

Original Research Article

Evaluation of pulmonary functions in patients of type-2 diabetes mellitus

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ABSTRACT

Background: The review of literature revealed conflicting documentation regarding the effect of type-2 DM (diabetes mellitus) on pulmonary functions. Some authors have reported normal pulmonary functions and even concluded that spirometry testing is not at all necessary in diabetic patients. Some studies have shown abnormal pulmonary functions in patients of DM. Moreover, the duration of DM and glycemic control have varied impact on the pulmonary functions. The present study was undertaken to resolve the conflict and also to explore the pulmonary functions in type-2 diabetics of this cross section of population.

Methods: The pulmonary function tests FVC, FEV1, FEV3, PEFR and MVV were performed in 50 type-2 diabetics and 50 controls by computerized medspiror using standard laboratory methods. The data was documented statistically analyzed. By giving suitable class intervals, intra-diabetic groups were made to assess the effect of extent duration of diabetics on pulmonary function test.

Results: Pulmonary functions FVC, FEV1, FEV3, PEFR and MVV were decreased in type-2 diabetes mellitus. Duration of type 2 DM was significantly associated with decrease in FVC, FEV1%, PEFR and MVV.

Conclusions: Longer duration of type 2 diabetes is significantly associated with reduction in pulmonary functions FVC, FEV1%, PEFR and MVV which underlines the respiratory system as one of the target organs of type-2 diabetes mellitus.

Keywords: DM, FVC, MVV, Pulmonary functions, PEFR

INTRODUCTION

Diabetes mellitus is accompanied by wide spread biochemical, morphological and functional abnormalities which may precipitate certain complications that affect the renal, cardio-vascular, nervous systems and also skin, liver, collagen and elastic fibers. Thus diabetes is a multisystem disorder that affects many organs of the body.¹ This metabolic disorder is a risk factor precipitating micro vascular pathologies leading to autonomic neuropathy, nephropathy, retinopathy and peripheral neuropathy, and macro vascular pathologies leading to coronary artery disease, cerebrovascular

accidents and peripheral vascular disease. The micro vascular complications appear early, within 5 to 10 years and macro vascular complications appear within 15 to 20 years from the onset of diabetes.² Pulmonary functions are reduced in type 2 DM and duration of diabetes has more influence on pulmonary functions than glycemic control.³ If diabetes is detected early and adequate steps are taken, it may be possible to significantly delay the occurrence of complications and thereafter the progression.

There are histopathological changes seen in lungs of diabetics such as thickened alveolar epithelial and

pulmonary capillary basal lamina leading to reduced pulmonary elastic recoil and lung volume. There is impaired diffusion due to reduced pulmonary capillary blood volume and thickening of the basement membrane. Non-enzymatic glycosylation induced alteration of lung connective tissue is the most likely mechanism underlying the mechanical pulmonary dysfunction in diabetic subjects. This suggests that lung should also be considered as target organ for damage in diabetes mellitus.⁴

Pulmonary complications of diabetes mellitus (DM) have been poorly characterized. Some authors have reported normal pulmonary functions and even concluded that spirometry is not at all necessary in diabetic patients. Some studies have shown abnormal respiratory parameters in patients of DM. Moreover, the duration of DM and glycemic control have varied impact on the pulmonary functions.

Hence this study is undertaken to analyze the effect of duration of type 2 diabetes on various pulmonary function parameters.

METHODS

This is a study of lung function in diabetics compared with age and sex-matched non-diabetic controls conducted at tertiary care center. 50 non-smoker type 2 diabetic patients and 50 age and sex matched healthy non-smoker controls were selected from relatives of diabetic patients visited to medicine outpatient department (OPD). Study was conducted over a period of one year. Subjects of both the sexes were included in the study. All the subjects were in the age group of 35-55 years. Every second subject was selected by systematic random sampling both from cases and controls, to avoid selection bias.

The type 2 diabetic patients having different duration of diabetes were included and they were divided in to three groups according to duration. The subjects below 35 years and above 55 years were excluded. Smokers and subjects with acute or chronic respiratory disease were excluded. Also the subjects having major neuropathy and major cardiac diseases like IHD, RHD, were excluded.

We had given patient information sheet to each subject and explained the procedure of test to each subject. We took written informed consent in prescribed format from each subject. Both study and control groups were studied for anthropometric and pulmonary functions parameters.

Age was measured in years and height was measured by standard technique with bare feet by a measuring tape in meters. Weight was measured by a standard weighing scale and recorded as Kg. Body mass index was calculated by using formula weight divided by height in meters square.

Further a preliminary clinical examination was carried out on selected subjects to rule out any medical problem.

Pulmonary functions were performed on the computerized Medspiror using standard laboratory methods. Medspiror, recorders and Medicare system (RMS) is manufactured by Chandigarh. The parameters studied were FVC, FEV1, FEV3, PEFR and MVV. Before each test the subjects were familiarized with the machine and a detailed instruction cum demonstration up to the satisfaction was done. All the procedures were carried out in sitting position in respiratory laboratory during morning hours between 8 AM and 11 AM, in a quite environment to avoid emotional and psychological stresses. During the tests the subjects were adequately encouraged to perform at their optimum level and also a nose clip were applied during the entire maneuver. Test was repeated at least 3 times and the best results were considered for analysis. The FVC, FEV1, FEV3, MVV and PEFR were recorded and the values best of the three were taken into account.

The master charts containing this data of 50 diabetics and 50 control subjects were prepared, statistical treatment is given by Student 't' test which has been used to find the significance difference of PFT parameters between healthy control and type-2 DM group. The Mann Whitney U test test, a non-parametric test has been used to find the significance difference of FEV1 to FVC between cases and controls. Analysis of variance has been used to find the significance of PFT for duration of type-2 diabetes mellitus.^{5,6}

The results were entered on a Microsoft Excel spreadsheet and were analyzed by using SPSS version 10.0 software.

RESULTS

The master charts of cases and controls were prepared and rearranged as per requirement of the parameters discussed, and the subjects were regrouped into subgroups of the parameters discussed. The mann whitney U test, a non-parametric test has been used to find the significance difference between cases and controls. Analysis of variance has been used to find the significance of PFT for duration of type-2 diabetes mellitus.

Kruskal Wallis test has been used to find the significance of ratio between different duration of type-2 diabetes mellitus. Total 50 (n = 50) cases and 50 (n = 50) controls were studied. Total numbers of male and female cases included in study were 68% and 32% respectively.

The effect of type-2 diabetes mellitus on different parameters of pulmonary function test is shown in the Table 1 and Table 2.

Table 1: Basic characteristic/ anthropometric parameters.

Basic parameters	Case (n = 50) Mean±S.D.	Control (n = 50) Mean±S.D.	Significance (p value)
Age in years	45.60 ± 6.47	45.9±6.34	0.8007 ^{MW}
Sex	M: 68 % ; F: 32 %	M: 68 % ; F: 32 %	1.0000 ^{MW}
Height in cm	163.7±7.523	163.8±7.72	0.8281 ^{MW}
Weight in kg	66.96±11.28	67.62±11.38	0.771 ^t
BMI	24.98±3.6	25.19±3.83	0.4993 ^{MW}
Inference	Samples are age, sex, height, weight and BMI; matched (P >0.05) i.e. non-significant.		

MW: Mann-Whitney U test; t: Student t test

Table 2: PFT in duration wise subgroups of type 2 diabetes mellitus.

PFT (PFT in L / min)	Duration of DM years (Mean±SD)			P value
	5-6	6-10	>10	
FVC	3.60±0.45	3.20±0.48	2.97±0.29	P = 0.002*
FEV 1	2.97±0.36	2.66±0.37	2.49±0.23	P = 0.003*
FEV 3	2.33±0.70	1.90±0.70	1.8±0.63	0.197**
PEFR	8.35±0.89	7.38±1.29	6.72±0.92	P = 0.001*
MVV	85.11±13.6	83.4±12.5	76.5±13.1	P = 0.034*

*Significant at 5 % level of significance; ** Non-significant at 5 % level of significance

DISCUSSION

The pulmonary function test was conducted on 50 type-2 diabetics with a history of diabetes for more than 5 years duration and 50 healthy individuals. An attempt was made to evaluate the effect of type-2 DM on pulmonary functions. The effect of extent of diabetes status as reflected by duration on pulmonary function was evaluated. Pulmonary function tests recorded were FVC, FEV1, FEV3, PEFR and MVV.

The basic character's age, sex, height, weight and BMI of cases and controls are shown in the Table 1. The P value for the basic characters age, sex, height, weight, BMI is >0.05 which is not significant.

Effect of duration of type-2 Diabetes mellitus on pulmonary function:

The effect of duration of type-2 diabetes mellitus on different parameters of pulmonary function test is shown in the Table 2.

FVC was decreased as the duration of diabetes increased as shown in Table 2. FVC at 5-6 years of duration is 3.60±0.45, at 6-10 years of duration is 3.20±0.48 and >10 years duration is 2.97±0.29. There was a decrease in FVC as the duration of diabetes increased with a P value = 0.002 which is highly significant. The present study is in agreement with Wendy DA et al who studied the glycemic exposure is associated with reduced pulmonary function in type-2 diabetes found a decrease in FVC at an annual rate of 68 ml/year.⁷

The FEV1 at 5-6 years of duration was 2.97±0.36, at 6-10 years of duration was 2.66±0.37, and >10 years duration

was 2.49±0.23 there was a decrease in FEV1 as the duration of diabetes increased with a P value = 0.003 which is highly significant.

The present study is in agreement with Davis .A. Wendy et al who studied the glycemic exposure is associated with reduced pulmonary function in type-2 diabetes and found decrease in FEV1 at an annual rate of 71ml/year.⁷

The FEV3 ratio at 5-6 years of duration was 2.33±0.70, at 6-10 years of duration was 1.90±0.70 and >10 years duration was 1.8±0.63. There is increase in ratio as the duration of diabetes mellitus increased with P value = 0.197 which is not significant.

The PEFR at 5-6 years of duration was 8.35±0.89, at 6 - 10 years of duration was 7.38±1.29, and >10 years duration was 6.72±0.92 with a P value P=0.001. There was a decrease in PEFR as the duration of diabetes increased and is highly significant.

The MVV at 5-6 years of duration was 85.11±13.6, at 6-10 years of duration was 83.4±12.5 and >10 years duration was 76.5±13.1 with a P value; P = 0.034 There was a decrease in MVV as the duration of diabetes increased and is highly significant.

The present study is in agreement with Wendy et al who studied the glycemic exposure is associated with reduced pulmonary function in type-2 diabetes and found decrease in MVV.⁷

Acceleration of aging process in the connective tissue of the lungs, interference with the connective tissue cross links. the presence of non-enzymatic glycosylation, and

modification of alveolar surfactant action causes reduction in FVC, FEV1%, PEFr% and MVV.

CONCLUSION

Longer duration of diabetes is significantly associated with reduction in pulmonary functions FVC, FEV1%, PEFr and MVV which underlines the respiratory system as one of the target organs of type-2 diabetes mellitus.

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Ethical approval: The study was approved by the institutional ethics committee

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