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Diabetes Mellitus and Its Relation with Pulmonary Function: A Cross-Sectional Study

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ABSTRACT

Introduction: Impaired respiratory functions have been found associated with diabetes mellitus. Moreover, reduced respiratory functions in diabetic patients have been reported in various studies. Therefore the present study was designed to investigate the pulmonary functions in type 2 DM patients.

Materials and Methods: Two hundred ten previously diagnosed with DM on the basis of fasting blood sugar (FBS) >126 mg/dl, random blood sugar (RBS) >200 mg/dl were included in the group I for the study. One hundred non-diabetic, same age and sex-matched subjects were included as a control in group II for the study. Measurements of forced vital capacity (FVC), forced expiratory volume in one second (FEV1) and the ratio of FEV1/FVC were done by using spirometer.

Results: FVC was significantly low 2.56±0.64 vs 2.94±0.76 in group I DM patients in comparison of control subjects of group II. Similarly, a significantly low FEV_1 (2.13±0.43 vs 2.46±0.54) was recorded in group I compared to group II. Further, there was an insignificant difference between FEV_1/FVC and MMEF of both groups. SVC (2.72±0.84 vs 2.94±0.94, p<0.04) was significantly low in DM patients in contrast to control subjects.

Conclusion: This study suggests that poor lung functioning is one of the important complication of DM. Further, finding of the present study shows impaired lung functioning was common in DM patients which can be a potential threat for development of a various type of lung diseases in future. Therefore, we strongly advocate for evaluation of lung functions during the treatment of DM especially in chronic cases for early detection of lung abnormalities.

Keywords: Diabetes Mellitus, Pulmonary Function, Forced Vital Capacity, Spirometer.

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INTRODUCTION

Impaired respiratory functions have been found associated with diabetes mellitus.[1] Moreover, reduced respiratory functions in diabetic patients have been reported in various studies.[2,3] Diabetes Mellitus (DM) is considered as a metabolic disorder which is characterized by constantly high blood sugar level, impaired insulin functions or secretion results in abnormal carbohydrate, protein and lipid metabolism. Chronically, it results in macro and microangiopathy which affects negatively the function and structures of internal organs.[4] WHO has suggested that presently 346 million people are suffering from DM among them 80% of causality due to DM occurs in developing countries. Further, the report reveals that this rate of death will be double up to 2030.[5]

Higher blood sugar level in type 2 DM induces various types of infections in different organs among them there is increased the risk of bronchitis, pulmonary abscess, bronchiectasis etc. This may decrease the pulmonary functions in type 2 DM patients.[2,3,6,7] Impaired glycemic control in type 2 DM patients leads to higher level of elastin and collagen in lungs which results in stiffness of parenchyma of lungs as well as thorax.[8] Therefore the present study was designed to investigate the pulmonary functions in type 2 DM patients.

MATERIALS AND METHODS

The present cross-sectional study was carried out in the study was in the medicine department of KD Medical College & Research Centre, Mathura, Uttar Pradesh, India. The study was approved by the institutional ethical committee. Two hundred ten previously diagnosed with DM on the basis of fasting blood sugar (FBS) >126 mg/dl, random blood sugar (RBS) >200 mg/dl were included in the group I for the study. One hundred non-diabetic, same age and sex-matched subjects were included as a control in group II for the study. Subjects suffering from asthma, bronchitis, chronic obstructive pulmonary (COPD), and any type of chronic diseases were excluded from the study. Informed written consent of the participants was taken before they participated in the study.

Anthropometric Measurement

All the anthropometric measurements including weight (kg) by using a weighing scale, height by height meter following protocol. Body mass index (BMI) was calculated by using the formula weight/height in all subjects.

Pulmonary Function Test

Pulmonary function test was done under the supervision of a physician by a trained spirometrist. The pulmonary function test included measurements of forced vital capacity (FVC), forced expiratory volume in one second (FEV1), Peak Expiratory flow rates (PEFR), the ratio of FEV1/FVC, slow vital capacity (SVC) and maximum mild expiratory flow (MMEF). Test of pulmonary functions was done by using spirometer spirotrac intuitive version V manufactured by Vitalograph UK and it was daily calibrated with 1-litre syringe. Patients were instructed to place mouthpiece attached to the spirometer in mouth tightly and avoiding the leakage of air. The patients were asked to inspire maximum and then expire forcefully at once through the mouth piece into the spirometer. The highest of the three readings were accepted as the measurement for the patient. FEV1/FVC >70%, FEV1/FVC < 70% were considered as normal and obstructive respectively. Restrictive ventilatory defect if the ratio of FVC <80% and FEVI/FVC >70% whereas, mixed ventilatory defect if FEV1/FVC < 70% and the ratio of obtained FVC > 80% were diagnosed.

Table 1: Anthropometric and biochemical parameters of both groups.

Variables	Group I	Group II	Mean difference	p value
Age (years)	52.66±11.22	53.12±12.14	0.46	<0.97
BMI (Kg/m²)	24.22±3.43	24.48±4.12	0.26	<0.26
SBP (mm Hg)	128.4±6.48	124.6±7.32	3.8	<0.04
DBP (mm Hg)	88.74±6.7	84.5±8.4	4.24	<0.038
FBS (mg/dl)	168±18.59	106±13.62	62	<0.001
RBS (mg/dl)	225±28.27	114±10.22	111	<0.001
TC (mg/dl)	193.8±20.6	199.8±17.6	-4.5	<0.04
TG (mg/dl)	185.5±21.2	165.9	19.6	<0.001
LDL (mg/dl)	117.4±18.19	127.4±16.4	-10	<0.05
HDL (mg/dl)	36.8±6.32	39.61±7.6	-3.19	<0.03

BMI=basal metabolism rate, SBP= systolic blood pressure, DBP= diastolic blood pressure, FBS=fasting blood sugar, RBS= random blood sugar, TC= total cholesterol, TG= triglycerides, LDL= low density lipids, HDL= high density lipids.

Table 2: Pulmonary function test in both groups

Variables	Group I	Group II	Mean difference	p value
FVC	2.56±0.64	2.94±0.76	-0.38	<0.003
FEV_1	2.13±0.43	2.46±0.54	-0.33	<0.003
FEV_1/FVC	83.42±7.33	83.59±8.64	0.17	<0.65
SVC	2.72±0.84	2.94±0.94	-0.22	<0.04
MMEF	2.56±1.06	2.45±1.13	0.11	<0.85

FVC= forced vital capacity, FEV_1= forced expiratory volume in one second, SVC= slow vital capacity, MMEF= maximum mild expiratory flow.

RESULTS

Results of the present study revealed that there was an insignificant difference between the age and of both group participants. However, systolic blood pressure and diastolic blood pressure showed a significant difference. Further, it is evident from table 1 that there was a significant difference in the FBS ($p<0.001$) and RBS ($p<0.001$) of group I patients in comparison of group II non-diabetic subjects. TC, LDL and HDL were significantly low in group I patients whereas, TG was significantly high in group I subjects.

Table 2 shows that FVC was significantly low 2.56±0.64 vs 2.94±0.76 in group I DM patients in comparison of control subjects of group II. Similarly a significantly low FEV_1 (2.13±0.43 vs 2.46±0.54) was recorded in group I compare to group II. Further, there was an insignificant difference between FEV_1/FVC and MMEF of both groups. SVC (2.72±0.84 vs 2.94±0.94, $p<0.04$) was significantly low in DM patients in contrast to control subjects.

DISCUSSION

Finding of the present study showed that TC, LDL, HDL were significantly low whereas, TG was significantly high in DM patients in comparison of control subjects which are consistent with the findings of previous study of Sinha et al.[10] This difference of lipid profile may have some relation with decreased pulmonary functions in DM patients as Sinha et al[10] observed a significant relation between pulmonary diffusion capacity for carbon monoxide and TG.

Further, finding of the current study revealed that pulmonary functions to diabetic patients were decreased in comparison of same age and sex-matched control subjects. There was a significant difference in FVC, FEV1, and SVC of diabetic patients in contrast to control subjects. However, there was an insignificant difference between FEV_1/FVC and MMEF of diabetic patients and control subjects. These findings are consistent with the previous studies of Devis WA et al,[2] Meo SA et al,[3] and Cooper BG et al.[7] Devis WA et al recorded a significant decrease of VC, FVC, FEV1,

and PEF in type 2 diabetic patients in their large community-based study in Western Australia. Meo SA *et al*.[3,11] reported a significant decrease in FVC, FEV1, and PEF in comparison of same age and sex-matched controls in their studies on diabetic patients of Saudi Arabia. Moreover, a strong association of diabetes duration and impaired pulmonary function was recorded in the same study. Similarly, Schnack C et al,[12] Innocenti F,[13] Primhak RA[14] and Matsubara T[15] observed significantly reduced pulmonary functions in DM patients in contrast to control subjects. Asanuma et al[16] also observed that FVC and FEV1 were significantly reduced in diabetic patients of Japan in comparison of control subjects. In contrast to the present study, Sinha et al[10] did not observe any significant difference between pulmonary functions of diabetic patients and control subjects.

This decrease of pulmonary function seems due to fibrosis and basal lamina thickness of lungs during diabetes.[17,18] Further, it has been suggested in reports that long-term higher level of blood sugar in diabetic patients induces changes in connective tissue especially elastin and collagen which results in stiffness of lungs.[11,19,20] Further, these structural changes of lungs including thickness of alveolar basal lamina in diabetics leads to impaired lung functions.[21] Chronic complications of diabetes mellitus likely include the decrease air flow due reduction in lung volumes.[2]

An important and significant finding of the current study is that systolic blood pressure and diastolic blood pressure were significantly high in DM patients in comparison of control non-diabetic subjects which is consistent with previous studies of Devis WA et al[2] and Sinha S et al.[10] These findings suggest that hypertension may be one of the important predictors of abnormal lung function among DM patients. Overall wellness of DM patients may be improved by adequate blood pressure control which can further improve lungs functioning in DM patients.[22]

CONCLUSION

This study suggests that poor lung functioning is one of the important complication of DM. Further, the finding of the present study shows impaired lung functioning was common in DM patients which can be a potential threat for development of various type of lung diseases in future. Moreover, adequate control of blood sugar level as well as hypertension management can decrease the risk of abnormal lung functions in DM patients. Therefore, we strongly advocate for evaluation of lung functions during the treatment of DM especially in chronic cases for early detection of lung abnormalities. However, studies on larger population are required to make a generalized policy to take care of lungs health in DM patients.

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