

Impact of type – II diabetes mellitus on forced vital capacity

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Abstract

Introduction: Diabetes mellitus is a metabolic disorder characterised by hyperglycemia and affecting multisystem organs of the body. In Lungs, diabetes causes thickened alveolar epithelium and capillary basal lamina leading to decrease elastic recoil and lung volume. So, present study is done to evaluate the impact of type - II diabetes mellitus on Forced Vital Capacity (FVC).

Materials and Method: 40 known diabetic patients having diabetes for more than 5 years and 40 healthy controls of both sexes were taken from October 2010 to September 2012. Age, sex, height, weight and Body Surface Area (BSA) were recorded and matched for both cases and controls. Computerized Spirometry was performed for both cases and controls. FVC values were recorded, compared and analysed by using student t-test.

Result and Conclusion: FVC was found to be decreased in Type-2 diabetes mellitus, which was statistically significant thus indicating restrictive pattern of lung disease.

Keywords: Diabetes, type - II diabetes, Forced Vital Capacity (FVC), Body Surface Area (BSA).

Introduction

Diabetes mellitus is a metabolic disorder characterised by hyperglycemia and affecting multisystem organs of the body. In type - I diabetes mellitus there is absolute deficiency of insulin secretion. In type - II diabetes mellitus there is a combination of resistance to insulin action and inadequate compensatory insulin secretory response.⁽¹⁾ Incidence of type - II diabetes mellitus has been steadily increasing in urban and rural areas due to change in lifestyle and ethnic susceptibility. This metabolic disorder is a risk factor for precipitating microvascular pathologies leading to autonomic neuropathy, nephropathy, retinopathy and peripheral neuropathy; and macrovascular pathologies leading to coronary artery disease, cerebrovascular accidents and peripheral vascular disease.⁽²⁾ Involvement of lung as a target organ in diabetes mellitus is receiving continuous attention all across the world.⁽³⁾ Therefore this study was undertaken to find out the effects of type II diabetes mellitus on force vital capacity (FVC).

Materials and Methods

The present study was conducted at Department of Medicine, Kamineni Institute of Medical Sciences (KIMS) and Hospital, Narketpally from October 2010 to September 2012. In this study, 40 known type - II diabetic patients having diabetes for more than 5 years were taken as cases and 40 age and sex matched subjects were taken as controls. Written consent was taken from both cases and controls. Also, permission from the ethical committee has been taken prior to the

study. The subjects with smoking, hypertension or suffering from any cardiorespiratory diseases were excluded. Age was recorded in years. Height was recorded in centimetres (cm) by measuring tape. Weight was recorded in kilograms (kgs) with the help of Krups weighing machine. Body surface area (BSA) in meter square (m²) was calculated by Mosteller formula - $BSA (m^2) = ([Height(cm) \times Weight(kg)] / 3600)^{1/2}$. Subjects were sent for routine blood sugar investigation i.e. fasting, post-prandial (2 hours after meal) blood sugar levels and glycated haemoglobin (HbA1c) in Biochemistry laboratory, KIMS hospital. Blood sugar was estimated by Glucose oxidase - peroxidase (GOD - POD) method and HbA1c was estimated by using Turbidimetric inhibition immunoassay principle. FVC, defined as the maximum volume of air expired forcefully and rapidly after a maximal inspiration to the level of total lung capacity, was measured in litres by using Medspiror (a self-calibrating computerized spirometer), for three times at every 15 minutes interval and best of three recording was taken. Statistical analysis was done by using student t-test. The Statistical software SPSS version 19 was used for the analysis of the data.

Observations and Results

Table 1 shows the gender distribution and basic characteristics of cases and controls. 62.50% of the study subjects were males whereas 37.50% were females. Age, Height, Weight and BSA of male cases with male controls and female cases with female controls were matched (p>0.05).

Table 1: Basic characteristics of cases and controls

Basic characteristics	Case (n=40)		Control (n=40)		Significance
	Male (Mean±SD)	Female (Mean±SD)	Male (Mean±SD)	Female (Mean±SD)	
Number of Individuals	25 (62.50%)	15 (37.50%)	25 (62.50%)	15 (37.50%)	p>0.05
Age in years	47.00± 6.70	46.27±7.08	47.28 ±6.69	45.67±6.89	p>0.05
Height in cm	166.24±6.17	161.80±5.21	163.96 ±7.28	158.00±8.25	p>0.05
Weight in kg	58.20±7.04	52.33±5.79	60.28±9.81	50.07±5.16	p>0.05
BSA in m ²	1.63±0.11	1.56±0.11	1.64±0.15	1.49±0.10	p>0.05
Inference Samples age, sex, height, weight and BSA are matched (p>0.05)					

Table 2 shows the blood glucose level of cases and controls. From the table it is clear that blood glucose level of male and female cases differs significantly with male and female controls.

Table 2: Blood sugar levels of cases and controls

Basic characteristics	Case (n=40)		Control (n=40)		Significance
	Male (Mean±SD)	Female (Mean±SD)	Male (Mean±SD)	Female (Mean±SD)	
FBS (mg/dl)	176.12±66.23	174.07±72.36	89.40±11.39	82.27±7.82	p<0.05
PPBS (mg/dl)	249.76±89.00	260.20±102.43	117.96±12.13	111.13±10.01	p<0.05
Inference p < 0.05 is significant					

From Table 3, it is clear that all cases were diabetic for more than 5 years with abnormal mean HbA1C levels.

Table 3: Duration and HbA1c levels of male and female cases

Basic characteristics	Case (n=40) M=25 F=15	
	Male (Mean±SD)	Female (Mean±SD)
Duration in years	7.36±2.18	7.60±2.23
HbA1C in %	7.65±1.94	7.90±1.19

Normal value for HbA1C = 4.8–6%

Table 4 shows the impact of type – II diabetes mellitus on force vital capacity. The mean FVC for male cases (2.55 litres) was found to be significantly different (p<0.05) from that of male controls with mean FVC value of 3.43 litres. The mean FVC for female cases (2.01 litres) was found to be significantly different (p<0.05) from mean FVC value of female controls (2.86 litres). Thus, FVC was found to be decreased significantly in diabetic cases as compare to controls.

Table 4: Impact of Type-2 diabetes mellitus on Force vital capacity

PFT	Cases (n=40)		Controls (n=40)		Mean difference	p-value
FVC	Range	Mean±SD	Range	Mean±SD		
Male	1.62-3.88	2.55±0.55	2.20-4.90	3.43±0.56	880 ml	p<0.05
Female	1.40-3.27	2.01±0.47	1.94-3.7	2.86±0.55	850 ml	p<0.05

p < 0.05 is significant

Discussion

The present study was undertaken to find out the impact of Type-II diabetes mellitus on FVC. Forced Vital Capacity of Type-II diabetes mellitus patients and controls were recorded, compiled, analysed and they were statistically compared by using student t-test.

In the present study FVC was significantly decreased in diabetic cases as compare to controls. This is in accordance with majority of researchers.^(4,5,6,7,8) However, Benbassat et al⁽⁹⁾ observed the FVC value within predicted values which contradicts with the findings of present study. The reason for this

contradiction may be attributed to the fact that they had not compared their results with matched controls.

Walter E et al⁽⁴⁾ studied the relationship between diabetes mellitus and pulmonary function. They noted a decrease in FVC by 109 ml/ year in diabetes mellitus.

In a study done by Lange P et al,⁽⁵⁾ it was observed that there was slight reduction in FVC in type II diabetic patients. The newly developed diabetes mellitus patients had twice as high decline in ventilatory functions and this according to authors might be due to cross-linking of pulmonary collagen.

Davis M.E. Timothy et al⁽⁶⁾ in his study found an average decrease of 9.5% in FVC values for diabetics.

A study which was done by Mahadeva Murthy et al⁽⁸⁾ reported that FVC was significantly reduced by 200 ml in male diabetics and by 240 ml in female diabetics.

Anand Dharwadkar et al⁽¹⁰⁾ in their study showed significant decrease in FVC in type 2 diabetic patients by 135 ml.

In a study done by Muhammad Irfan et al⁽¹¹⁾ there was significant reduction in FVC by 360 ml in diabetic patients as compared to non-diabetic controls.

Bhavneesh Sharma et al⁽¹²⁾ and Kaur S et al⁽¹³⁾ in their study concluded that FVC was significantly reduced in type 2 diabetic patients.

Shah S et al⁽¹⁴⁾ predominantly emphasize restrictive pattern of dysfunction in their study.

This all suggests that type II diabetes mellitus adversely affects the FVC.

Review of literature suggested that in diabetes mellitus there occurs thickening of the alveolar epithelium and pulmonary capillary basal lamina leading to pulmonary microangiopathy. There is impaired diffusion due to decreased blood volume. Also there occurs reduced pulmonary elastic recoil caused by non-enzymatic glycosylation of the connective tissue which reduces the FVC in diabetics and hence responsible for restrictive respiratory defects.⁽³⁾

Increased cross linkage formation between polypeptides of collagen in pulmonary connective tissue, increased susceptibility to respiratory infections in diabetic patients also contributes to reduction in FVC.^(15,16)

Conclusion

FVC was found to be statistically decreased in Type-2 diabetes mellitus patients as compared to controls thus indicating restrictive pattern of lung disease. Lack of knowledge about diabetes and its deadly complications attributes to its more prevalence in rural India. Chronic diabetic patients must be screened for pulmonary functions along with other routine investigations to prevent long term complications as pulmonary dysfunction may be one of the earliest and easily measurable non metabolic alterations in diabetes.

References

1. Alvin C Powers. Diabetes Mellitus. In Harrison's Principles of Internal Medicine, 2005; 16th edition, vol. 2: 2152-2162, 2170-2172.
2. Alberti, Zimmet PZ. Definition, diagnosis and classification of diabetes mellitus and its complications (part 1). Diabetic medicine, 1998;15:539-555.
3. Sandler, Malcolm. Is the lung a 'target organ' in diabetes mellitus. Arch Intern med 1990;150:1385-1388.
4. Walter E Robert. Alexa Beiser, Rachel J. Givelber, George T. O'Connor, and Daniel J. Gottlieb. Association between glycemic state and lung function. Am J Respir crit care med. 2003;167:911-916.
5. Lange P, Groth S, Kastrop J, Mortensen J, Appleyard M, Nyboe J, et al. Diabetes mellitus, plasma glucose and lung function in a cross sectional population study. Eur. Respir J. 1989;2(1):14-19.
6. Davis A Wendy, Matthew Knuiman, Peter Kendall, Valerie Grange, Timothy M.E. Davis. Glycemic Exposure is associated with Reduced Pulmonary Function in Type-2 Diabetes. Diabetes care 2004;27:752-757.
7. Sanjeev Verma, Mumtaz Goni, Rattan P Kudyar. Assessment of Pulmonary Functions in Patients with Diabetes Mellitus. www.jkscience.org. JK SCIENCE Vol. 11 No. 2, April-June 2009:71-74.
8. Mahadeva Murthy et al. "Changes in lung function tests in type-2 diabetes mellitus." International journal of Basic Medical Sciences – June 2012;3(2):54-61.
9. Benbassat Carlos A, Evin Stern. PFT in patient with diabetes mellitus. The Am J med sci 2001;322(3):127-132.
10. Anand Dharwadkar, Asha Dharwadkar et al. "Reduction in lung functions in type-2 diabetes in Indian population: correlation with glycemic status." Indian J Physiol Pharmacol 2011;55(2):170-175.
11. Muhammad Irfan, Abdul Jabbar, Ahmed Suleman Haque, Safia Awan, Syed Fayyaz Hussain. "Pulmonary functions in patients with diabetes mellitus." Lung India 2011;28(2):89-92.
12. Bhavneesh Sharma, Mradul K. Daga, Nitin Tiwari and Manisha Kaushik. "Pulmonary Dysfunction in Type 2 Diabetes Mellitus Patients with Incipient Diabetic Nephropathy and Effect of Glycemic Control and Losartan Therapy on Pulmonary Function". <http://chestjournal.chestpubs.org>. Clinical Application of PFTs, 2003 by the American College of Chest Physicians.
13. Kaur S, Agarwal N. Pulmonary function tests in type 2 diabetes mellitus. Arch Med Health Sci 2016;4:35-9.
14. Shah S, Sonewane P, Nahar P, Vaidya S, Sethi S. Pulmonary function tests in type 2 diabetes mellitus and their association with glycemic control and duration of the disease. Lung India 2013;30:108-12.
15. Keerthi Shravya G, Singh Saran B M, Bandi Hari k, Suresh M, Preetham JK, Reddy M. Deterioration of Pulmonary Functions in Type 2 Diabetes Mellitus. IOSR. Journal of Pharmacy and Biological Sciences (IOSRJPBS) 2012;1(1):39-43.
16. Fine MJ, Smith MA, Carson CA, Mutha SS, et al. Prognosis and outcomes of patients with community acquired pneumonia: a meta-analysis. JAMA. 1996;275:134-41.