ORIGINAL RESEARCH

Pulmonary dysfunction in diabetes mellitus

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ABSTRACT
Diabetes mellitus is a public health problem in developing and developed world .The great attention was centered on the diabetic complications like cardiovascular, nephropathy, retinopathy and neuropathy. The pulmonary complications of type-2 diabetes mellitus have been poorly characterized. Several studies are suggested that diabetes is associated with impaired pulmonary functions. The underlying mechanism seems to be microangiopathy brought in by the non enzymatic glycosylation of various scleroproteins in lungs and elsewhere. Since collagen is the most abundant tissue protein in major bronchi, vessels and interstitium, the alterations in pulmonary functions occur as a rule. The aim of the present study is to assess the effects of chronic hyperglycaemia on lung functions, which focused on mechanical aspects of lung dysfunction – maximal forced spirometric pulmonary function tests like FVC, FEV1, PEFR, FEV1/FVC% to be specific.
Keywords: Diabetes mellitus, Microvascular angiopathy, Pulmonary function Test

INTRODUCTION
Diabetes mellitus is a public health problem in developing and developed world, according to WHO, India will be world diabetic capital in 2025 [1].The world health organization estimates that more than 180 million people worldwide have diabetes and by 2030 it is expected that this number will have double. The organization of reduced lung function and diabetes mellitus (DM) has been described for many years. Though great attention was centered on the diabetic complications which had a cardiovascular nature, nephropathy, diabetic retinopathy, and neuropathy, the pulmonary complications of type 2 diabetes mellitus have been poorly characterized (Figure.1).

Several studies have suggested that diabetes is associated with impaired pulmonary function. DM affects almost all the organ systems in the body producing biochemical, morphological and functional abnormalities mainly of collagen and elastine. The alterations in these scleroproteins in turn affect the mechanical behavior of the lungs manifesting in altered lung volumes measured by pulmonary function tests. The underlying mechanism seems to be microangiopathy brought in by the non enzymatic glycosylation of various scleroproteins in lungs and elsewhere. Since collagen is the most abundant tissue protein in major bronchi, vessels and interstitium, the alterations in pulmonary functions occur as a rule.

The aim of the present study is to assess the effects of chronic hyperglycaemia on lung functions, which focused on mechanical aspects of lung dysfunction – maximal forced spirometric pulmonary function tests like FVC, FEV1, PEFR, FEV1/FVC% to be specific.

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Spirometry is the most common of the pulmonary function test (PFTs) which measures mechanical lung function, specifically the amount (volume) and or speed (flow) of air that can be inhaled and exhaled.

Figure. 1

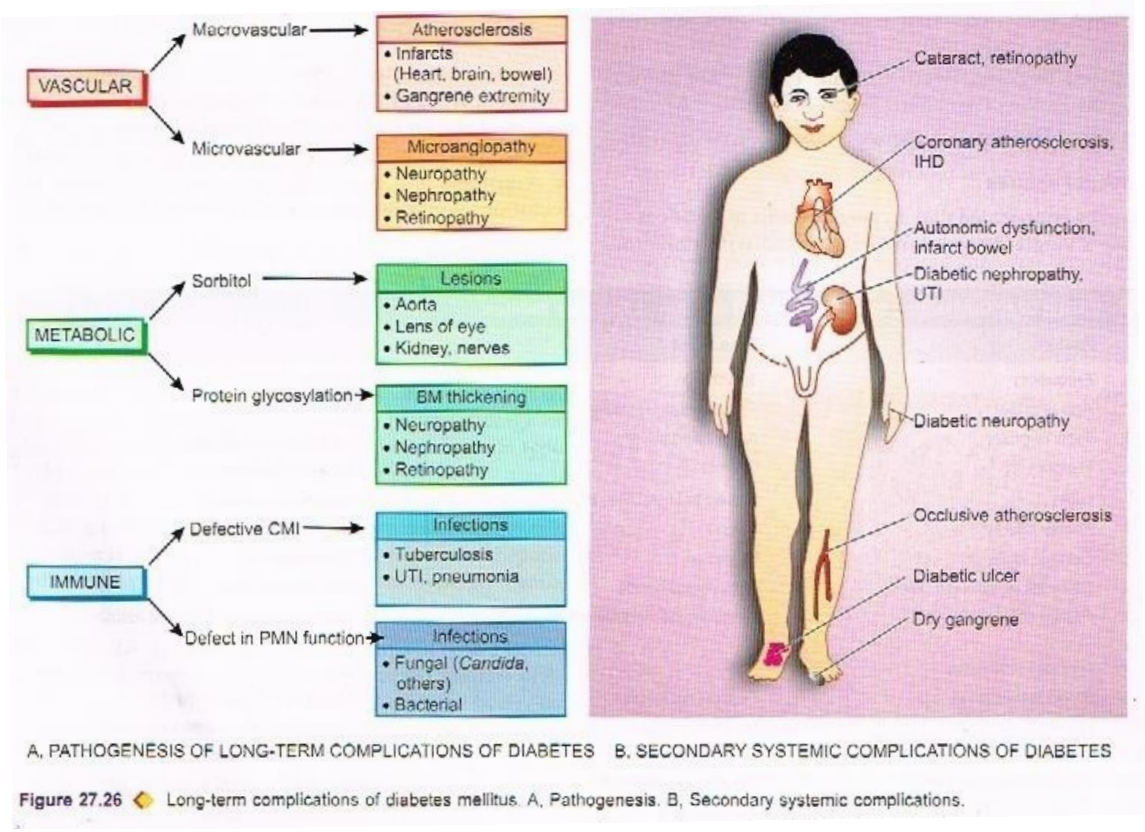


Figure 27.26 Long-term complications of diabetes mellitus. A, Pathogenesis. B, Secondary systemic complications.

Davis et al suggested that the lung is a target organ in DM and that glycemic exposure is a strong determinant of reduced pulmonary function in type 2 patients. Theoretically, several pathological changes may affect the lungs in patients with DM. Ljubic etal showed that diabetes could lead to the development of pulmonary complications due to collegen and elastin changes. Another theory suggested that increased non-ezymatic glycation of proteins and peptides of the extracellular matrix at chronic high circulating glucose levels may also have an important role in the pathological changes of the lungs in DM patients.

The present study was carried out to assess the lung functions in patients with DM taking oral medication and insulin administration in the Kolhapur district, Maharashtra, India because of the following reasons

The pulmonary complications of type 2 diabetes mellitus have been poorly characterized.

These complications have a significant impact on the quality of life of the affected individuals and they impose a heavy burden on health care providers worldwide.

Relatively few studies have been done on pulmonary mechanical function. The present study focused on mechanical aspects of lung dysfunction, maximal forced spirometric PFTs to be specific.

Most of the studies were done on type 1 diabetes. The present study was done on type 2 diabetes.

MATERIAL AND METHODS

DESIGN OF THE STUDY

A cross-sectional study, descriptive, prospective study of the lung function of diabetics compared with age and sex-matched non-diabetic controls.

MATERIALS

RMS Helios 702 spirometer, Microsoft Excel and SPSS Version 10 software.

METHODOLOGY

Over a period of 2 years, patients with type 2 diabetes mellitus who were attending medical OPD of Dr. D. Y. Patil Medical College Hospital were included in the study. They were requested to attend a medical interview, and underwent physical examination including fundoscopy. Non-smoking diabetic patients who had no history of respiratory disease, and who gave informed consent were selected for this study, and underwent pulmonary function testing. Healthy, non-smoking, non-diabetics who were matched for age and sex were chosen as controls, and also underwent pulmonary function testing. The results were entered on a Microsoft Excel spreadsheet and were analyzed using SPSS version 10.0 software.

INCLUSION CRITERIA

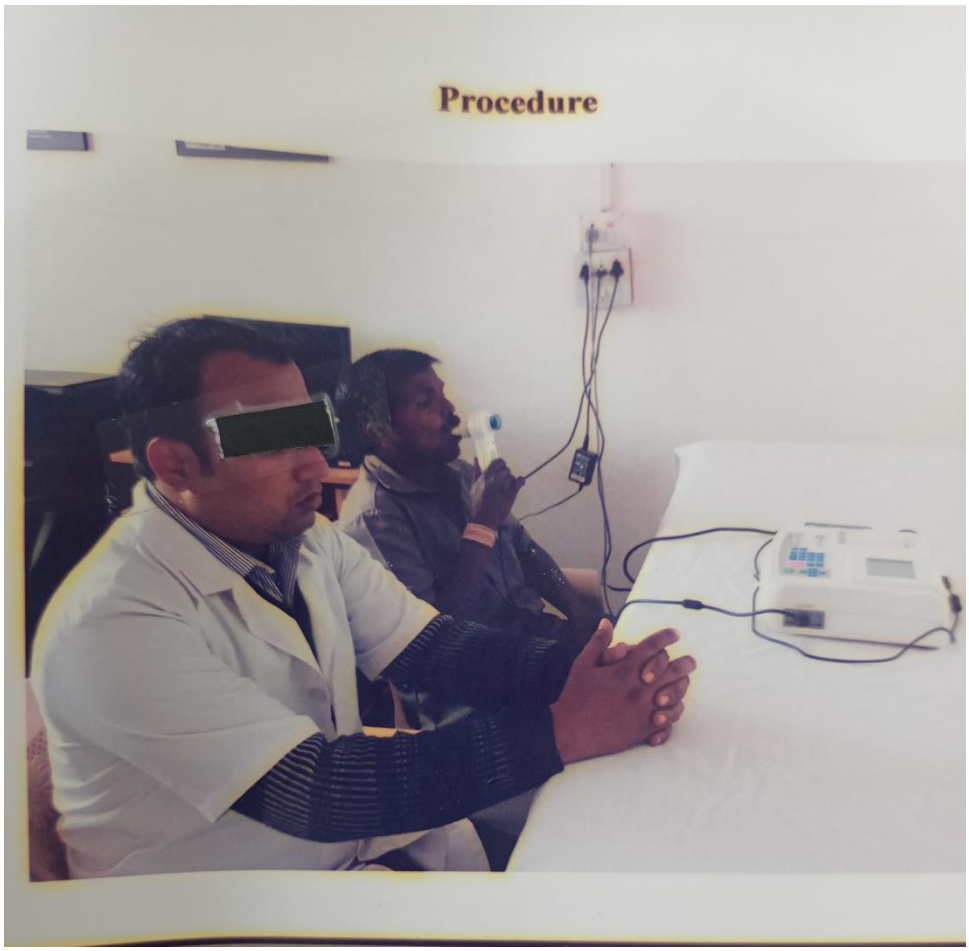
Type 2 Diabetes mellitus of at least 6months duration, able to give informed consent. Diabetics who have never smoked, with any past history of lower respiratory illness and who did not show at the time of the examination, symptoms related to respiratory illness. These included nasal itching, nasal congestion, running nose, dry throat, hoarseness, epistaxis, sneezing and pain suggestive of sinusitis, cough, expectoration and dyspnea.

EXCLUSION CRITERIA

SMOKERS

Present or past history of respiratory diseases that might affect lung function such as asthma, COPD, tuberculosis, bronchiectasis, interstitial lung disease.
History of occupational exposure to any substances that could affect lung function.
Individuals with current or recent upper respiratory or lower respiratory infection, that could pre-dispose to heightened airway reactivity.
Individuals with unacceptable spirometric technique. An unacceptable spirometry was that in which FEV1 or FVC could not be correctly measured due to Cough,
Obstruction of teeth or tongue
Sub-maximal effort
Air escape
Effort sustained for less than 6 seconds duration
Failure to attain a plateau on volume time curve
Lack of understanding of the procedures
Recent surgery.
RMS Helios spirometer calibrated daily, was used for all pulmonary function measurements according to ATS performance criteria.
The subjects' details including age, sex, and height of the subject were recorded on the patient data sheet of Spirotrac was software. The test procedure explained to the subjects. The object of the test was to obtain reproducible records of the flow volume loop and a volume time curve. All efforts were made to secure three satisfactory and reproducible expiratory maneuvers, and the best results ("ATS best") recorded in an ATP (ambient, temperature and pressure, saturated) scale (Figure.2). The final spirometric reports were saved and analyzed using Microsoft Excel worksheet and SPSS software.

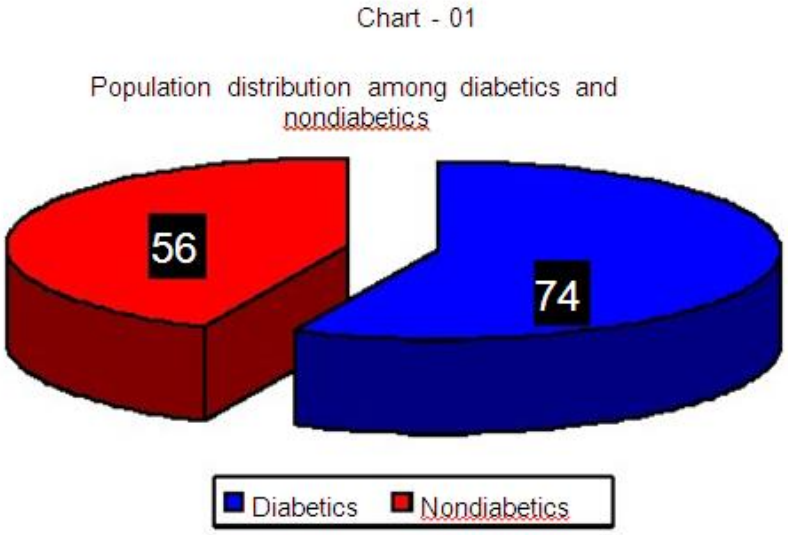
Figure. 2



INSTRUMENTS USED DURING RESEARCH WORK

OBSERVATION AND RESULTS

A total number of 130 cases were suitable for analysis. There were 74 diabetics (STUDY GROUP) and 56 non-diabetics (CONTROL GROUP).



Spirometric values were consistently lower in diabetic than non-diabetic (Table.1).When diabetics with duration of diabetes greater than 5 years were considered. Spirometric values were consistently lower in diabetics >5 years (Table.2). The test used for statistical analysis is unpaired T test Welch corrected.

**Highly significant

***Extremely significant

Table no.1: PFT parameters between Diabetic and Non diabetic control group

	DM	NDM	P Value
FVC Pred	13.78 ± 7.12	14.72 ± 7.54	0.942
FVC Observed	5.7 ± 1.3	6.32 ± 0.78	0.004
FVC Pred %	465.1 ± 215.48	613.74 ± 248.92	<0.002
FEV 1 Observed	7.74 ± 3.9	10.6 ± 3.6	<0.002**
FEV 1 Pred %	334.6 ± 154.34	480± 170.94	<.00002***
FEV 1/FVC Pred %	137.06 ± 30.98	155.18 ± 23.82	0.0004**
FEV1/FVC Observed	108.6134 ± 25.56	137.4 ± 33.46	P<0.0002**
FEV 1/FVC Pred	162.82 ± 23.36	176.196 ± 28.9	P<0.0002**
PEFR Pred.	11.64 ± 2.42	14.02 ± 1.08	P<0.002***
PEFR Observed	11.7 ± 4.42	16.94± 5.9	P<0.0002***
PEFR Pred %	198.6 ± 73.2	249.56±53.32	P=<.0002***
MVV pred	171.04±33.2	192.56±19.2	P<0.0002

Table no.2: PFT parameters according to duration of diabetes

	Less < 5	Greater > 5	
FVC Pred	14.9 ± 7.26	11 ± 6.06	P=0.066
FVC Observed	5.7 ± 1.14	5.72 ± 1.68	P=1.898
FVC Pred %	503.88 ± 217.32	367.26 ± 198.66	P=0.026
FEV 1 Observed	8.28 ± 3.98	6.38 ± 3.4	P=1.9
FEV 1 Pred %	353.26 ± 154.82	296.56 ± 132.18	P=0.1914
FEV 1/FVC Pred	132.6 ± 31.68	148.1 ± 27.3	P=0.0908**
FEV1/FVC Observed	107.54 ± 25.26	111.14 ± 26.7	P=1.18
FEV 1/FVC Pred %	167.6 ± 21.4	151.68 ± 24.9	P=0.03**

PEFR Pred	11.98 ± 2.36	10.76 ± 2.36	P=0.1002
PEFR Observed	15.516 ± 19.38	10.16 ± 4.26	P=0.1228
PEFR Pred %	239.76 ± 237.06	182.26 ± 68.46	P=0.1228
MVV	176.192 ± 30.16	158.038 ± 37.52	P=0.1228

DISCUSSION

This study was undertaken to assess the ventilatory function in patients with type II diabetes mellitus and compare it with those of non-diabetic healthy subjects of same age groups; to correlate changes in PFT with duration of disease. Few studies have focused on the relationship between pulmonary function and diabetes. Most such studies have been conducted on subjects with type 1 diabetes.

In this study, there were a larger number of females than males (66.2% vs 33.8%). Because most males were excluded on smoking history.

The different groups i.e diabetic and non-diabetics were comparable in terms of age, height and weight. The main determinants of ventilatory differences are the presence of diabetes mellitus were it is compared with control groups.

They are groups according to BMI and duration of diabeties. The smokers and respiratory disease are excluded .In the study of Hiroshi Mori [2], smokers were included in the analysis, and this was therefore an additional confounding variable.

Non diabetic subjects had higher mean values on all parameters than diabetic subjects.

When duration of disease was compared with all parameters FVC, FEV1, FEV1/FVC%, PEFR and MVV the following was observed:

There was a tendency for all parameters to fall with longer duration of diabetes. However, a multiple regression analysis showed that this was not significant. Those with a longer duration of diabetes also were older, and the effect of decline in lung function with age was a greater contributing factor.

Poor diabetic control was associated with poorer lung function.

In our study diabetics showed reduced lung function .Mean values in diabetics was less when compared with non–diabetics for FVC, FEV1, FEV1/FVC% PEFR and MVV. Our study is in agreement with the previous studies in which they have found diminished lung function among type 2 diabetic subjects .Both in the Copenhagen city heart study [3] and in the Fremantle diabetes study, lung function among diabetic subjects are diminished when compared with the lung function among controls. Walter et al [4] found that both the diagnosis of diabetes and an elevated level fasting blood glucose were associated with lower than predicted levels of pulmonary function. Our result confirms these previous findings.

Our study shows a strong association with the duration of disease and decreased pulmonary function in diabetic patients .Type 2 diabetics with duration longer than 5 years showed reduction in FVC, FEV1, PEFR and staistically significant reduction in FEV1/FVC. According to a study by Asanuma, Lange et al & Boulbou et al [5] FVC and FEV1 were reduced in diabetic subjects when duration of disease is considered. Our result for FVC and FEV1 confirms the results observed by them. They also found that both IDDM and NIDDM patients are associated with reduction in FVC and it was because of impaired defense against environmental challenges such as smoking and airway infections in diabetes.

The association between PFT & diabetes is also affected by age, sex and BMI. Diabetics showed reduction in PFT when compared with matched control.

We observed significant reduction in mean FVC in all diabetic patients and the reduction was more pronounced in female diabetics than male diabetics.

Age was found to be significant determinant of PEFR in the FDS. The age of the diabetic subject with ventilatory defects was also significantly higher than the age of the diabetes

subjects with normal ventilatory function, reflecting the expected age-related decline in lung function.

The effect of BMI in reducing lung function has been well documented. Another more important effect of BMI on lung function is related to the metabolic syndrome in which low grade inflammation plays a central role in the development of diabetes as well as reduced lung function.

Some of the prospective and cross sectional studies have shown low vital capacity or restrictive pattern in type 2 DM. Meta-analysis by Vandenborst et al showed that DM is associated with statistically significant impaired pulmonary function in a restrictive pattern. More ever these results were irrespective of body mass index (BMI), smoking, diabetes duration and HBA1c levels.

On correlating the FVC and FEV1 with duration of disease we found that there is no significant correlation between them.

Uchida et al [6] found that there was decreased pulmonary diffusing capacity in patients with diabetes with perfusion defect on ventilation perfusion scintigrams. It was not possible for us to analyze the pulmonary diffusing capacity because of practical difficulties.

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DECLARATION OF CONFLICT OF INTEREST

None

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