e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2023; 15(8); 381-385

Original Research Article

Assessment of Variation in Spirometric Parameters among Type 2 Diabetes Mellitus Patients and their Association with Glycemic Control at a Tertiary Centre

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Received: 26-05-2023 / Revised: 27-06-2023 / Accepted: 29-07-2023

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Conflict of interest: Nil

Abstract:

Background: A major public health problem is diabetes mellitus (DM). According to the World Health Organisation, India will be the diabetes capital of the world by the year 2025.

Aims and Objectives: The goals of the present study are to use spirometry to measure pulmonary function in Type 2 diabetic mellitus patients and to find out the correlation of the pulmonary function test variables with Glycemic control.

Methods and Materials: The present cross-sectional prospective study was done on 90 (Ninety) Type 2 Diabetes mellitus patients and non-diabetic patients, selected randomly from patients attending general medicine outpatient department of Government Medical College and Hospital, Bettiah, West Champaran, Bihar, India. Patients with diabetes mellitus were classified as study group 1 (45 patients), whereas those without diabetes were classified as control group 2(45 patients).

Results

The mean age of the study group with Diabetes Mellitus was 48.57 years, and the control group was found to be 47.62 years, and the p value was found to be insignificant ($p > 0.05$). The mean BMI among the study group with Diabetes Mellitus was 27.58 kg/m2, and the control group was found to be 26.91 kg/m2, which was also found to be not statistically significant. There is a significant ($p<0.05$) decrease in Pulmonary function test parameters (FVC, FEV1, PEFR, FEF 25–75%) and diffusion capacity (DLCO), whereas FEV1/FVC is significantly increased in cases compared to controls. Applying an ANOVA test between three groups according to HBA1c level shows that there is a significant decrease in FVC and DLCO and a significant increase in FEV1/FVC in those groups with HBA1c levels >7%.

Conclusion: The present study shows significant changes in FVC%, FEV1/FVC%, and DLCO% in Type-2 diabetes patients, and they have been correlated with poor glycemic control.

Keywords: Type-2 diabetes mellitus, Glycemic control, Spirometry, Pulmonary function test.

Introduction

A major public health problem is diabetes mellitus (DM). According to the World Health Organisation, India will be the diabetes capital of the world by the year 2025 [1]. The pathogenesis of diabetic complications is still a matter of debate and is thought to involve both a microangiopathic process and non-enzymatic glycosylation of tissue proteins and peptides of the extracellular matrix at elevated circulating glucose levels [2,3]. Several biochemical processes result in impaired collagen and elastin cross-linkage, a reduction in the strength and elasticity of connective tissue, and both microvascular and macrovascular complications causing thickening of the basement membrane, enothelium, and epithelium [2,4]. Diabetic problems are hypothesised to be caused by a microangiopathic process as well as non-enzymatic glycosylation of tissue proteins. The lung has a large amount of

connective tissue and a large microvascular bed, making it a vulnerable target organ [5]. These people's alveolar capillary basal lamina thickens, which is a symptom of microangiopathy. Respiratory autonomic neuropathy, which is characterised by decreased cholinergic bronchomotor tone and neuroadrenergic denervation in the lung, can cause abnormal lung function. When compared to subjects without diabetes and in relation to glycemic control [6].

Aims and Objectives

The goals of the present study are to use spirometry to measure pulmonary function in Type 2 diabetic mellitus patients and to find out the correlation of the pulmonary function test variables with Glycemic control.

Methods and Materials

The present cross-sectional prospective study was done on 90 (Ninety) Type 2 Diabetes mellitus patients and non-diabetic patients, selected randomly from patients attending the outpatient department (OPD) or Emergency care, General medicine department of the Government Medical College and Hospital, Bettiah, West Champaran, Bihar, India. Patients with diabetes mellitus were classified as study group 1 (45 patients), whereas those without diabetes were classified as control group 2(45 patients). The duration of the study was six months, from November 2022 to April 2023. Before starting the clinical study, participants' informed consent and approval from the institutional ethical committee were obtained. Patients were evaluated with a pretested structured questionnaire which includes history, general examination, systemic examination, clinical and laboratory parameters.

Inclusion Criteria

a) Both the genders were considered.
b) Participants in the age group of 25 to 75 years who are non-smokers

Exclusion Criteria

a) Smokers;
b) History of respiratory diseases such as asthma, COPD, tuberculosis and others systemic diseases lung trauma, cardiovascular disease and heart failure,
c) Autoimmune diseases

Statistical Analysis

SPSS Version 22 and Microsoft excel 15 was used for calculating mean values, standard deviation and data analysis. All the descriptive data was presented as frequency and percentage with mean values. The chi-square test and the T test were both used for calculating the p value. Statistical significance was defined as a p-value ≤ 0.05.

Results

The present cross-sectional prospective study was done on 90 (Ninety) Type 2 Diabetes mellitus patients and non-diabetic patients. The mean age of the study group with Diabetes Mellitus was 48.57 years, and the control group was found to be 47.62 years, and the p value was found to be insignificant ($p > 0.05$).

The mean BMI among the study group with Diabetes Mellitus was 27.58 kg/m2, and the control group was found to be 26.91 kg/m2, which was also found to be not statistically significant. The mean FBS and PPBS value among study group with Diabetes Mellitus was 156.81mg/dl and 248.32 mg/dl respectively whereas the mean FBS and PPBS value among control group with Diabetes Mellitus was 95.02mg/dl and 118.60mg/dl respectively, which was a found to be statistically significant ($p < 0.05$). The mean HbA1c of the study and control groups was 7.52% and 4.53%, respectively(Table1,Figure1).

Table 1: Comparison of basic characteristics between study and control groups

Parameters	Study group (n=45)	Control group (n=45)	P value
	Mean±SD		
Age (in years)	48.57±4.67	47.62±4.50	0.201
FBS (mg/dl)	156.81±30.79	95.02±4.51	0.002*
PPBS (mg/dl)	248.32±40.95	118.60±8.71	0.001*
HbA1c (%)	7.52±1.83	4.53±1.02	0.001*
BMI (Kg/m^2)	27.58±1.76	26.91±1.60	0.430

FBS= Fasting blood sugar, PPBS= Postprandial blood sugar, BMI= Body mass index
*P value<0.05= Significant

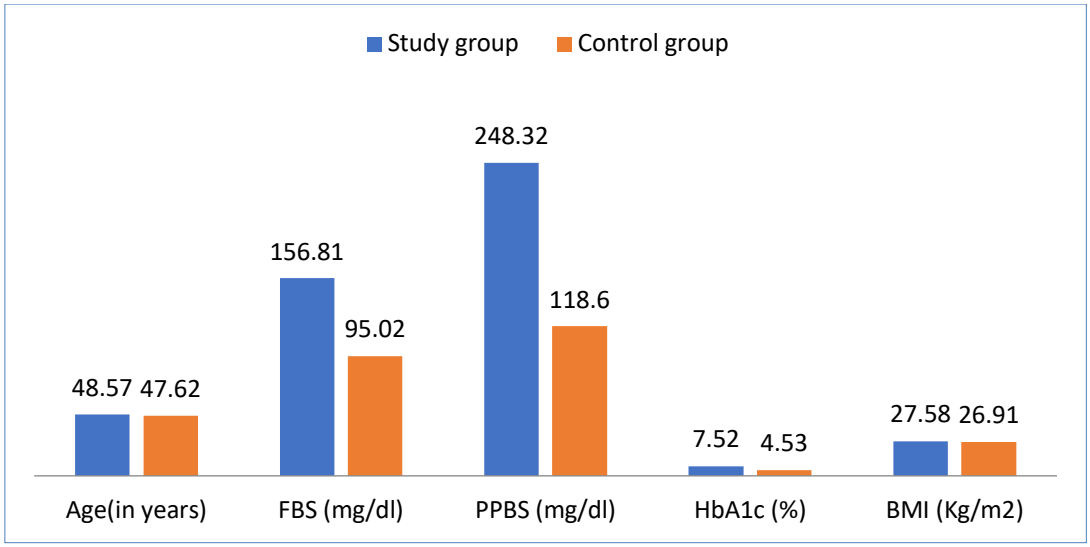

Figure 1: Comparison of basic characteristics between study and control groups

Table 2: Comparison of Spirometry parameters between study and control groups

Parameters (% of predicted)	Study group (n=45)	Control group (n=45)	P value
	Mean±SD		
FVC (Litre)	76.57±6.82	88.12± 8.65	0.002
FEV1(Litre)	80.13±3.68	94.60±8.60	0.001
FEV1/FVC (%)	93.52±5.91	92.79±5.12	0.010
PEFR(L/S)	84.13±6.73	95.65±7.23	0.008
FEF 25-75%(L/S)	80.90±5.82	90.71±6.80	0.002
DLCO (mL/min/mmHg)	88.31±12.58	102.35±12.93	0.001

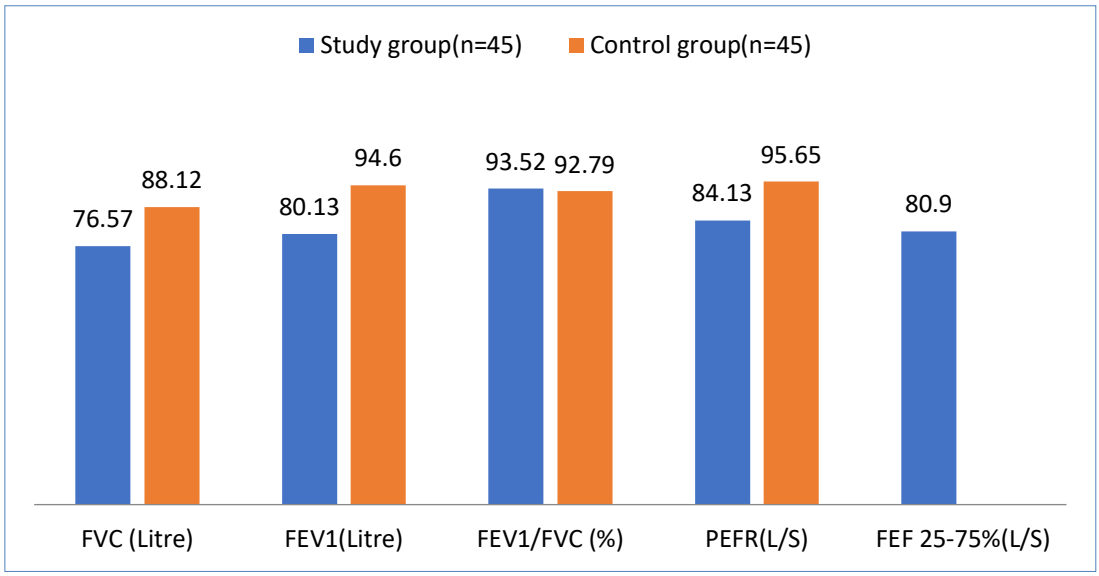

Figure 2: Comparison of spirometry parameters between study and control group

The mean FVC value among study group patients was found to be 76.57%, and among control group patients it was 88.12% of what was predicted. Other Spirometry parameters between the study group and the control group are given above in Table 2. There is a significant ($p<0.05$) decrease in PFT parameters (FVC, FEV1, PEFR, FEF 25–75%) and diffusion capacity (DLCO), whereas FEV1/FVC is significantly increased in cases compared to controls. Applying an ANOVA test between three groups according to HBA1c level shows that there is a

significant decrease in FVC and DLCO and a significant increase in FEV1/FVC in those groups with HBA1c levels >7% (Table 2, Figure 2).

Discussion

Table 3: Comparision of Spirometry parameters studied by different authors

Parameters Mean ± SD (% of predicted)	Present Study	Salim uz–Zaman et al. [9]	Shah et al. [10]	Agarwal et al. [11]
FVC (Litre)	76.57±6.82	77.75 ±5.655	77.97±12.99	83.13±7.36
FVC1	80.13±3.68	81.31±3.864	78.98±14.09	83.0 ± 8.0
FEV1/FVC (%)	93.52±5.91	102.97±8.402	112.83±9.35	-
PEFR(L/S)	84.13±6.73	85.31±5.173	59.16±99.35	86.6±13.09
FEF25-75% (L/S)	80.90±5.82	82.83±4.934	67.00±15.08	87.67±9.37

HbA1c% is an indicator of diabetes control. The higher the level of HbA1c%, the poorer the diabetic control. If circulating glucose is constantly at a higher level for 3 months (as measured by HbA1c %), it can lead to more and more non-enzymatic glycosylation of tissue proteins.

In the present study, fasting and post meal blood glucose levels and HbA1c% were found to be significantly higher in type 2 diabetics than in controls, pointing to the fact that there was poor glycemic control. This may be because of irregular drug intake, inappropriate drugs, sub-dosing, overeating, a lack of diabetic lifestyle discipline, etc., practised by the patients.Similar findings by Ramirez t al. [7].

We found that FVC and FEV1 were significantly reduced in type 2 diabetics, whereas FEV1/FVC was significantly increased in the study group compared to the control group. It suggests that diabetes is associated with restricted lung pathophysiology. Other studies found similar findings [8, 9, 10].

Another Study by Sinha et al. [8], also showed that lung function parameters were decreasing with deterioration of glycemic control and that there was a negative correlation between DLCO and HBA1c level ($r = 0.62$, $p < 0.05$). Other studies [8,11] have observed only a correlation between diffusing capacity and spirometric values that did not differ in type-2 diabetes patients.

Agarwal et al. [11], found that there was a decrease in FVC%, FEV1%, PEFR%, FEF25-75%, DLCO%, and DL/VA% and an increase in FEV1/FVC% with an increase in HBA1c level.

A study conducted by Femognari et al. [12] found significant decreases in FVC, FEV1, and normal FEV1/FVC, showing restrictive impairment in lung function.

We observed that in type 2 diabetic patients, FEF 25–75% is significantly reduced compared to controls. FEF 25-75% is an indicator of the force of expiration of gases during the middle 50% of forced expiration. Forced expiration is supported by the muscular and recoil forces of the respiratory system. Thus, a decrease in muscular and recoiling forces of the respiratory system because of increased glycosylation is responsible for a significant decrease in FEF (2–75%). Other studies found similar findings [13]. We found that PEFR is the volume of gas exhaled in one-tenth of a second during a forced expiratory manoeuvre when the lungs' recoiling forces and the respiratory muscles' contractile forces are both functioning at their peak and supporting the expiration to the maximum. The recoiling forces of the lungs and the contractile forces of the respiratory muscles may be decreased as a result of glycosylation of the connective tissues of the respiratory apparatus, which could result in a significant reduction in PEFR. Other studies found similar findings [14, 15].

Lung function measures and glycemic control (HBA1c) were correlated, according to in a study conducted in Bangladesh by Md Omar Ali et al. [16] , on 60 diabetic male patients between the ages of 40 and 60 years, PEFR and FEF25-75% were lower in diabetic men and inversely proportional to disease duration. According to Davis et al. [6], people with higher baseline HbA1C showed faster decreases in FVC and FEV1.

Limitations of the study

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

Conclusion

The present study shows significant changes in FVC%, FEV1/FVC%, and DLCO% in Type-2 diabetes patients, and they have been correlated with poor glycemic control. The above pattern of changes is possibly due to hyperglycemia-induced non-enzymatic glycosylation of tissue proteins and chronic diabetic microangiopathy causing basement membrane thickening (capillaries and endothelium), leading to a reduction in strength and elasticity of connective tissues and reduced pulmonary blood

volume with a V/Q mismatch impairing the diffusion capacity.

Acknowledgement

Vikash Kumar gave concept and idea, study design, and manuscript drafting data collection and analysis; and Ravi Ranjan Kumar Raman, Md. Shahid gave data collection and analysis, manuscript revision, and data interpretation.

We would like to acknowledge the support extended by Sumit Kumar, head of department, Department of General Medicine, Government Medical College and Hospital, Bettiah, West Champaran, Bihar, India, for their valuable support in undertaking this study.

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