Original Article ISSN (O):2395-2822; ISSN (P):2395-2814

Study of Pulmonary Function in Patient with Type 2 Diabetes Mellitus.

Suma Rama Gopal Gangisetty[1], S S Devarmani[2], Santosh Nemagouda[3], Vijay Kumar Warad[2], S G Balaganur[4], Ravi Kattimani[5]

[1]Post Graduate, Department of General Medicine, Shri B.M.Patil medical college, Vijayapura.
[2]Professor, Department of General Medicine, Shri B.M.Patil medical college, Vijayapura.
[3]Associate professor, Department of Chest And TB, Shri B.M.Patil medical college, Vijayapura.
[4]Associate professor, Department of General Medicine, Shri B.M.Patil medical college, Vijayapura.
[5]Senior resident, Department of General Medicine, Shri B.M.Patil medical college, Vijayapura.

Received: December 2017
Accepted: January 2018

ABSTRACT

Background: Diabetes mellitus (DM) is multisystem disease involving many organs of the body. It affects kidneys, eyes, nerves, vessels and heart due to its microvascular and macrovascular complications. It has been reported in previous studies, most of which are from western world that lung capacities are reduced in DM. We tried to evaluate the involvement of lungs in DM in Indian population in present study. Aims and Objective: To record and evaluate the impact of pulmonary function tests in type 2 diabetes mellitus patients and their matched control group. **Methods:** This study was undertaken in patients admitted to Shri B.M.Patil Medical College Hospital and Research Centre, Vijayapura between November 2015 to July 2017. A total of 73 cases each of type 2 diabetes mellitus cases and normal controls were selected and compared with duration of type 2 diabetes mellitus. **Results & Conclusion:** Total of 60 females and 86 males were included in study. Comparison of Forced vital capacity (FVC), Forced expiratory volume during first second (FEV1) and Forced expiratory volume during first second / Forced vital capacity (FEV1/FVC) was done and concluded that restrictive pattern with reduced spirometry values was seen in diabetic cases compared to age, gender and BMI matched controls. Mean Also type 2 DM patients with duration more than 10 years were more affected than those with duration less than 10 years. In females, there was more restriction in lung volumes when compared to males of type 2 diabetes of same duration.

Keywords: Diabetes mellitus, Lung function tests, Microvascular complications, Restrictive pattern.

INTRODUCTION

Diabetes mellitus is a metabolic disorder as a result of insulin deficiency. It is of two types. Deficiency of insulin leads to type 1 diabetes whereas type 2 is due to insulin resistance leading to inadequate compensatory insulin secretion. Diabetes Mellitus is risk factor for micro vascular complications like nephropathy, retinopathy and neuropathy.[1] It is also a cause for coronary disease, peripheral vascular disease and cerebrovascular disease.[1] The microvascular complications appear early, i.e. within 5 to 10 years and macrovascular complications appear within 15 to 20 years from the onset of diabetes.[2] It is possible to significantly delay the occurrence of complications and thereafter the progression of diabetes if detected early.

Name & Address of Corresponding Author
Dr. Suma Rama Gopal Gangisetty,
Post Graduate,
Department of General Medicine,
Shri B.M.Patil medical college,
Vijayapura.

Histopathological changes in diabetic lungs show thickened pulmonary capillary and alveolar epithelial basal lamina leading to thickened basement membrane, due to which there is decreased lung volume and impaired diffusion.[3] Non - enzymatic glycosylation of connective tissue especially basement membrane of lung in diabetics is the most possible mechanism for lung abnormality.[3]

MATERIALS AND METHODS

It is Hospital based cross sectional study. Information was collected through prepared proforma for each patient.

Total sample size

73 + 73 = 146 using statistical formula

$$n = \frac{(Z\alpha + Z\beta)2 \times 2 \times SD2}{MD2}$$

Zα = Z value at the level of significance = 99%; Zβ = Z value at the level of significance = 90%

MD= Anticipated mean difference; SD= Anticipated standard difference.

Pulmonary function tests (PFTs) are a group of tests that are performed to measure lung function.[4] Spirometer was used to measure the various PFT's like FEV1, FVC AND FEV1/FVC.

FEV1: It is the volume of air expired in the 1st second of maximal expiration after a maximal inspiration.[5,6]

FVC: It is the maximum volume of air that can be exhaled during a forced manoeuvre.[5,6]

FEV1/FVC: It gives a clinically useful index of air flow limitation.[5,6]

Sampling Method

Simple random sampling. Chi-square ($\chi 2$) / Freeman-Halton Fisher exact test was employed to determine the significance of differences between groups for categorical data. Bivariate correlation analysis using Pearson's correlation coefficient (r) was used to test the strength and direction of relationships between the interval levels of variables. If the p-value was < 0.05, then the results were considered to be statistically significant

Statistical Software

Data were analyzed using SPSS software v 23.0 and Microsoft office.

Exclusion Criteria

Previous history of lung disease
Respiratory infections at the time of test
Smokers
History of being admitted during past six months with respiratory symptoms
History of cardiovascular illness

RESULTS

Among the 73 subjects in the diabetic group, 42 were males and the other 31 were females. In the control group, 44 were males and 29 were females out of the 73. The patients in both case and control groups were matched by age and gender.

Highest number of subjects were in age group of 50 - 59 years making 42.50 % of the total.

FEV_1, FVC & FEV_1 / FVC were compared between males and females [Figure 1]. FEV_1 & FVC were statistically insignificant. However Mean FEV_1 / FVC was 114.3 in males whereas in females it was 121.9 with a p value of 0.018 which was significant.

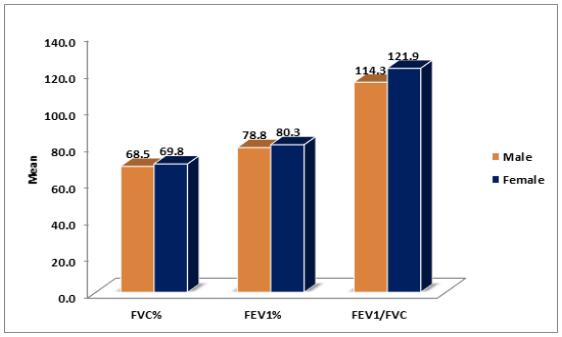

Figure 1: FVC, FEV1 and FEV1 / FVC between males and females in diabetic cases.

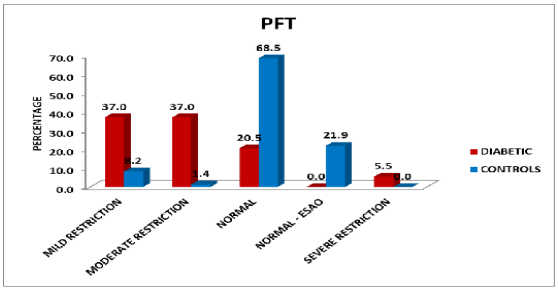

Figure 2: Distribution of PFT between cases and controls.

Distribution of pulmonary function tests between cases and controls was studied [Figure 2] which revealed restrictive type of ventilatory impairment with p value <0.001 which was significant. The PFT patterns were classified as mild, moderate, severe restriction, normal, normal with early sign of airway obstruction (ESAO). Majority of cases showed mild and moderate restrictive pattern (37 % each) while majority of controls showed normal PFT's (50% of total). Significantly, there was no diabetic noted with ESAO.

Mean FVC, FEV1 and FEV1/FVC were compared between cases and control (Figure 3). FVC among diabetics was low with a mean of 67.4 as compared to controls with mean of 91.5 and p value of <0.001 which is statistically significant. FEV1 was reduced in cases with mean of 79.4 compared to controls with mean of 107.8 with a p value of <0.001 being statistically significant. No significant difference was noted in mean values of FEV1 / FVC among cases and controls.

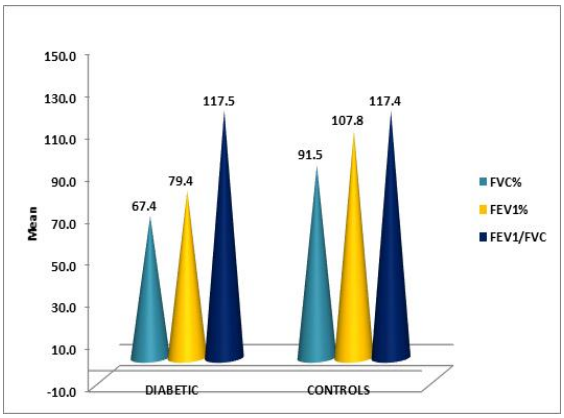

Figure 3: Comparison of mean FVC, FEV1 and FEV1/FVC between cases and control.

Mean FVC value was higher in diabetics with duration of diabetes between 5 - 10 years as compared to those with diabetes between 10 - 15 years and more than 15 years with a p value of <0.001 suggestive of high statistical significant. There was a inverse linear relationship between mean FEV1, FVC with duration of disease. FEV1 / FVC was less in diabetics with duration of >15 years compared to diabetics of 5 – 10 years and 10 – 15 years which was not statistically significant.

DISCUSSION

Many large studies have consistently demonstrated reduced pulmonary functions in patients with Diabetes Mellitus. There was no significant difference among cases and controls with reference to the gender of patients.

In the study by Ortiz Aguirre A R it was observed that pulmonary function test values decrease with increase in age. Therefore age acts as a confounding factor and thus it is removed in this study by age matched subjects in case and control groups.[7]

Crapo et al. concluded that BMI in diabetic patients with target organ damage was high compared to those subjects without target organ damage.[8] These subjects with target organ damage with high BMI had reduced mean pulmonary function parameters. The present study shows no significant difference in BMI values among diabetic and non diabetics nullifying BMI as one of the confounding factors.

Mean value of FVC was low in both case and control groups in subjects with low BMI compared to those with higher BMI values. The mean FEV1 and FEV1/FVC showed no significant difference in diabetic and non diabetics with reference to BMI.

Table 1: Comparison of FVC with other studies among diabetics and controls:

Study	Diabetics	Controls	p Value
D L Klein et al.[9]	2.79	3.19	<0.0001
Sultan et al.[10]	3.68	3.74	>0.05
Mohammad irfan et al.[11]	2.46	2.82	0.01
Dharwadkar A et al.[12]	1.742	1.877	0.33
Present study	2.25	2.92	<0.001

Table 2: Comparison of FEV1 with other studies among diabetics and controls.

Study	Diabetics	Controls	P value
O L Klein et al.[9]	1.16	1.68	0.000
Sultan et al.[10]	3.12	3.13	>0.05
Muhammad Irfan et al.[11]	2.04	2.29	0.04
Dharwadkar A et al.[12]	1.16	1.68	0.000
Present study	2.15	2.32	<0.001

Table 3: Comparison of FEV1/FVC with other studies among diabetics and controls

Study	Diabetics	Controls	P value
Sultan et al.[10]	0.8514	0.84	>0.05
Muhammad Irfan et al.[11]	0.819	0.814	0.69
Present study	0.85	0.863	0.961

The study proves the hypothesis of reduced FVC in diabetics compared to their age, sex and BMI matched controls. Comparison of FVC, FEV1 and FEV1/FVC with other studies among diabetics and controls [Table 1-3]. FVC was reduced by 24.1ml, FEV1 was reduced by 28.4 ml and FEV1/FVC increased by 0.1.

In the present study although diabetic subjects had low FVC compared to controls, the group of diabetics with diabetes mellitus more than 15 years had lower FVC than in those with duration of 5 – 10 years and 10 – 15 years.

Asanuma et al., Lange et al., reported that FVC and FEV1 were reduced in subjects with diabetes when compared to control subjects. The present study is in agreement with previous studies which have shown marginally high values of FEV1 / FVC in diabetic subjects when compared to age, sex and BMI matched controls.[13,14]

A small sample size and non-measurement of TLC, cross-sectional study with no follow-up are the limitations of the present study.

CONCLUSION

Our study shows significant changes of FEV1, FVC%, and FEV1/FVC% in Type II diabetes patients and it correlated with poor glycemic control. The above pattern of changes are possibly due to hyperglycemia induced non enzymatic glycosylation of tissue proteins and chronic diabetic microangiopathy causing basement membrane thickening (capillaries and endothelium) leading to reduction in strength and elasticity of connective tissues.

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How to cite this article: Gangisetty SRG, Devarmani SS, Nemagouda S, Warad VK, Balaganur SG, Kattimani R. Study of Pulmonary Function in Patient with Type 2 Diabetes Mellitus. Ann. Int. Med. Den. Res. 2018; 4(2):ME12-ME15.

Source of Support: Nil, **Conflict of Interest:** None declared