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Original Research

Effect Of Type 2 Diabetes-Mellitus On Pulmonary Function Test

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ABSTRACT

Background: Diabetes mellitus type 2 is associated with wide spread hormonal, metabolic and microvascular and, cardiovascular functional abnormalities which may precipitate certain complications that may affect neural, renal systems and also organs and tissues like skin, liver, collagen and elastic fibers. **Material &method:** This study describes the association of type 2 diabetes-mellitus (NIDDM) with lung function. A case-control study was conducted on 50 type 2 diabetes mellitus patients and age; sex matched 50 controls at Department of Physiology, Jhalawar medical college, Jhalawar. Cases were recruited at Department of Medicine, Jhalawar medical college & hospital, Jhalawar. These case and control group were subjected to pulmonary function test (PFT) by using computerized "MIR Spirolab III". **Result:** Among pulmonary function tests, difference in means of FEV1, PEF, FEF25-75%, and FVC/ FEV1 were found highly significant in both the group in this study. **Conclusion:** This study demonstrated that pulmonary function is significantly decreased in type 2 diabetes mellitus, independent of smoking.

Keyword: Diabetes mellitus, pulmonary function test, Peak expiratory flow rate, forced expiratory volume

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INTRODUCTION

Diabetes mellitus type 2 is a multisystem disorders that affect many organs of the body.[1] It is associated with wide spread hormonal, metabolic and microvascular and, cardiovascular functional abnormalities which may precipitate certain complications that may affect neural, renal systems and also organs and tissues like skin, liver, collagen and elastic fibers.

Globally, an estimates 422 million adults are living with diabetes mellitus, according to the latest 2016 data from World Health Organization (WHO)[2]

According to WHO (World Health Organization) 346 million people worldwide currently have diabetes with more than 80% of diabetes deaths occurring in low and middle income countries. It is projected that this will double between 2005 and 2030.[3]

According to the Indian heart association, India is projected to be home to 109 million individuals with diabetes by 2035.[4]

The most probable reason of this high incidence of diabetes in India is the rapid economical development over the last 20 years; this has resulted in the adaptation of western life style, nutritional habits and physical activity, which results in a high incidence of diabetes-mellitus. These core factors are responsible for the high incidence of diabetes in the years to come.[5]

Diabetes has micro-vascular and macro-vascular disorder with debilitating diabetic complications which had a cardiovascular nature, nephropathy, diabetic retinopathy, and neuropathy, the pulmonary complications of type 2 diabetes mellitus have been poorly characterised.

Diabetes mellitus causes early maturation, abnormal cross linkages and stiffening of the collagen and elastin fibers of connective tissues all over body. Uncontrolled diabetes mellitus with elevated blood glucose levels for Long period causes increased and rapid non-enzymatic glycation of the collagen and elastin fibres and this process also affect the lungs and central tendon of diaphragm.[6]

The alveolar capillary network in the lung is a large micro-vascular unit and may be affected by microangiopathy.[7]

AIMS AND OBJECTIVES

1. To describe the association of type 2 diabetes-mellitus (NIDDM) with lung function, and compare the following lung function with type 2 diabetes mellitus versus adults without diabetes.
   - Forced expiratory volume in first second (FEV_1)
   - Peak-expiratory flow-rate (PEFR)
   - Forced expriatory volume in first sec / Forced vital capacity (FEV_1/FVC)
   - Forced expiratory flow ($FEF_{25-75\%}$)

2. To assess the utility of lung function test as a tool, for diagnosing early complications of lung-function-abnormalities in type 2 diabetes mellitus patients.

MATERIAL AND METHODS

In this perspective the present study was conducted at the Jhalawar Medical College and associated hospital, Jhalawar, (Rajasthan) India. A case-control study was conducted on 50 type 2 diabetes mellitus patients and age; sex matched 50 controls at Department of Physiology, Jhalawar medical college, Jhalawar. Cases were recruited at Department of Medicine, Jhalawar medical college & hospital, Jhalawar, who were diagnosed to have type 2 diabetes mellitus by physician according to WHO criteria.[4]

Diabetes is defined when fasting blood glucose >=126 mg /dl, Mild -140mg/dl to 180mg/dl, moderate-180 to 250 mg/dl, severe >250mg/dl.

Methodology: simple random sampling technique. In this method every third patient coming to OPD at Department of Medicine, Jhalawar medical college & hospital, Jhalawar were chosen.

Ethical clearance: Ethical clearance was taken from departmental research committee, Department of Physiology, Jhalawar Medical College, Jhalawar as well as Institutional Ethics and Research Board of Jhalawar Medical College and associated hospital, Jhalawar.

DATA COLLECTION PROCEDURE-

Inclusion criteria:

- Age : 30 to 70 years.
- Male and female both the subjects having type 2 diabetes mellitus included in the study group.
- Normal healthy individual between 30 and 70 years of age will be taken as controls.
- Non-smoker and free from any acute/chronic pulmonary disease
- Who gives written informed consent.

Exclusion criteria:

- Extremes of ages were also excluded i.e. <30 years and >70 Years.
- Subjects between 30-70 years of age who were suffering from any diseases which directly or indirectly affects the lung functions of the subjects.
- Patients with acute complications of diabetes-mellitus like diabetic-keto acidosis, non-ketotic hyper-osmolar coma and hypoglycemia.
- Subjects with gross abnormalities of the vertebral column or thoracic cage.
- Known history of neuromuscular disease, malignancy and those who had undergone major abdominal or chest surgery.
- Smokers with regular smoking of 1 year or more and obese subjects.
- Who do not give written informed consent.

Method-

- 50 type 2 diabetic patients suffering since 10-20 years and 50 normal subjects from general population confirming the inclusion criteria was included in the study. The patients were randomly selected for the sole purpose of studying, lung function by using computerized "MIR Spirolab III". Age, height (m), weight (kg), body mass index (BMI) (Quetlet's index – weight (kg) / Height^2 (m)) of both patients and controls were measured.
- Age and height matched 50-subjects without any health ailments were selected as normal controls for the present study.
- A pretested structured Performa (Annexure 1) were used to collect the relevant information regarding clinical findings and investigation test results of patients. These patients and normal control group was subjected to pulmonary function test (PFT) by using computerized "MIR Spirolab III".
- "MIR Spirolab III" is a computerized spirometer self calibrating, which fulfils the criteria for standardized lung function tests.Detailed Pulmonary functions tests (PFTs) including forced vital capacity (FVC), forced expiratory volume in first second (FEV1), peak-expiratory flow rate (PEFR), forced expiratory flow (FEF25-75%) & FEV1/FVC were measured by MIR Spirolab III, for 3 times at every 15 minutes interval and best of 3 readings was taken in a quiet room in sitting position, according to American Thoracic Society/European Respiratory Society ATS/ERS guidelines.[5,8]

Contraindications of Spirometry in diabetic patients-

- Nausea, vomiting, headache, dizziness (these disorders affect the test performance)
- Hemoptysis of unknown origin
- Current history of any abdominal or thoracic surgery
- Current history of any limb amputation
- Current history of glaucoma or any eye surgery
- Recent history of severe chest pain, unstable angina or myocardial infarction
- Thoracic aneurysms/pneumothorax
- Diabetic patients with a history of HIV/hepatitis B/hepatitis C (because of high risk of transmission of infection. However, spirometry can be performed after taking high standard sterilizing measures)

STATISTICAL ANALYSIS:

Statistical analysis of data is done by help of SPSS 20.0 Software (trail Version).And Significance of difference of pulmonary parameters in both the groups was inferred with Unpaired 'T' Test and Chi square test is use in data analysis.

OBSERVATION & RESULT

In the present study difference in means of age, BMI between cases and controls were not significant (P>0.05) (Table 1) while mean of serum glucose level were significant.(Table 2)

Among pulmonary function tests, difference in means of FEV1, PEF, FEF25-75%, and FVC/ FEV1 were found highly significant in both the group in this study. Means of FEV1, PEF, FEF25-75%, were found significantly less whereas FVC/ FEV1 were found significantly more in cases group (Table3) Furthermore, PEF, FEF25-75%, FVC/ FEV1 were not found to be associated with severity and duration of illness whereas FVC and FEV1 were found to be associated with duration of illness. There was no linear correlation found between–PFT and duration of illness where FVC and FEV1 both were found minimum in 15-20 years old DM whereas both of the tests were found maximum in 10-15 years old DM (Table3)

Table 1: Distribution of Age according to Groups

	Group	N	Mean AGE	Std. Deviation	T value	P value
AGE(YEARS)	Case	50	53.1800	12.14150		
	Control	50	54.7000	11.20723	0.650	0.517

Table 2: Distribution of Serum glucose level (mg/dl) according to Groups

	Group	N	Mean	Std. Deviation	P value
SERUM GLUCOSE LEVEL(mg/dl)	Case	50	177.2600	40.07229	
	Control	50	91.1000	13.28226	<0.0001*

Table 3: Pulmonary Function Tests Comparison of Cases with Controls

	Group	N	Mean	Std. Deviation	P value
FEV1(L)	Case	50	1.6094	.64626	
	Control	50	2.0156	.86998	0.009*
FEV1/FVC%	Case	50	77.7980	10.98196	
	Control	50	81.8260	45.10710	0.541
PEF(L/s)	Case	50	4.7100	1.86093	
	Control	50	5.6468	2.48681	0.035*
FEF25-75%(L/s)	Case	50	1.7100	1.03901	
	Control	50	2.2374	1.34422	0.031*

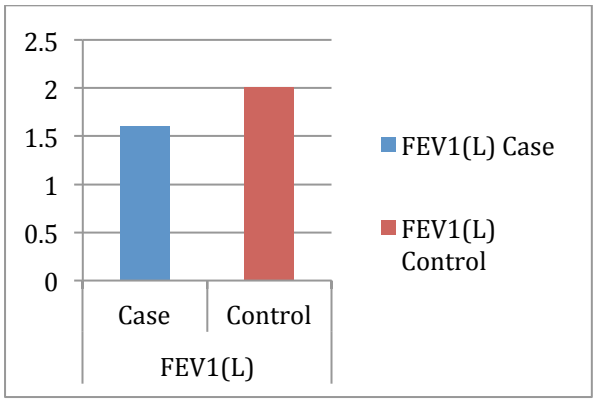

Fig 1: **Depicting comparison of FEV1 (L) in case & control**

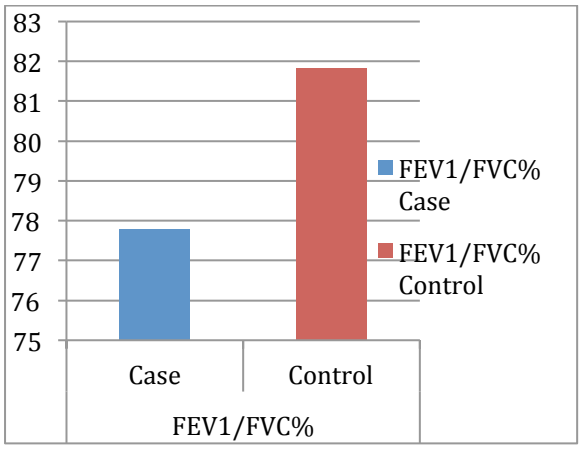

Fig 2: Depicting comparison of FEV1/FVC in case & control

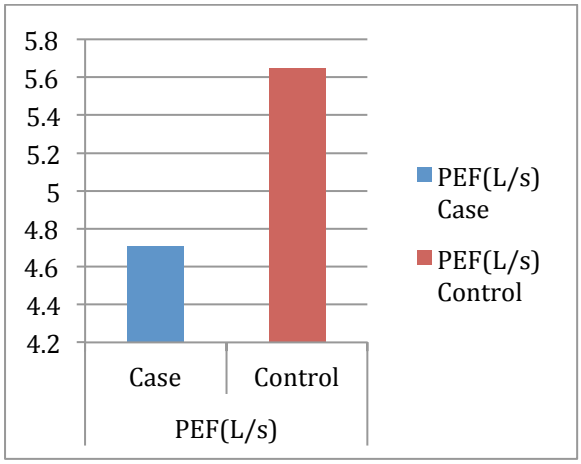

Fig 3; **Depicting comparison of PEF(L/s) in case & control**

DISCUSSION

The present study was conducted in the Department of physiology, Jhalawar medical college & hospital, Jhalawar (Rajasthan) in collaboration with Department of Medicine to observe the alterations in lung functions in patients with Diabetes Mellitus. Various observations depending on duration of disease and pulmonary function impairment were analysed.

Physical Parameters:-

The mean age is comparable in case & control. There is no significant difference between the mean age of case and control (p = 0.517).

Forced Expiratory Volume In One Second (FEV1):-

The fraction of the vital capacity expired during the first second of a forced expiration is referred to as FEV1. In the present study, the mean value of FEV1 were 1.60 litres, 2.01 litres in case, control respectively (table 3).

FEV1/FVC Ratio:-

FEV1/FVC% is the volume of air expired in the first second, expressed as percentage of FVC. It is more sensitive indicator of airway obstruction than FVC or FEV1. In the present study, the mean value of FVC/FEV1% were 77.79%, 81.82% in case & control group respectively (table 3).

Our observations are quite in agreement with Nandhini R et al who reported there was a rough decrease in the values of FEV1/FVC in diabetes as compared to that in non diabetics, though it didn"t reach a statistical significance.[9]

Peak expiratory flow (PEF):- Lung Function data for type 2 diabetes patients (case), healthy persons (control) are shown in table 3 with mean PEFR in case group (4.71) and that of control group (5.64).Type 2 diabetic patients had statistically significant reduction in PEFR (P =0.035).

Pulmonary function testing has been a major step forward in assessing the functional status of the lungs. In our study restrictive type of lung function defects were observed in DM type 2 patients, other authors also had reported similar findings.[10,11]

Present study showed that all the pulmonary parameters, that is FEV 1 , FEF 25-75 , and PEF were significantly reduced, however there was no significant difference in FEV1/FVC ratio. Pulmonary function pattern which we got in diabetic patients were mainly restrictive pattern (58 %) which has significant compared to that of control. We got obstructive and mixed pattern in 10% and 16 % of the cases however it was not significant compared to control. Normal pattern was seen in 56 % of the control in contrast to only 16 % of the control. Thus in this study findings were suggestive of restrictive pattern except FEV 1 /FVC in patients of type 2 DM as compared with the healthy controls ($P <$ 0.0001). The ratio FEV 1/FVC is greater in diabetic patients ($P > 0.05$). Similar findings were also seen in DM type 2 by some authors.[12,13] Meo(2006) observed that lung function parameters like forced vital capacity (FVC), forced expiratory volume in one second (FEV1), FEV1/FVC ratio, have shown a significant reduction in type 2 diabetes of longer duration.[12]

Some authors like Verma et al also reported that there is a significant average reduction in FVC, and FEV1 in type 2 diabetic patients, and it is also demonstrated that peak expiratory flow rate (PEFR) and forced expiratory flow in 25-75% (FEF25%-75%) may be lower in diabetics, which is inversely relxated to the duration of the disease.[14]

DM being a systemic disease, which also affects lungs causing restrictive type of ventilatory changes, because of glycosylation of connective tissues, reduced pulmonary elastic recoil and inflammatory changes in lungs. The histopathological changes in the lungs of diabetics are associated with the thickening of the alveolar epithelium and the pulmonary capillary basal lamina and also due to the reduced recoiling of the lung.[15] This is caused by biochemical alteration of connective tissue constituents, particularly collagen and elastin. There is increased cross-linkage formation between polypeptides of collagen which leads to thickening, leading to restriction of lung volume and alveolar gas transport, reduced membrane diffusion capacity and pulmonary capillary blood volume.[16,17]

CONCLUSION

This study was conducted to determine the influence of duration and severity of type 2 diabetes mellitus on pulmonary function test. This study included a total of 100 subjects amomg them 50 were healthy control group and 50 were type 2 diabetes patients in the age group of 30-70 years from O.P.D. of Department of Medicine, Jhalawar Medical College, Jhalawar.
Pulmonary function tests were measured by MIR Spirolab III spiromete
According to our study, there was a significant reduction of FEV1 and PEFR and normal FEV1/FVC%. From the results of this study following conclusions were drawn:-

1. This study demonstrated that pulmonary function is significantly decreased in type 2 diabetes mellitus, independent of smoking. Reduced lung functions were of particularly restrictive pattern and more in long durational diabetes mellitus.

2. There is a need for periodically assessing the pulmonary function in type 2 diabetes mellitus and spirometry remains a cost effective, a simple non-invasive diagnostic tool and its judicious use can give warning signal for patients to take early preventive measures.

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