

A Comparative Study of Pulmonary Function Tests Type 2 Diabetes Mellitus and Non-Diabetes

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Abstract

Background: Diabetes Mellitus still remains one of the foremost causes of Morbidity and Mortality in both the developing and developed nations. Diabetes Mellitus includes a heterogenous group of hyperglycemic disorders. The presence of extensive microvascular circulation and abundant connective tissue in lungs, raises the possibility that lung tissue could be a target organ in Type2 Diabetes Mellitus

Objective: To study the effects of Type 2 Diabetes Mellitus on lung function tests.

Materials and Method: 80 male subjects, 40Type 2 Diabetes-study group, 40 Healthy-controls selected from Vaishnavi Hospital, Hyderabad. Medspiror instrument was used to record lung functions. Following parameters were recorded: Forced vital capacity (FVC), Forced Expiratory Volume in 1st sec (FEV1), FEV1 /FVC ratio, Forced Expiratory Flow in middle half of FVC (FEF 25-75%) and Peak Expiratory Flow Rate (PEF). Statistical analysis was done using unpaired t-test in windows stat 9.2 software.

Results: Study group showed statistically greater percentage reduction in FVC, FEV1, FEF 25-75% and PEF compared to control group.

Conclusion: Type2Diabetes Mellitus may be a causative factor for derangement in lung functions due to altered connective tissue, thickening of basal lamina of alveolar membrane and capillary endothelium. All these factors are leading to Restrictive Lung disorder, which exacerbate with increasing blood sugar levels and duration of Type2 Diabetes Mellitus. Therefore lung is considered as a TARGET ORGAN in Type2Diabetes Mellitus.

Keywords: T2DM & Pulmonary Function Test.

Introduction

Diabetes mellitus, a pan-metabolic disorder, is principally characterized by chronic/sustained hyperglycemia: 'A syndrome rather than a disease entity'¹.

Type 2 Diabetes is known to include wide range of disorders differing in progression and outlook. The underlying mechanism is due to either **DIMINISHED INSULIN SECRETION**, an islet cell defect, associated with increased peripheral resistance to the action of

insulin resulting in decreased peripheral glucose uptake or **INCREASED HEPATIC GLUCOSE OUTPUT**.²⁻³

This entity is accompanied by wide spread biochemical, morphological and functional abnormalities which induce certain complications involving kidney, heart, blood vessels, nerves, skin, liver, collagen and elastic fibers. Thus Diabetes is a multisystem disorder that affects many organs of human body.⁴

There are histopathological modifications seen in lungs of Diabetic subjects such as thickened alveolar epithelial cells and pulmonary capillary basal lamina leading to decreased elastic recoiling of lung tissue. There is defective diffusion of gases due to reduced pulmonary capillary blood volume and thickening of basement membrane.

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This non-enzymatic glycosylation inducing modification of lung connective tissue is most likely the mechanism underlying the mechanical pulmonary dysfunction in Diabetes.

This suggests lung as a “**Target organ**” in Diabetes Mellitus.⁵

Epidemiology: There were 66.8 million cases of Diabetes in India in 2014, Diabetes raw national prevalence (%) 8.56. WHO projects that Diabetes will be the 7th leading cause of death in 2030.⁶⁻⁷

Prevalence of Diabetes in adults worldwide was estimated to be 4.0% in 1995 and to rise to 5.4% by the year 2025. It is higher in developed than in developing countries.

The major part of this numerical increase will occur in developing countries. There will be a 42% increase from 51 to 72 million, in the **developed** countries and a 170% increase from 84 to 228 million, in the **developing countries**.

1. By the year 2025, >75% of people with Diabetes will reside in developing countries, as compared with 62% in 1995.
2. In the year 2025 the countries with the largest number of people with Diabetes will be India, China, and the U. S.
3. The majority of people with Diabetes are aged > or =65 years. This pattern will be accentuated by the year 2025.
4. It is appraised that there will be more than 200 million Diabetes with in next 10 years. By this time India has become the ‘**DIABETES CAPITAL**’ of the world, with 3 crore people affected, which is tip of ice berg.⁸⁻⁹
5. COPD, which is defined functionally by a reduction of the ratio between FEV1 and forced vital capacity (FVC) below 70%, is one of the leading causes of mortality and quality-adjusted life years lost in the US as well as worldwide.

This restrictive spirometric pattern is also associated within significant functional impairment.¹⁰⁻¹³

Materials and Method

Methodology: Ethical committee approval was obtained from the institutional ethical committee of Osmania Medical College.

Informed consent was taken from the subjects and purpose of study was explained along with the benefits and risks.

Sample Size:

- 80 Male subjects were selected. 40 healthy males subjects with age group being 40-55yrs with no history of Type 2 Diabetes Mellitus are taken as control group.
- The present study was undertaken in co-operation with Vaishnavi hospital, Hyderabad, during the period of 2014-2015.
- The present study was done to elicit the consequence of Type 2 Diabetes Mellitus on lung function test among adult male of age group 40-55yrs. The lung function tests were correlated with those in normal healthy adult male subjects having no history of smoking. The duration of Type 2 Diabetes Mellitus and blood sugar levels were contemplated to study the effects of Diabetes Mellitus.

Preparation:

- The subjects were asked to wear loose-clothing to prevent compression of thorax
- They were asked to relax for 5-10min before and after Pre-test and Post-test
- Subjects were instructed not to have heavy meal before the test.

Inclusion Criteria:

1. 40 male subjects with history of Type 2 Diabetes Mellitus for more than 10 yrs
2. Age group: 40-55yrs

Exclusion criteria: Female subjects, smokers, previous lung diseases or infections, any cardiovascular diseases, any known history of neuromuscular diseases, malignancy, any surgery in past, any abnormalities of thoracic or vertebral column, obese person (BMI:<30Kg/m²)

Study and Control group were preferred as per inclusion and exclusion criteria. Clinical examination of Respiratory system was done to know its function as base level. FBS/PPBS were done on same day of lung function tests.

The PFT'S were done in morning sessions 11-1pm, using MEDSPIROR parameters taken were

FVC, FEV1 (L), FEV1/FVC%, FEF25-75%, PEFR

Spirometry Recording: Spiro lab II was employed to measure pulmonary function. The recordings were carried out in the Vaishnavi hospital, spiro-lab between 11:30 am and 3:00 pm at a room temperature of 28-32 degree celsius.

The maneuver was demonstrated to the patients.

Written consent was obtained for participation in this study.

Patient was asked to take a full maximal inspiration followed by forceful, maximal and complete exhalation without delay. Minimum three recordings were performed, with time gap of 2min. Readings with highest values were recorded.

The Parameters recorded were

FEV1, FVC, FVC/FEV1, FEF25-75%, PEFR.

Three satisfactory blows were performed and best values are taken for interpretation. Criteria for satisfactory blows are:

- The blow should continue until a volume plateau is reached
- FVC and FEV1 readings should be within 5% or 100 ml
- The expiratory volume-time graph should be smooth and free from irregularities.
- Employing unpaired student’s t test the difference between means of the two groups was compared.
- p value less than 0.05 were taken as significant.
- Using SPSS Version 15 software the parameters were analyzed.

Results

Table No. 1: Comparison Of PFT in Study and Control Group

Parameters Recorded	Study group (n=40)	Control group (n=40)	p-value
FVC	2.07±0.74	2.72±0.43	<0.001, HS
FEV1	2.02±0.47	2.38±0.38	0.00034, HS
FEV1/FVC	0.78±0.079	0.80±0.087	0.22, NS
FEF25-75% (L/SEC)	1.88±0.51	2.68±0.49	< 0.001, HS
PEFR (L/SEC)	5.64± 1.. 81	6.87±1.82	0.00335, HS
Inference	FVC, FEV1, FEF 25-75%, PEFR=HS- Highly significant. FEV1/FVC ratio=NS-Not significant		

Table No. 2 Comparison of Age, Height, Weight, BMI, BSA, SES, FBS and PPBS in Type 2 Diabetes Mellitus and Control group

Basic Characteristics	Study group (n=40)	Control group (n=40)	p-value
Age (years)	47.9± 5.27	47.6 ± 5.33	0.81, NS
Weight (kg)	64.2 ± 5.03	65.0± 6.80	0.52, NS
Height (cm)	167±6.42	166±7.98	0.77, NS
BSA (m ²)	1.72±0.09	1.73±0.12	0.73, NS
BMI (kg/m ²)	23±1.84	23±1.98	0.52, NS
SES	2.32±1.34 2.37±1.14 0.85, NS		
FBS (md/dl)	175± 53.6	84±9.17	< 0.001, HS
PPBS (mg/dl)	226±57.9	125±8.44	< 0.001, HS
Inference	Age, Height, Weight, BSA, BMI, SES of both study and control group-NS (p> 0.05). FBS and PPBS-HS in Study group.		

NS-not significant and HS-highly significant

Discussion

Diabetes seems to cause injury in the pulmonary microcirculation by increasing vessel wall thickness. In fact, considering its large vascular network and richness in collagen and elastin, the pulmonary system is susceptible to microvascular damage and non-enzymatic glycation in diabetes. The presence of these alterations could be regarded as the manifestation of Diabetic Microangiopathy.¹⁴⁻¹⁷

Decreased elasticity of collagen especially in Type 2 pneumatocyte increase permeability of capillary basement membrane. Since normal mechanism of gas exchange is influenced by the integrity of pulmonary connective tissue and microvasculature, development of abnormal lung functions is attributed to abnormality in either of these two structural components.¹⁸

Lange P, Groth S J et al determined the co-relation between Diabetes Type 2 study group and healthy as controls, measured the FVC and FEV in 1 second. They observed that Diabetic patients in all age groups

showed a reduction in lung functions FVC, FEV1 and forced mid-expiratory flow by 8-20% with a moderate restrictive defect without restrictive defect without airway obstruction. FVC, FEV₁ values correlated with present study.¹⁹⁻²²

Sanjeev Verma, Mumtaz Goni, there is a significant decrease in FEV in subjects with Type 2 Diabetes Mellitus compared with normal healthy controls. The ratio of FEV₁ /FVC was found to be statistically insignificant. This study co-related with present study.²³

Dhaher J. S. Al-Habbo et al conducted PFT in Type 2 Diabetes subjects and observed significant effects in FVC%, FEV₁ and FEV₁/FVC ratio when compared with the controls.²⁴

Conclusion

Type 2 Diabetes Mellitus may be a causative factor for derangement in lung functions due to altered connective tissue, thickening of basal lamina of alveolar membrane and capillary endothelium, loss of bronchomotor tone & weakness of respiratory muscles.

Limitations of the Study

1. Mean HbA1C co-relation with pulmonary function parameters as FVC and FEV1 could predict better the extent of hyperglycemia impairing the pulmonary function test.
2. Follow up of Diabetic subjects could not be done as it was a one time study.

Conflict of Interest: No interest of conflict

Source of Funding: Self

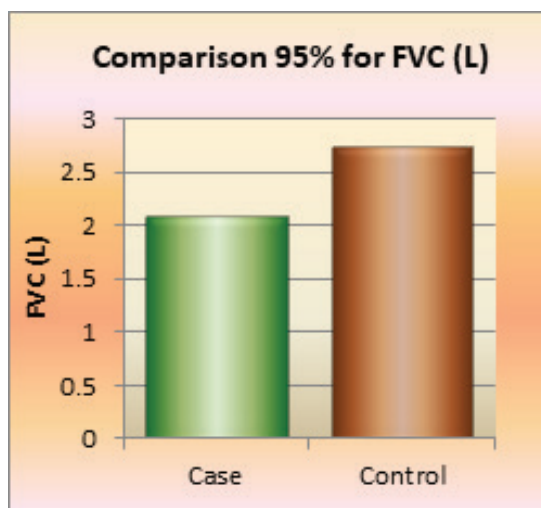


Fig No. 1

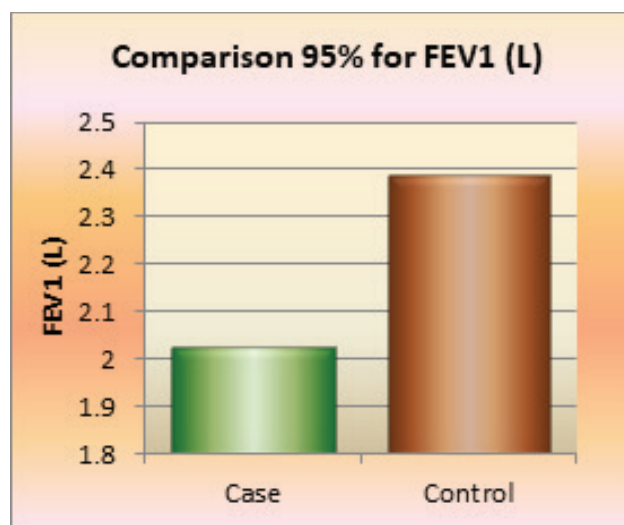


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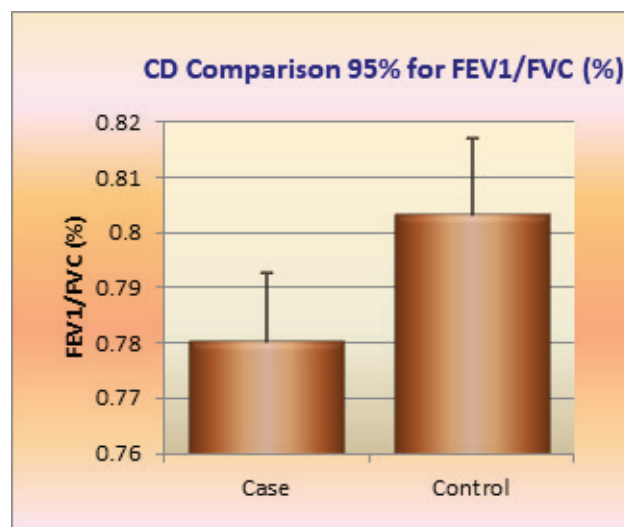


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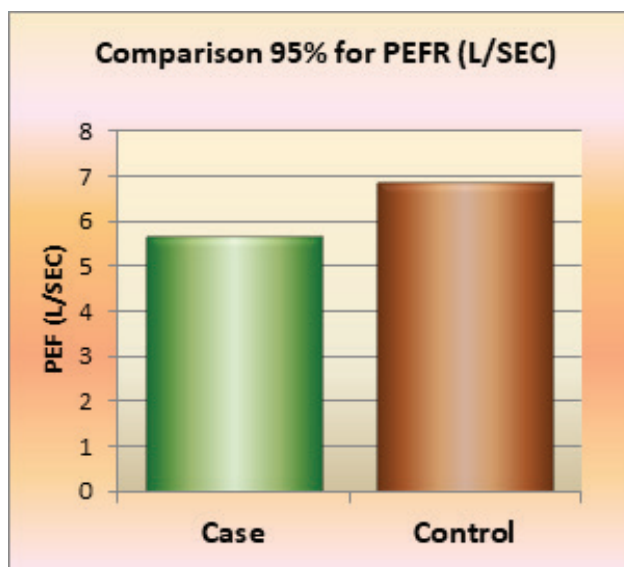


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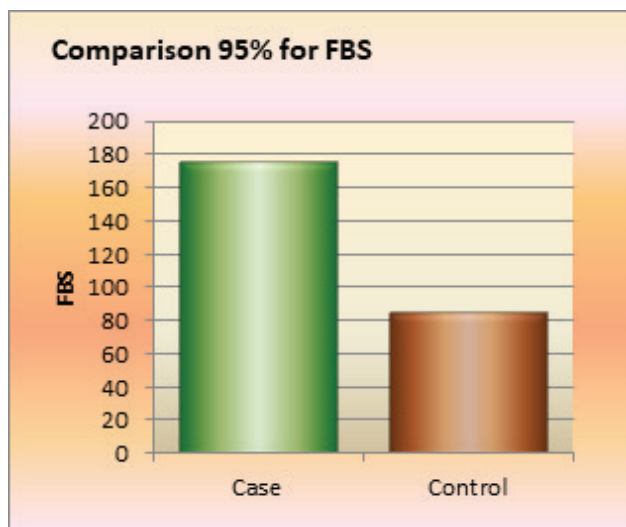


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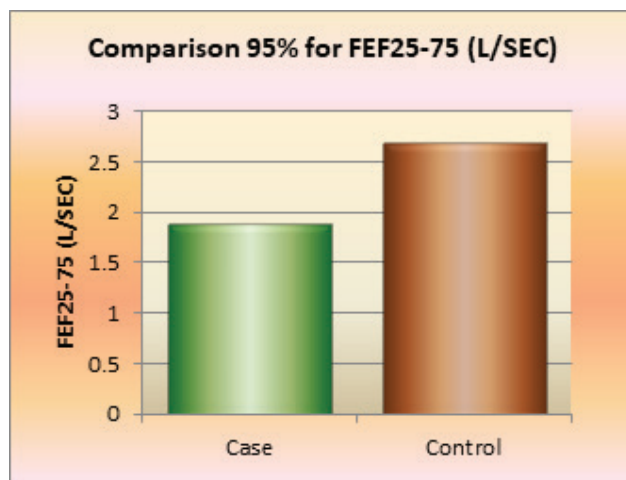


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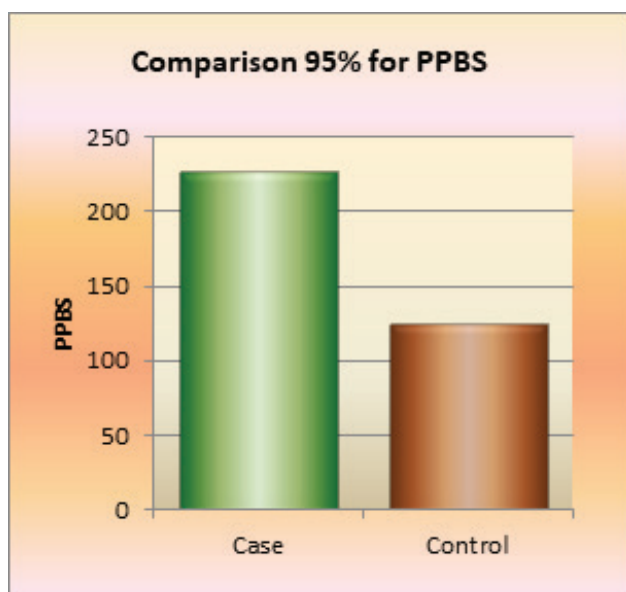


Fig No. 7

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