

Pulmonary Function Tests in Type 2 Diabetes

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Abstract:

Background and objective: Diabetes mellitus (DM) is a metabolic disorder leading to various microvascular and macrovascular complications. This study is intended to know the extent of impairment of lung function in diabetics among rural population around Bangalore.

Methods: 100 patients with diabetes mellitus and 100 non diabetics from rural areas of bangalore were included in the study. Pulmonary function tests were performed using computerized spirometer and random blood sugar was estimated via glucometer.

Results: Diabetic patients have significantly lesser values of Forced Vital Capacity (FVC), Forced Expiratory Volume 1 (FEV1) and FEV1/ FVC as compared to normoglycemic subjects.

Conclusion: Our study showed that diabetic patients had reduced pulmonary functions compared to normoglycemic subjects which was of restrictive pattern.

Keywords: Diabetes Mellitus, Forced Vital Capacity (FVC), Forced Expiratory Volume 1 (FEV1)

I. Introduction

Type 2 Diabetes Mellitus (T2DM) is increasing alarmingly in the world and India has more than 62 million people suffering from it. India ranks next to china and it is increasing upto 2 million every year.¹

Accumulating clinical evidence suggests that there is increased incidence of impaired lung function in diabetes mellitus (DM). Some studies have demonstrated the association between both obstructive and restrictive lung impairment and insulin resistance or DM. However, an accelerated decline of lung function has been observed in patients with DM.

Diabetes leads to microvascular and macrovascular complications which results in many of the systemic functional derangements. DM causes glycosylation of alveolar-capillary proteins leading to microangiopathy in the lungs. Experimental studies on lung tissue from diabetic rats, autopsy and transbronchial biopsy studies in a few diabetics confirmed this hypothesis. Patients with DM had increased thickness of the alveolar capillary and bronchial-capillary basement membranes. These biological changes translate into clinical findings such as impairment in pulmonary functions.²

Though studies have been conducted for estimating the lung functions in diabetes in small groups, not many large scale studies are done in early diabetes. To our knowledge, such a community based study has not been conducted in any of the rural areas of Bangalore. We studied the effect of diabetes on the lung function tests in the rural area of Bangalore.

Aim:

To assess the pulmonary function in diabetic patients

II. Objectives Of The Study:

To study the effect of diabetes mellitus of 5-10 yrs duration on lung function in diabetics.

III. Materials And Methods

Study period:

The present study was carried out in March 2015 for a period of one month.

Study design and participants:

Computerized PFT was conducted on 100 diabetic and 100 normoglycaemic male subjects who were age, BMI matched. These subjects were selected from rural areas of Bangalore.

100 male diabetics were selected based on the inclusion and exclusion criteria.

Inclusion Criteria:

1. Type 2 Diabetic males for more than 5 years but less than 10 years.
2. Age between 40 to 60 years.
3. HbA1c value > 6% but <8%.

Exclusion Criteria:

1. Smokers.
2. History of any lung diseases, restrictive or obstructive such as asthma or any other COPD.
3. Tobacco users.
4. Deformities of chest wall or spine
5. History of or symptoms of any neuromuscular disorders
6. Hypertensive patients.
7. Those with severe or communicable lung infections like tuberculosis.

100 normoglycemic subjects who were age , gender and BMI matched were included in the study.subjects were selected based on similar criteria and :

1. Fasting blood sugar < 100mg/ dl
2. Post prandial blood sugar <140 mg/dl.

The procedure of Pulmonary Function Test was explained to the subject in his own language and a written informed consent was taken. The anthropometric parameters and blood pressure values were recorded. The random blood sugar was estimated using a glucometer. The PFT was conducted using a computerised spirometer: RMS Helios 401. Sufficient care was taken to sterilise the filters and disposable mouth pieces were used.

Various PFT parameters were recorded and studied such as :

FEV 1, FVC, FEV 1/ FVC , PEFR .

Data thus obtained were analyzed by unpaired t-test using the statistical software namely SPSS version 20.0.

IV. Results:

The study group included 100 diabetics and control group included 100 healthy controls.

There was no statistical significance in the differences between the mean age and BMI of the study group and the control group (p>0.05).

In our study we found that diabetic patients have significantly lesser values of FVC, FEV₁, FEV₁/ FVC and PEFR(p<0.05) as compared to normoglycaemic subjects (Table 1).

Table.1: PFT parameters in normoglycemic subjects and diabetic patients

PFT Parameter	Normoglycemic Subjects	Diabetic Patients	Significance (p value)
FVC (litres)	3.15 ±0.27	2.82±0.34	<0.05
FEV1 (litres)	2.53±0.29	2.31±0.39	<0.05
FEV1/FVC	0.86±0.12	0.78±0.07	<0.05
PEFR	5.21±0.73	4.59±0.65	<0.05

V. Discussion:

Diabetes is a disease which leads to microvascular and macrovascular complications resulting in multisystem dysfunction.These microvascular changes in lung tissue will lead to impairment in pulmonary functions. Few studies have shown that T2DM with microangiopathies show reduced diffusion capacity for carbon monoxide (DLCO).The study further suggested that hyperglycaemia and dyslipidaemia might have a contributory role in its pathogenesis.³

In this study we found that diabetics had reduced lung function compared to normoglycemic subjects. FVC, FEV1,FVC/FEV1 & PEFR werestatistically significantly lower in diabetic patients than in normal controls (p<0.05): [Table: 1].

Similar to our study Gregory L. Kinney et al have observed a moderate reduction in FVC,FEV1 and diffusing capacity for carbon monoxide of the lung in patients with type 1 and type 2 diabetes.⁴Similarly,Mori H et al have found that increased duration of diabetes is associated with proportionate loss of %DLco. They also suggested that pulmonary function tests such as %VC, FEV1 and PaCO2 had no significant association with duration of diabetes.⁵

It is also suggested by some earlier studies that collagen and elastin changes seen in diabetic patients could be attributed to the small vessel involvement which may eventually lead to significant structural changes. Chronic high levels of circulating glucose is also believed to cause an increase in non-enzymatic glycation of proteins and peptides in the pulmonary extracellular matrix . These factors may be involved in the pathological changes of the pulmonary parenchyma of T2DM patients.³

Some studies state that chronic low grade tissue inflammation along with microangiopathy and accumulation of advanced glycation end products can result in lung restriction in diabetes finally leading to diabetic morbidity and mortality.⁶

Yeh HC et al have suggested that a PFT test in middle aged nondiabetic adult showing a restrictive pattern of lung pathology is predictive of subsequent type 2 diabetes.⁷ Similarly, researchers have found that the risk for the development of prediabetes is more in subjects with increased IGT (Impaired Glucose Tolerance) and with Low lung volume. They also state that IGT, was significantly associated with reduced lung volume and not IFG (Impaired Fasting Glucose).⁸ Hsin-Chieh Yeh et al, in their study have found that reduced vital capacity independently predicts the onset of type 2 diabetes. It is also suggested that vital capacity be considered as an important risk factor for developing insulin resistance and diabetes.⁹

Bruce B. Duncan et al have found in their study that an increase in levels of interleukin-6 signifying a low-grade inflammation may predict an impending onset of type 2 diabetes.¹⁰

Connie C.W. Hsia have stated that moderate lung restriction is seen in type 2 diabetes as in type 1 diabetes. FVC and FEV1 are proportionately reduced as the increase in glycemic levels and loss of lung diffusing capacity (DLCO).⁶

Similarly, The Copenhagen City Heart Study done over 15 years showed that there was consistently lower (FEV1) and (FVC) in diabetics compared to normal individuals.¹¹

Muhammad Irfan et al., studied PFT in diabetics and showed that there was a significant reduction in forced vital capacity (FVC), FEV1 and slow vital capacity. They also studied that impaired lung function was independent of smoking and is likely to be a complication of diabetes itself.¹² This study concurs with our study.

Research done by Wendy A. Davis et al., showed that reduced lung volumes are the result of chronic complications of DM and is related to glycemic exposure. They also revealed that airflow limitation is a predictor of mortality.¹³

David A. Kaminsky has opined that lung function is an important marker of increased risk of mortality in diabetic patients. Further, it is suggested that low FEV1 is a marker of diabetes or poor glycemic control, it is better to add the spirometer to the equipments available for monitoring the control of diabetes and its important complications.¹⁴

VI. Limitations

In this study we were not able to measure the diffusing capacity for carbon monoxide as well as total lung capacity in our subjects.

VII. Conclusion

Our study conferred that diabetic patients had reduced pulmonary functions compared to normoglycemic subjects which was of restrictive pattern.

Pulmonary impairment leads to decreased physical working capacity in diabetics. Since majority of the work force in our country is in 30s and 40s age group, the pulmonary dysfunction in the early years of diabetes could affect productivity drastically at both individual and community levels. Hence it is important to do periodic lung function as part of diabetes check up for early detection of lung abnormalities.

Acknowledgement

We hereby thank the management of our hospital for all the support and equipments they have provided. We are thankful to our HoD, Department of Physiology and the entire staff of the department for their guidance and support.

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