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Medicine

EFFECT OF DIABETES MELLITUS TYPE 2 ON PULMONARY FUNCTION TESTS- A PROSPECTIVE CLINICAL STUDY

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ABSTRACT

BACKGROUND & OBJECTIVE: The aim of this study was to assess pulmonary functions in patients with type 2 diabetes mellitus and to determine any correlation between type 2 diabetes mellitus and pulmonary functions.

MATERIALS & METHODS: Sixty diabetic and thirty Non diabetic were selected by random sampling. Detailed anthropometric and physiological data were collected, spirometry was performed and Forced vital capacity (FVC), Forced expiratory volume in 1 second(FEV1), FEV1/FVC, Peak expiratory flow rate (PEFR), forced expiratory flow (FEF 25 -75%) were measured. Results were analyzed by calculating Mean ± SD, using Student"s t test and Anova test by SPSS statistical software.

RESULTS: From the above study we see that all the respiratory parameters are reduced in study group compared to control group. FEV1, FVC, FEV1/FVC, PEFR and FEF 25-75% are significantly reduced. (p value < 0.01)The study also shows that the respiratory parameters are inversely related with glycemic status and duration of Diabetes mellitus. There was reduction in dynamic lung function variables. There was a mixed pattern (restrictive and obstructive) of involvement in lung functions.

CONCLUSION: The present study showed reduction in Mean FVC% and mean FEV1% were significantly reduced in cases group as compared to controls. PFT parameters were also significantly correlated with microvascular complications namely neuropathy, nephropathy and retinopathy. An inverse association was found between PFT parameters and duration of diabetes mellitus and poor glycemic control.

KEYWORDS : Type 2 diabetes; PFT; FVC; FEV1; FEV1/FVC; PEFR; FEF 25-75%,

INTRODUCTION: Diabetes mellitus is the most common metabolic disorder having an increasing trend globally. According to the International Diabetes Federation, diabetes affects at least 285 million people worldwide, and by the year 2030 this number is expected to reach 438 million, with two-thirds of all cases occurring in low- to middle-income countries.[1] The recently published study report of The Indian Council of Medical Research–India Diabetes (ICMR-INDIAB) showed that there are 62.4 million people with type 2 diabetes (T2DM) and 77 million people with pre-diabetes in India.[2]

Morbidity and mortality associated with Diabetes mellitus is due to wide spread biochemical, morphological and functional abnormalities and is responsible for the complications affecting neural, cardiovascular, renal systems, and also organs and tissues like skin, liver, collagen, and elastic fibers. It is indeed a multi-system disorder that affect multiple organs of the body.[3,4] These biochemical processes are responsible for precipitating microvascular pathologies leading to autonomic neuropathy, nephropathy, retinopathy, and macrovascular pathologies leading to coronary artery diseases, cerebrovascular accidents, and peripheral vascular diseases. The microvascular complications usually appear early, within 5 to 10 years and macrovascular complications appear late i.e. after 15 to 20 years from the onset of diabetes.[5]

Diabetes is not associated with any specific pulmonary symptoms and hence periodic screening for lung disease is not done in diabetic patients. The presence in the lung of an abundant connective tissue and systemic microvascular circulation, raises the possibility that lung may be a target organ in diabetes patients.[6] Additionally, diabetes related oxidative stress and increased susceptibility to respiratory infections have been shown to induce muscle dysfunction. Impaired lung function has attracted growing interest as a potential complication of diabetes.[7]

There have been several studies which have studied pulmonary function abnormalities in Type1 DM [6] which evidenced reduced elastic recoil [8] reduced lung volumes [7-9] diminished respiratory muscle performance, decreased in pulmonary diffusion capacity (DLco) for carbon monoxide [10] but there are only a few studies which have measured lung function in Type 2 DM. [11] There was graded, inverse association between hyperglycemia, severity of diabetes and FVC and FEV_1. [12, 13]

Although a lot of research work has been done on the after effects of diabetes mellitus but the literature pertaining to pulmonary functions is not in abundance in India. Therefore this study was planned to find out the effects of diabetes mellitus type 2 on pulmonary function tests.

MATERIALS AND METHODS:

In the present study, 60 patients with a diagnosis of type 2 DM admitted in J.A. Group of Hospitals, and those who attended medicine OPD were taken after due consent and their pulmonary function test was done and compared with 30 age and sex matched healthy controls. Association between type 2 diabetes mellitus and pulmonary function was assessed.

Inclusion Criteria:

Patients of type-2 diabetes mellitus who are under treatment with OHA or insulin or its combination or dietary control, and all newly diagnosed case of type-2 diabetes mellitus. Body mass index (BMI) < 30 kg/m2 with no previous history of any respiratory diseases and clinically ruled out cardiovascular diseases.

Exclusion Criteria:

Patients with H/o smoking and associated secondary lung diseases including pulmonary tuberculosis, asthma, interstitial lung disease, occupational diseases, chronic obstructive pulmonary disease and pneumonitis. All patients of type I diabetes mellitus. Patients with impaired fasting glucose tolerance.

Patient's detailed clinical history including age, sex, height, weight, occupation alongwith personal history and symptomatology was taken. They were undergone thorough physical examination. Their written consent was taken.

Pulmonary functions test were carried out using the instrument medspiror (a computerized spirometer self-calibrating, which fulfill the criteria for standardized lung function tests) available in department of chest medicine, GRMC, Gwalior. It is a low cost high performance instrument with capable results and represents a major advancement in computerized pulmonary function testing. Testing procedures are quite simple from the patient point of view. Full series of tests and related printout usually take four to five minutes. The computer stores and calculates all the necessary flow and volume data. To determine the reproducibility and validity of spirometric results, at least three acceptable spirograms were obtained. The test session was

finished when the difference between the two largest FVC measurements and between the two largest FEV_1 measurements was within 0.2 litre. If both the criteria were not met after three maneuvers, the test was not interpreted. Repeat testing was continued until the criteria were met or until eight tests had been performed.

The lung functions parameters included were FVC, FEV1, FEV1/FVC, PEFR, FEF25-75%. The actual values of cases were compared with actual values of subject. The FVC, FEV1, PEFR, FEV1/ FVC, FEF 25- 75% were recorded. Master chart was prepared. GLYCEMIC STATUS of a diabetic patient was determined by 1. Fasting blood sugar. 2. Postprandial blood sugar. 3. HbA1c

1. Fasting blood sugar is determined by glucose oxidase and peroxidase method (GOD-POD), after 12 hours of fasting. Value ≥126mg% is diagnostic of diabetes and Post prandial blood sugar is determined by glucose oxidase and peroxidase method after 2 hours of meal. Value ≥200mg% is diagnostic of diabetes. HbA1c was recorded by ion exchange resin method. Values of > 7 were considered significant for diabetics.

Statistical Analysis Statistical analysis was done by descriptive statistics as mean; SD, percentage etc. were done using SPSS statistical software. Comparison of diabetic and non-diabetic groups were done by applying Student"s Unpaired „t" test

RESULTS:

There was no significant difference (p value >0.05) between the two groups regarding demographic profile of the study and control groups depicted in Table 1. There exists a non-significant (P > 0.05) between the anthropometric parameters, thus both the groups were comparable to one another.

The mean BMI in cases group was 23.36±3.94 while in control group it was 23.409±3.84 and was statistically not significant (p value >0.05). As expected, fasting blood sugar levels were significantly higher in study group versus the control group. (151.748±82.382 and 83.967±8.22) p value < 0.002

In our study Mean FVC% was significantly decreased (P < 0.0027) in study group (85.216 ± 13.519) with respect to control group (94.21±11.913). Similarly, Mean FEV1% was also significantly lower in study group (85.889±15.551) as compared to controls (97.76±13.561) (p value <0.002). Mean FEV1/FVC was 103.687±10.536 in diabetics versus 108.39±9.569 in controls (P < 0.043). (Table-1)

Table 1: Comparison of PFT parameters in cases & control group

No. of patients	Mean FVC %	Mean FEV1 %	Mean FEV1/FVC%
Cases (n=60)	85.216±13.519	85.889±15.551	103.687±10.536
Control (n=30)	94.21±11.913	97.76±13.561	108.39±9.569
P value	0.0027	<0.002	0.043

Since FVC was significantly decreased (85.216 ± 13.519) in the study group versus control group (94.21±11.913), which is pathognomic of restrictive airway disease. Although FEV1/FVC ratio was103.687±10.536 in diabetics, which is >70% but it was significantly decreased in diabetics versus control population; which reflects obstructive airway pattern (P < 0.05). Thus, a mixed (obstructive–restrictive) pattern is seen.

When, we calculated the correlation between fasting blood sugar and FEV1/FVC in study group, a strong positive correlation is seen as compared to controls, wherein correlation was 0.0067.

In table 2 duration of diabetes was compared with pulmonary function parameters. Duration of diabetic patients was divided in three groups (1-5 yrs, 5-10 yrs and > 10 yrs). In our study we found out that with increase in duration there was reduction in PFT"s.

Table 2: Correlation of PFT with duration of diabetes

Duration of Diabetes (in years)	Mean FVC %	Mean FEV1%	Mean FEV1/FVC%
< 5 (n=33)	86.855±13.926	87.885±16.069	103.633±12.0
5-10 (n=21)	83.591±13.398	82.889±16.316	103.27±9.50
>10 (n=6)	81.883±12.459	85.412±8.477	105.43±4.34
P value	0.57	0.52	0.91

In table 3 HbA1C levels were corelated with pulmonary function test. In our study we found out that with increase in HbA1C levels there was no significant reduction in PFT"s.

Table 3: Correlation of PFT with HbA_1C levels

HbA_1C	Mean FVC %	Mean FEV_1%	Mean FEV_1/FVC%
< 7 (n=4)	96.445±8.628	97.625±4.93	105.9±12.227
7-10 (n=34)	84.579±13.052	85.042±14.544	103.717±10.711
>10 (n=22)	84.158±14.466	85.064±17.77	103.24±10.4
P Value	0.23	0.30	0.90

DISCUSSION

In this study, we tried to associate the lung function in patients with Diabetes Mellitus. Our study shows that pulmonary functions are impaired in patients of DM as compared to non diabetics. Irfan et.al, studied PFT in diabetics and showed that there was a significant reduction in FVC, FEV1.[14] They also stated that impaired lung function was independent of smoking and is likely to be a complication of DM itself. Davis et.al also showed that reduced lung volumes are the result of chronic complications of DM and is an important marker of increased risk of death in patients with diabetes.[15] The study by David. A Kaminsky in 2004 speculates that lung functions are commonly affected by factors involved in the pathogenesis of diabetes and abnormal lung function may precede the diagnosis of diabetes.[16] Few studies have also shown that there is no significant difference in pulmonary function test (PFT) parameters in diabetics as compared to controls.[12,17]

The pathogenesis of diabetes complications is still a matter of debate and is thought to involve both, a microangiopathic process and non ezymatic glycosylation of tissue proteins. This process results in impaired collagen and elastin cross linkage with a reduction in strength and elasticity of connective tissue. The presence in the lung of an abundant connective tissue and systemic microvascular circulation, raises the possibility that lung may be a target organ in diabetes patients.[18]

There was no correlation of duration of diabetes on pulmonary function test in our study although Mo et al., In 2009 observed that some spirometric lung function parameters were decreased in type 2 diabetics and the decline was more in patients with longer duration of diabetes.[19]

Periodic monitoring of pulmonary function (FEV1 and FVC) has been advocated as a general measure as well as a prognostic indicator of premature death from all causes, including cardiovascular disease, chronic obstructive pulmonary disease, and lung cancer. An association has been found between impaired lung function and death. A 10% decrease in FEV1 was associated with a 12% increase in overall mortality in type 2 DM.[20]

Limitations: The present study is a cross sectional study. A prospective study with long term follow up of subjects is required to demonstrate definite association of type-2 DM and derangement in lung function. More invasive techniques like diffusion capacity for carbon-mono-oxide (DLco) is required to further strengthen the association between type-2 DM and pulmonary functions. Measurement of pulmonary function depends on the competence of the patient and how well patient performs this test. The state of illness and inadequate patient effort can lead to false results.

CONCLUSION

In our study we conclude that pulmonary functions are adversely affected by type-2 DM and lung may be a target organ for its microvascular complications. There is Mixed Pattern (restrictive and obstructive) of Pulmonary Dysfunction.

As pulmonary parameters are affected in patients of diabetes, PFT should be essentially done in these patients for better management. PFT if done in patients presenting with diabetes as a routine OPD procedure will not only help to delay the onset of various respiratory ailments but also help the patient to comply with the various diabetic complications.

The observations in present study suggest that further studies with larger sample size may be required for its confirmation.

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