were collected from patients who were a known case of Diabetes mellitus and a recently noticed type 2 diabetes mellitus according to the American diabetes association criteria for diagnosing type 2 diabetes mellitus who attended medicine opd in the form of Age, Sex, Height, Weight, BMI, Random blood sugar, HBA1C value from both male and female with type 2 Diabetes mellitus those who were having symptoms of diabetes mellitus in a age between 30 to 50.

I have examined the patients properly and I have excluded those who were not fit for study according to my study exclusion criteria. All participants in my study underwent electrocardiography examination, echocardiogram examination, chest x-ray examination, proper neurologic examination to eliminate those who were not fit for study.

I referred all the participants to department of thoracic medicine for pulmonary function testing. Before I refer the patients I have instructed the proper way of spirometric examination and procedure of the examination. I have collected the pulmonary function test results mainly FVC, FEV1, FEV1/FVC for all participants of 50 participants with type 2 diabetes mellitus and 50 participants without type 2 diabetes mellitus.

Statistical Methods

The data collected during the study was formulated into a master chart in Microsoft office excel and statistical analysis was done with help of computer using statistical software package SPSS V.17 for windows. 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. P value of <0.05 was taken as significant.

RESULTS

In our study majority of the population are in between the age group of 41 to 45 years (30%) [Figure 1, Table 1]. Males were 54% and females 46% [Table 2]. 50 cases were diabetics and 50 cases were non diabetics. In our study correlation between HbA1c and Pulmonary function is statistically significant (p value is <0.0001) [Table 3]. From this pearson correlation test we had come to the conclusion that there is a relationship between the HBA1C level and the results of the pulmonary function test. Most of the patients with the elevated levels had the abnormality in the pulmonary function tests mainly the restrictive pattern of the lung disease. In diabetics both FEV1 and FVC are reduced, in which FVC has reduced more than FEV 1 so that FEV1/FVC has increased, and the 'p' value is significant in all the parameters according to independent sample t test. [Figure 2, Table 4]. This test depicts that most of the patients with type 2 diabetes mellitus having the restrictive pattern of the lung disease. In our study the patients with diabetes are 14% normal and 80% are with restrictive lung disease and 6% with obstructive lung disease of pulmonary function tests.

In non-diabetics 78% having normal and 12% having restrictive pattern and 10% having the obstructive pattern of lung disease [Figure 3]. The relation between type 2 diabetes mellitus and restrictive pattern of lung disease is statistically significant. (Pearson's chi square test P<0.0001).

OBSERVATION AND RESULTS

Age	Patients
<30	4%
31-35	25%
36-40	20%
41-45	30%
>46	21%

Table 1. Age Profile

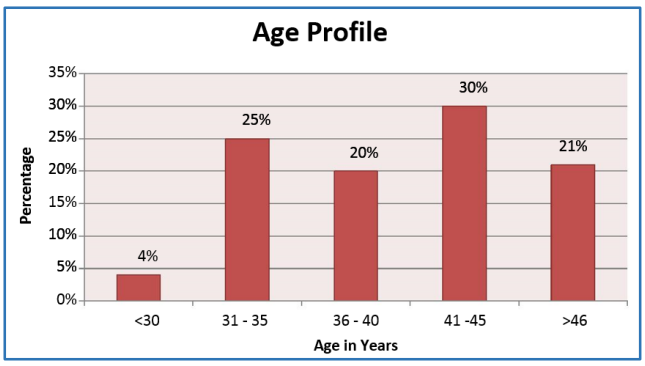

Figure 1. Age Profile

Male	54%
Female	46%

Table 2. Gender Distribution

Pearson of HBA1c and PFT

PFT Coefficient Correlation		P value
HbA1c	0.447	<0.0001

Table 3. Pearson Correlation Test

	Group A		Group B		P VALUE
Parameters	**(Type 2 Diabetics)**		**(Non- Diabetics)**		
	(n=50)		**(n=50)**		
	Mean	**SD**	**Mean**	**SD**	
FEV1	68.37	11.19	77.27	13.47	0.001
FVC	68.18	13.25	84.52	6.33	<0.0001
FEV1 / FVC	100.66	13.86	90.8	15.46	0.001

Table 4. Comparison of PFT among Two Groups

Independent Sample T Test

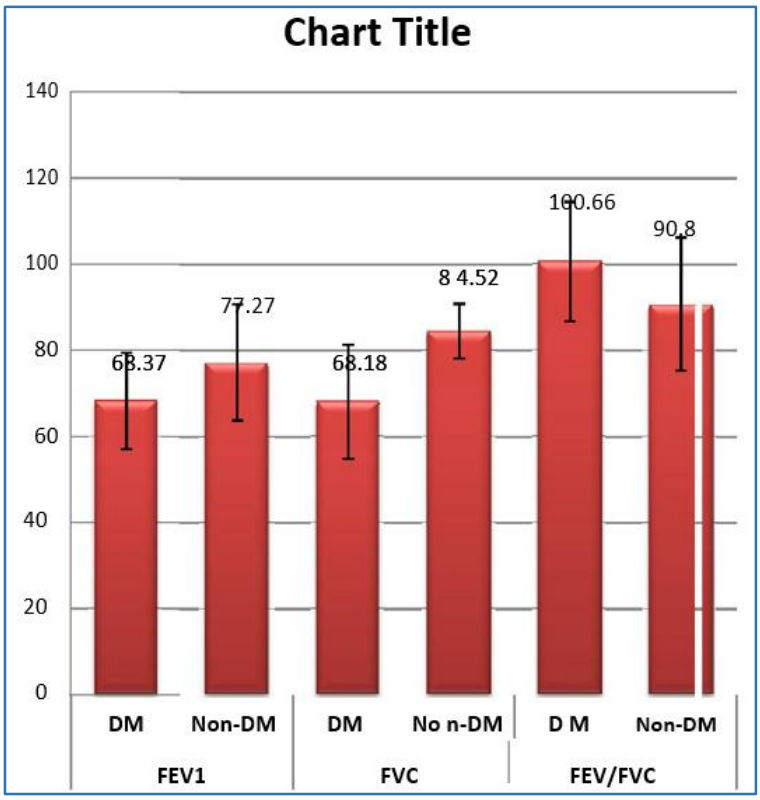

Figure 2. Comparison of PFT

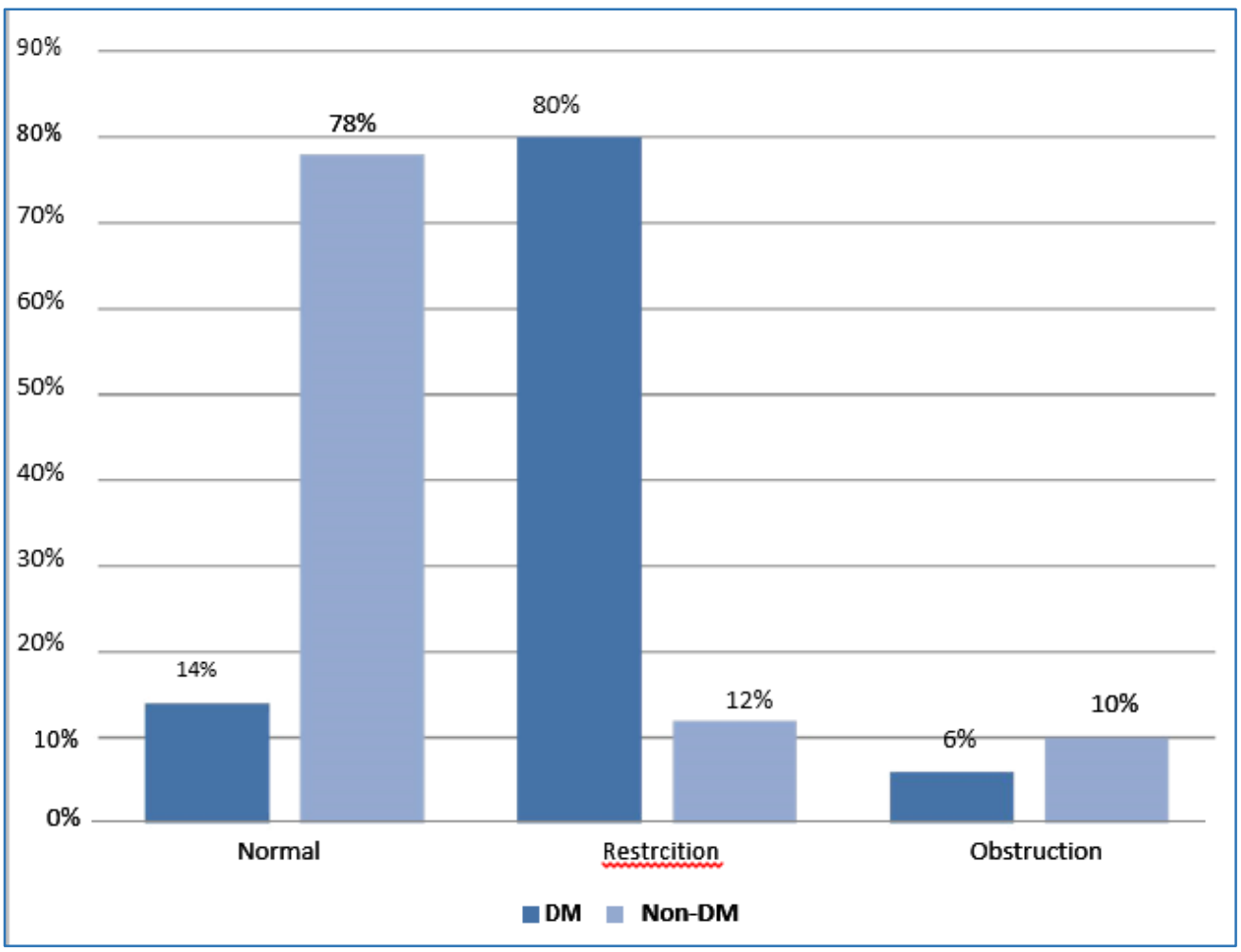

Figure 3. Pattern of Pulmonary Functions between Diabetics and Non diabetics

DISCUSSION

The present study has assessed that type 2 diabetes was associated with reduced lung functions, by doing forced Spirometric Pulmonary Function Tests. This study clearly showed a highly statistically significant p value when the lung function tests (FVC, FEV1) were compared between type 2 diabetics and controls (age, sex and BMI matched).

In our study done in Kanyakumari medical college hospitals, about 100 participants were studied of which 50 are having type 2 diabetes mellitus are cases and 50 without diabetes mellitus are controls and the males are 54 and females are 46 in number. The age distribution in our study mostly between 41 to 45 years (30%). Pulmonary function test has been conducted in all the persons.

There is statistically significant value in correlation between HbA1c and pulmonary function test results were noted and the p value is <0.0001. The FEV1 and FVC both are reduced in type 2 diabetic patients and the FEV1/FVC is increased. Mean, standard deviation are decreased in type 2 diabetics when comparing to non-diabetics. The p value for FEV1 in type 2 diabetics is0.001 and for FVC is <0.0001 and for FEV1/FVC is 0.001.

The pattern of lung disease is mostly restrictive pattern in patients having type 2 diabetes mellitus. Only 3 persons with diabetes having obstructive type of disease. And the p value is <0.0001 is statistically significant.

Recent studies which were conducted by Lange et al[13] indicated that the type 2 diabetic patients are having mild decrease in forced vital capacity maybe because of impaired immunity against environmental challenges such as infections in diabetes and smoking. In a study which was done by Boulbou et al[8] it was found that there was a decrease in mean FVC values in type 2 diabetics. In a study which was done by Robert E. Walter et. al., it was found that there was a progressive decrease in mean forced vital capacity value is 109 ml/year.[10]

The FEV1/FVC% was increased in type 2 diabetics as compared to that in the controls and the increase was statistically significant. The increased FEV1/FVC % suggested that the impairment of pulmonary functions in type 2 diabetics was primarily restrictive in nature

Davis et al., study detected that almost all the parameters like forced vital capacity, forced expiratory volume at 1st second are decreased so that the ratio is increased almost most of the patient with uncontrolled diabetes mellitus.[12] So it is clear that type 2 diabetes mellitus affect the lung and lung may the target organ for damage and the pattern of disease is restrictive in nature.[1,9,13,12]

Although the underlying mechanisms which relate type 2diabetes to reduced lung functions remains unclear, previous studies have suggested several possible explanations, which include glycosylation of chest wall and bronchial tree proteins and increased cross-linkage formation between polypeptides of collagen in pulmonary connective tissue, which decrease Forced vital capacity, basal lamina thickening, and increased susceptibility to respiratory infections.[1,2,12]

The study which was done by Mario Cazzola et al., on human isolated bronchi elucidated the obstructive nature of pulmonary pathology in diabetes at a molecular level.[5,7] Thus hyperglycaemia may contribute to obstruction of airways.

The lungs are affected by diabetic microangiopathy.[14,15,6] This was evidenced autopsy findings in human diabetic subjects, which showed pulmonary microangiopathy, thickening of alveolar epithelia, pulmonary capillary basal lamina thickening, centrilobular emphysema, and, thickening of alveolar epithelia. Type 2 Diabetes mellitus can cause the development of pulmonary complications due to collagen and elastin changes as well as microangiopathy.

Limitation

1. Few studies showed there is no correlation between HBA1C and PFT's.
2. Sample size is small
3. Patients refusal
4. There is no explained exact mechanisms of restrictive lung pattern of lung disease in type 2 diabetics.

CONCLUSION

The findings from our study is nearly related with other studies that have done in the diabetics pulmonary function test. It has clearly shown that diabetes will affect the lung too that too mainly restrictive pattern of lung disease is formed but some study shows obstructive pattern also. Now it is clear that lung may the target organ in diabetes mellitus. Chronic uncontrolled diabetes is the leading cause of lung complications. So an intensive management will decrease the rate of death by an improved ventilatory function. pulmonary dysfunction may one of the earliest and easiest measurable non–metabolic variation in diabetes, so the diabetic patients should undergo pulmonary function testing along with other tests.

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