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Evaluation Of Spirometric Parameters In Patients With Type 2 Diabetes Mellitus - A Cross-Sectional Study In A Tertiary Care Hospital In North East India

Bhattacharjee S[1], Saha S[2] & Chakraborty D[3]
Mr. Subhrajit Bhattacharjee, 3rd Professional MBBS Student, Agartala Govt. Medical College.
Dr. Satabdi Saha, MD & DNB (Physiology), Assistant Professor, Department Of Physiology, AGMC, Agartala
Prof. (Dr.) Debasish Chakraborty, MD (Physiology), Professor, Department Of Physiology, AGMC, Agartala
(Corresponding Author)

Abstract:
Introduction: *Diabetes mellitus is a common metabolic disorder that affects different organ systems in our body. Pulmonary complication of diabetes is not well characterized because of scarcity of data. Purpose of the present study was to evaluate the lung functions among the patients with Type2 DM.*
Materials and method: *To evaluate the lung functions 85 type 2 diabetic patients were included in the study. Informed consent was obtained from the study participants. After taking a brief history, spirometry was performed among the recruited patients. The data were recorded in Microsoft excel and analyzed using SPSS software.*
Result: *The quantitative data were expressed in terms of mean and standard deviation. Lung function parameters FVC, FEV1, and MVV were (2.05±0.66) Liters, (2.05±0.66) Liters and (52.22±18.17) L/min respectively. FEV1/FVC ratio was 73.74±13.36. FEV1 had a significant (p value: 0.002) negative correlation with duration of diabetes (r value: -0.330).*
Conclusion: *The spirometric parameters FVC, FEV1 and MVV were found to be reduced among the study participants, whereas FEV1/FVC ratio was normal. These findings suggest presence of deterioration of lung functions among type 2 diabetic patients which is of restrictive type. Our study also showed that deterioration of lung function is more as the duration of disease increases. Therefore, the patients with type2 diabetes are needed to undergo pulmonary function testing periodically.*
Keywords: *Type 2 Diabetes Mellitus (T2DM), Spirometry, Lung function*

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I. Introduction

Diabetes is the most common metabolic disorder which is on increasing trend globally.[1]Diabetes is long known for target organ dysfunction because of its macrovascular and microvascular complications. Complications involving neural, cardiovascular, and renal system are well recognized. These complications decrease the quality of life, increase the morbidity of the patients and increase the disease burden of the society.[2]

Pulmonary dysfunction of DM has been poorly defined as it showed conflicting results. But pulmonary complications may be one of the earliest measurable non-metabolic alterations in diabetes.[3] Microangiopathy in diabetes can affect the alveolar capillary network in the lung. Structural abnormalities of connective tissues of lung and alveolar capillary membrane can also be seen in Type 2 DM. Impaired collagen and elastin cross linkage to leads reduction in strength and elasticity of connective tissues in type 2 DM. These abnormalities in the structural components can lead to alteration of pulmonary function such as a reduction in the vital capacity, total lung capacity, lung compliance, reduction of central and peripheral airflows, acceleration of the ageing process.[4,5,6]Oxidative stress and deposition of advanced glycosylation end products can lead to thickening of the alveolar and capillary endothelial basement membranes. These might cause modifications of alveolar surfactants altering its function leading to reduction in diffusing capacity of lungs.[7]

Spirometry is a basic, noninvasive test widely used to assess pulmonary function. It assesses the lung volumes, capacities and flow. Spirometry is well suited for describing the effects of obstruction or restriction on lung function.[8] In this study we planned to assess the lung function using spirometry among type2 diabetic patients.

Very little is known about pulmonary complications of diabetes. Studies conducted to assess the pulmonary function in Type 2 DM are very few. The results of these studies are also conflicting. As the prevalence of type 2 diabetic mellitus is increasing gradually in developing countries like India, it is utmost important to evaluate all the aspects of diabetes related complications including status of lung function. Thus, this study was undertaken to evaluate the pulmonary function in patients with type 2 DM using spirometry.

II. Objective

Objective of this study was to assess the pulmonary function in type 2 diabetes mellitus patients.

III. Material And Methodology

Study type: Observational Study

Study design: Hospital based Cross- sectional study

Study area/Location: Department of Physiology in collaboration with Department of Medicine, Agartala Govt. Medical College (A.G.M.C), Agartala.

Study Population:85 Adults with type 2 Diabetes Mellitus attending Diabetes and Nutritional Clinic of A.G.M.C & GBP Hospital, Agartala

Sample size: The minimum sample size requirement for this study was calculated by using the Cochran's formula, taking 95% of confidence interval and 51% prevalence of lung disease in T2DM[9]. Thus, sample size is determined to be around 85.

Inclusion criteria for cases:
1. Only patients aged between 30-60 years.
2. Diagnosed cases of Type 2 Diabetes Mellitus as given by the American Diabetes Association (ADA).[1]

Patients who fulfill the following criteria for the diagnosis of diabetes mellitus:
a. Symptoms of diabetes plus random blood glucose (RBS) concentration ≥ 11.1 mmol/l (200 mg/dl) or
b. Fasting plasma glucose (FBS) ≥7.0 mmol/l (126 mg/dl) or
c. Haemoglobin A1c ≥ 6.5% or
d. 2-hour plasma glucose (PPBS) ≥ 11.1 mmol/l (200 mg/dl) during an oral glucose tolerance test.
3. Patients having no cardiovascular complaints.
4. No recent history of respiratory illness.
5. Co-operative and willing to participate in the study.

Exclusion Criteria:
Subjects with the following were excluded from the study.
1. Already existing chronic complications of Diabetes like retinopathy, neuropathy, nephropathy.
2. Present or past history of respiratory illness that might affect lung function such as bronchiectasis, tuberculosis, asthma, interstitial lung diseases, COPD.
3. History of occupational exposure to any substance that could affect lung function.
4. Individuals with unacceptable spirometry techniques. Unacceptable spirometry means any effort in which FEV1 or FVC could not be measured due to:
- Cough
- Submaximal effort
- Obstructed teeth
- Air escape
- Effort sustained for less than 6 seconds duration
- Failure to attain a volume time curve
- Lack of understanding the procedure
- Recent surgery
5. Known case of cardiovascular disorders like Hypertension, Coronary Artery Disease, Congestive Cardiac failure, etc.
6. History of smoking, alcoholism or intake of any drugs like Vasodilators, Diuretics, Anti-arrhythmic, Beta-blockers, Alpha-agonist or Alpha-blockers, etc.

Study tools:

Spirometry –model SPM –A
Sphygmomanometer-Mercury deluxe BP apparatus manufactured by diamond allied products SSI no- UAN-MH33A0014692
Stethoscope
Height measuring stand-Bioplus; height -200cm
Weighing machine
Investigating materials and Kit for estimation of blood sugar and glycosylated haemoglobin (HbA1c).
Case study format.

Ethical clearance: Ethical clearance was obtained from institutional ethical committee on September 2023.

Data Collection: Data were collected from the participants (selected as elaborated in the sub-heading sampling procedure) only after obtaining their informed consent as per the inclusion criteria. Socio-demographic variables like name, age, sex, etc. were noted as per the case study format. The duration for which they were suffering from Type 2 Diabetes Mellitus and their Blood Sugar (RBS, FBS, PPBS) and HbA1c levels were also noted from their medical documents. A pre-designed case study format was used to collect relevant information, demographic data, medical history and clinical features for each patient using a standard questionnaire.

Spirometry- After taking detailed history and relevant clinical examination, an informed consent was taken. Then, the anthropometric parameters like height and weight were measured and BMI were calculated. After demonstrating the technique for carrying out pulmonary function tests, subjects were made to undergo pulmonary function tests.

The participants were made to relax and wore comfortable loose clothing. The participants were made to sit comfortably and nose clips were applied on the nose. The spirette was kept in the mouth with the lips sealing around it and was instructed to breathe calmly and care was taken not to block or bite the spirette.

All the tests were conducted according to American Thoracic Society/European Respiratory Society (ATS/ ERS guidelines) in a quiet room in sitting position by the Spirometer SPM-A for 3 times at every 15 minutes interval and best of 3 was taken into account[10]. The forced vital capacity (FVC), forced expiratory volume in 1 second (FEV1), peak expiratory flow rate (PEFR), FEV1/FVC, and FEF 25-75% were recorded. Data were entered in computer using Microsoft Excel. Descriptive statistics and other suitable statistical were used as per applicability. A probability value less than 0.05 were considered as significant.

IV. Results

A total of 85 patients were included in the study. Among them 49.4% were female and 50.6% were male as shown in Figure 1. Mean age group of the study participants were 50.72 ± 8.64 years. Mean height, weight and BMI of the study participants were (1.55 ± 0.09) meter, (60.91 ± 11.46) kg and (25.37 ± 3.8) kg/m^2. Mean HbA1C level was 9.51±2.65%. Duration of diabetes among the study participants were 5.16±1.13 years. Variables among the study participants are summarized in Table 1. Lung function parameters FVC, FEV1, and MVV were (2.05±0.66) Liters, (2.05±0.66) Liters and (52.22±18.17) L/min respectively. FEV1/FVC ratio was 73.74±13.36. Mean values of the parameters and standard deviations are mentioned in Table 2. The lung function parameters FVC, FEV1, MVV, FEF25, FEF50, and FEF75were significantly less in cases of females as compared to males. The mean values of parameters between males and females and their p values are mentioned in the Table 3. FVC had a negative correlation with the duration of diabetes where r value was -0.017 but the correlation was not statistically significant (p value: 0.880). FEV1 had a significant (p value: 0.002) negative correlation with duration of diabetes (r value: -0.330) as shown in Figure 2.

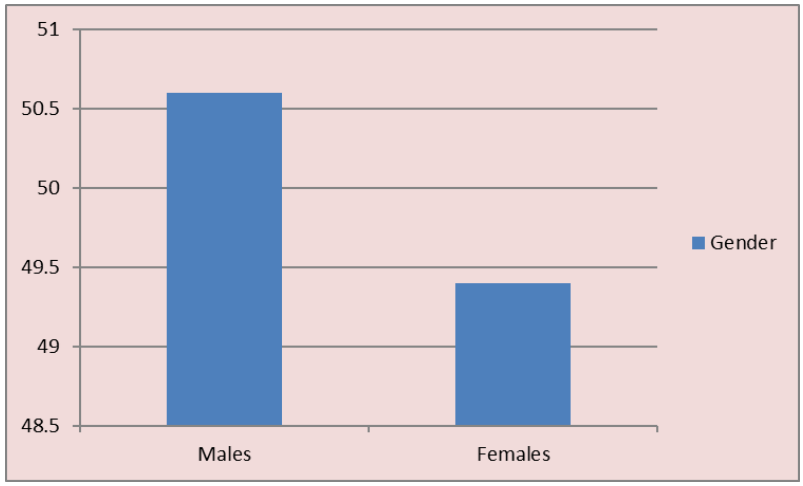

Fig 1. Gender wise distribution of study participants

VARIABLES	MEAN ± STD. DEVIATION
Age (years)	50.72 ± 8.64
Height (meter)	1.55 ± 0.09
Weight (Kg)	60.91 ± 11.46
BMI (Kg/m²)	25.37 ± 3.8
HbA1c Level (%)	9.51±2.65
Duration of Diabetes (yrs)	5.16±1.13

Table 1. Variables among the study participants

Sl. No.	Spirometric parameters	Mean ± Std. Deviation
1	FVC L	2.05±0.66
2	FEV1 L	2.05±0.66
3	FEV1/FVC	73.74±13.36
5	MVV L/m	52.22±18.17
6	FEF25 L/S	2.13±1.07
7	FEF50 L/S	1.77±0.75
8	FEF75 L/S	1.15±0.51

Table 2. Spirometric parameters among the study participants

Spirometric parameters	Males (Mean ± Std. Deviation)	Females (Mean ± Std. Deviation)	p value
FVC L	2.46±0.64	1.63±0.32	0.000*
FEV1 L	1.77±0.56	1.21±0.27	0.000*
FEV1/FVC	72.28±12.80	75.25±13.90	0.31
MVV L/m	61.88±19.49	42.33±9.42	0.000*
FEF25 L/S	2.57±1.24	1.69±0.62	0.000*
FEF50 L/S	2.12±0.81	1.40±0.46	0.000*
FEF75 L/S	1.39±0.55	0.90±0.31	0.000*

Table 3. Spirometric parameters between males and females

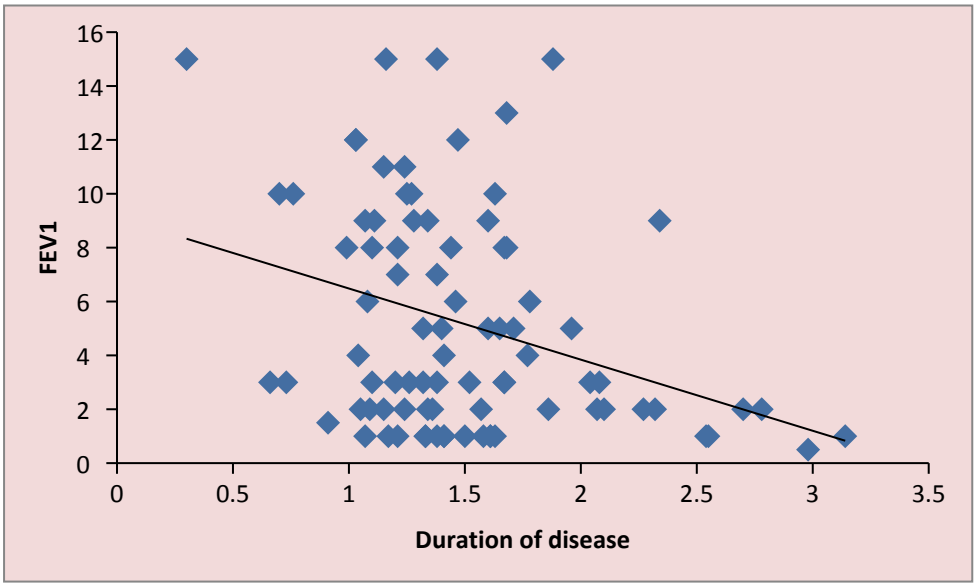

Fig 2. Correlation of FEV1 with duration of disease

V. Discussion

In the present study was conducted among 85 Type 2 Diabetic patients. The spirometric parameters FVC, FEV1 and MVV were found to be reduced among the study participants, whereas FEV1/FVC ratio was normal. These findings suggest presence of deterioration of lung functions among type 2 diabetic patients which is of restrictive type. FEV1 also had a significant negative correlation with duration of diabetes. FEV1 value decreased as the duration of diabetes increased.

The findings of the present study were similar with a cross-sectional study, where FVC and FEV1 values were found to be lower in adult patients suffering from diabetes mellitus as compared to the non-diabetics.[11]Another study conducted on T2DM patients showed deterioration of pulmonary function in the form of lower forced vital capacity (FVC), FEV1, and low peak expiratory flow (PEF) values.[12]Study conducted by Talpur AS et al found in their study that T2DM was significantly associated with restrictive lung disease and there was a positive correlation between duration of diabetes and deterioration of lung function.[13]

Findings of the study conducted by Lee DY et al also showed similar results with higher association of T2DM and restrictive lung disease.[14]Study conducted by Irfan M et al. showed a significant reduction in the forced vital capacity (FVC), forced expiratory volume in one second (FEV_1) and slow vital capacity (SVC), in diabetic people relative to nondiabetic controls.[15]

The occurrence of lung disease in T2DM can be because of various factors. Hyperglycemia in diabetes causes increase in oxidative stress and free radical formation which might contribute to lung dysfunction. Autonomic neuropathy, a common complication of T2DM can also affect the pulmonary vascular tone resulting in pulmonary hypertension and deterioration of lung function. Long standing hyperglycemia leads to non-enzymatic glycation of extracellular proteins in the pulmonary interstitium leading to pulmonary dysfunction.[16]

In our study there was a significant difference between lung function parameters of males and females. FVC, FEV1 and MVV were significantly lower in Females compared to males. Study conducted by Zakaria R et al. had shown lower mean values for all PFT parameters in females compared to males.[17]Possible explanation for gender differences of pulmonary function parameters would be smaller airways and lung volumes in females than males.

To summarize, there is deterioration of lung function in long standing type 2 DM which if of restrictive type. Multiple pathological factors in type 2 DM attribute to the decline in lung function. Hence regular evaluation of lung function is necessary in type 2 diabetics to avoid further complications.

VI. Conclusion

Our study showed that pulmonary function was compromised in T2DM and the changes were of restrictive pattern. Therefore, the patients with type2 diabetes are needed to undergo pulmonary function testing periodically. Regular breathing exercises might strengthen respiratory muscles to improve the pulmonary function in type 2 diabetics.

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