



A STUDY ON THE ALTERATION OF RESPIRATORY FUNCTION IN PATIENTS WITH DIABETES MELLITUS

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ABSTRACT To study the alteration, determine and correlate the type of pulmonary function in diabetes that is restrictive or obstructive or mixed with respect to duration of Diabetes, glycemic control and the presence of micro vascular complications. A total of 100 patients are studied in a Tertiary Care Hospital. 77% patients had normal respiratory function and 23% patients had restrictive pulmonary function. No patients had any obstructive or mixed air way disorder.

KEYWORDS : Respiratory Function, Diabetes Mellitus, Micro vascular

INTRODUCTION

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 doubled ⁽¹⁾. There is an alarming increase in the incidence and prevalence of diabetes in Asian Indians⁽²⁾.

Diabetes is a micro-macro vascular disorder with debilitating effects on many organs. Pulmonary complications of Diabetes Mellitus (DM) have been poorly characterized with conflicting results. The alveolar capillary network in the lung is a large micro-vascular unit and may be affected by micro angiopathy³.

In DM pulmonary functions have been studied frequently in countries other than India⁽⁴⁾ while in our country there are few studies concerning these abnormalities and their relationship with glycosylated hemoglobin (HbA1c) and duration of the disease.

Effect of diabetes on lung capacity have been reported previously but with controversial results. Despite the unclear nature, the relationship between DM and pulmonary function tests (PFTs) remains important because of potential epidemiological and clinical implications. The loss of pulmonary reserve may become clinically important.

AIMS AND OBJECTIVES

1. To study the alteration in pulmonary function in diabetic patients.
2. To determine the type of alteration in pulmonary function in diabetes, that is, restrictive/ obstructive/ mixed.
3. To correlate the alteration of respiratory function with respect to duration of Diabetes, glycemic control and the presence of micro vascular complications.

MATERIAL & METHODS

The present study is carried out in a Tertiary Care Hospital, from December 2017 to November 2019. A total of 100 patients with alteration of Respiratory Function in patients with Diabetes Mellitus were included in this study.

Inclusion Criteria

Patients diagnosed to have Diabetes, both male and female in the age group 18-60 years.

Exclusion Criteria

Patients with history of any chronic respiratory diseases like Asthma, COPD and Pulmonary Tuberculosis. A) Occupational exposure to smoke B) BMI >35.

After obtaining informed consent, a total of 100 patients with Diabetes meeting the inclusion and exclusion criteria, attending the Out Patient Department (OPD) Tertiary Care Hospital, during December 2017 to November 2019 were selected randomly for the present study.

The respiratory function among the patients was measured by Pulmonary Function Test Spirometry. All these subjects were subjected to Spirometry using Portable Spirometer (RMS Helios 401).

The outcomes of the test were classified as:

Normal if FEV1/FVC% was greater than 70%, Obstructive ventilatory defect if FEV1/FVC less than 70%. Restrictive ventilatory defect if the ratio of FEV1/FVC greater than 70% and the ratio of obtained FVC/predicted FVC less than 80%. Mixed ventilatory defect if FEV1/FVC was less than 70% and the ratio of obtained FVC to predicted FVC was less than 80%.

All the patients were also assessed for the presence of other microvascular complications.

Diabetic Retinopathy diagnosis was made by fundoscopy, defined as at least one micro aneurysm in either eye or worse. A diagnosis of neuropathy was defined as a score of >2/8 using the Michigan Neuropathy Screening Instrument clinical portion⁽⁵⁾.

HbA1c of all the patients was estimated by ion exchange resin method.

RESULTS

Age Distribution

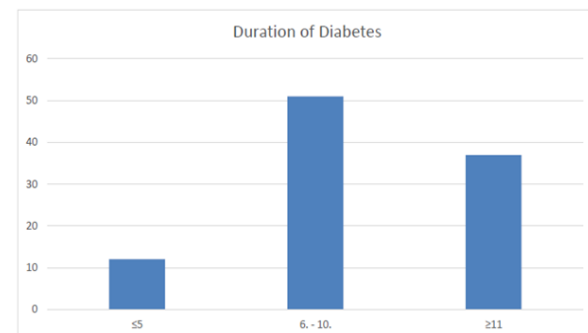
In the present study, the mean age in the study population was observed to be 47.29 ± 9.2 years. The age range was observed to be between 18 – 60 yrs.

Distribution Of Patients Based On Age

Age Group (in Years)	Frequency	Percentage
≤ 20	2	2.0
21-30	6	6.0
31-40	7	7.0
41-50	42	42.0
51-60	43	43.0
Total	100	100

Diabetes Duration And HbA1c Levels

	Mean	SD
Duration of DM (in years)	9.29	3.67
HbA1c (in gm%)	7.68	1.69



Duration Of DM Among The Study Population

In the present study 51 % patients had duration of diabetes between 6 - 10 years, followed by 37% had duration of diabetes of ≥ 11 years and 12 % patients had duration of diabetes ≤ 5 years.

Frequency Of Each Type Of Micro Vascular Complication

	Frequency	Percent
None	65	65.0
Retinopathy only	7	7.0
Nephropathy only	5	5.0
Neuropathy only	3	3.0
Retinopathy + Nephropathy	12	12.0
Nephropathy + Neuropathy	2	2.0
Retinopathy + Neuropathy	0	0.0
Retinopathy + Nephropathy + Neuropathy	6	6.0
Total	100	100

Pulmonary Function Test: Mean Spirometry values

	Mean	SD
FEV1	2.35 L	0.31L
FEV1% of predicted	94.40	8.82
FVC	2.93 L	0.49 L
FVC % of predicted	85.58	9.11
FEV1 / FVC%	80.95	6.10

Frequency Of Altered Respiratory Function

Respiratory Function	Frequency	Percent
Normal	77	77.0
Restrictive	23	23.0
Obstructive	0	0.0
Mixed	0	0.0
Total	100	100

Correlation Of Spirometry Parameters With Duration Of DM, HbA1c And The Presence Of Microvascular Complications Of DM

		Duration DM	HbA1c	Micro vascular Complications
FEV1% predicted	r value	307	594	509
	p value	002	<0.001	<0.001
FVC% predicted	r value	530	664	417
	p value	<0.001	< 0.001	< 0.001
FEV1 / FVC%	r value	102	363	168
	p value	313	< 0.001	094

DISCUSSION

In the present study 100 patients of DM were selected randomly over a period of 2 years from the Out Patient Department of Osmania General Hospital.

Parameter	Present Study	Swati H. Shah et al
Number of DM	100	60
Mean age	47.29 $\pm$ 9.2 years	53.9 $\pm$ 8.45 years
Duration of DM	9.29 $\pm$ 3.67 years	6.56 $\pm$ 5.86 years
HbA1c	7.68 $\pm$ 1.69 gm%	7.12 $\pm$ 1.36 gm%
FEV1 % of predicted	94.40 $\pm$ 8.82	78.98 $\pm$ 14.09
FVC % of predicted	85.58 $\pm$ 9.11	77.97 $\pm$ 12.99
FEV1 / FVC%	80.95 $\pm$ 6.10	112.83 $\pm$ 9.35

The present study is a cross-sectional study whereas the study by **Swati H. Shah et al.** was a case control study where 60 patients of DM were compared with 60 healthy subjects (controls)

However in the present study, the FEV1/FVC% of the study population was in the normal range, that is, 80.95 $\pm$ 6.10 as compared to the FEV1/FVC% in the study by **Swati H. Shah et al.** which was increased (112.83 $\pm$ 9.35) but both studies indicate a restrictive pattern of lung disease on PFT.

In a study by **Nidhi et al**⁷ the respiratory functions namely FVC, FEV1 and PEF were found to be significantly decreased ($P < 0.001$) in type 2 diabetes mellitus while FEV1/FVC was not significantly decreased ($P = 0.645$). There was no significant difference seen with duration of the disease ($P > 0.05$).

The duration of DM among patients with restrictive lung disease was 10.87 $\pm$ 3.11 years which was longer when compared to the duration of DM among patients without restrictive lung disease which was 8.82 $\pm$ 3.71 years. This indicates that a longer duration of DM is a risk factor

for the occurrence of restrictive lung disease.

The above findings can be explained by the physiological loss of elasticity of connective tissue with age and the acceleration of aging process in connective tissue by the presence of non-enzymatic glycosylation and modification of alveolar surfactant action in the presence of elevated blood sugar levels⁽³⁾.

In the study by **Weynand et al.**⁽⁸⁾ it was found that alveolar epithelium, endothelium capillary, and basal laminae were thickened in lungs on electron microscopy, when compared with the controls.

In the previous studies no emphasis was given to the correlation of the occurrence of micro vascular complications and alteration of PFTs. In the present study, it was observed that 73.9% patients with restrictive lung disease had other micro vascular complications like retinopathy, neuropathy and nephropathy.

A study by **Sinha et al**⁽⁹⁾ concluded that impairment of pulmonary diffusion capacity for carbon monoxide was common in T2DM Asian Indian patients having micro angiopathy.

In a study by **Adeyeye et al**⁽¹⁰⁾, more than half of the diabetics, that is, 114(57%) had abnormal ventilatory pattern with 76(38%) having restrictive defect. There was significant associations between Age ($r = -28$, $p = 0.00$), duration of DM ($r = -15$, $p = 0.34$) and lung function which is identical to the observations of the present study. A possible predictor of abnormal pulmonary function test was the presence of hypertension (Odds ratio=0.39, $p = 0.009$).

According to **The Fremantle Diabetes Study**⁽¹¹⁾, one of the largest studies on the effect of DM on PFT included 495 subjects out of which 125 subjected were followed up. The FVC, FEV1, VC, and PEF decreased at an average of between 1.1 and 3.1% per year. Glycemic exposure (principally in the form of the updated mean or follow-up HbA1c) was a strong and consistent negative predictor of follow-up lung function which is in agreement with the results of the present study.

In a study by **Kaur S et al**⁽¹²⁾, there was significant reduction in all the PFT parameters (FVC%, FEV1% and FEV1/FVC) in diabetics as compared to controls. Thus, mixed obstructive-restrictive pattern of pulmonary dysfunction was seen where as in the present study the PFT showed only restrictive pattern.

Functional lung impairment was observed in 54% of patients, which was graded according to American thoracic society (ATS) criteria of restrictive lung diseases based on FVC% (44). In the present study, 77% of the cases had normal lung function; 23% had mild restrictive lung impairment. None of the diabetics had severe or very severe restrictive pattern of lung impairment.

SUMMARY

In the present study it was observed that in the 100 patients of DM, 43 patients were in the age group of 51 – 60 yrs. The mean age in the study population was observed to be 47.29 $\pm$ 9.2 years.

77% patients had normal respiratory function and 23 % patients had restrictive pulmonary function. No patients had any obstructive or mixed air way disorder.

The mean FEV1 % and FVC% was significantly lower in patients with HbA1c > 7 gm% compared to patients with HbA1c < 7 gm%. Mean FEV1/FVC % was significantly higher in patients with HbA1c > 7 gm% indicating a restrictive pattern of PFT among patients with poorly controlled DM.

It is observed that 73.9% patients with restrictive lung disease had micro vascular complications which were significantly higher than the occurrence of micro vascular complications among patients with normal lung function.

65 patients did not have any micro vascular complications of which only 6 had restrictive lung disease.

Mean duration of diabetes and HbA1c was observed to be significantly higher in patients with restrictive disease than when compared to normal patients.

There was a significant and negative correlation between FVC% of predicted and FEV1% of predicted with duration of DM, HbA1c levels and the presence of micro vascular complications.

There was a significant and positive correlation between FEV1/FVC% with HbA1c levels.

CONCLUSIONS

- The prevalence of restrictive lung disease in the present study was found to be 23% which suggests that the lung is a target organ in diabetes.
- The prevalence of restrictive lung disease was higher among patients with poor glycemic control and in patients with other micro vascular complications indicating that uncontrolled DM is a strong determinant of reduced pulmonary function.
- Duration of diabetes is also an indicator of poor lung function. Furthermore, because measures of airflow limitation predict allcause mortality in diabetes, intensive glycemic management may reduce the risk of death through improved ventilator function independent of other beneficial effects.

REFERENCES

1. World Health Organization. Fact sheet: Diabetes No 312, November 2008. [Last accessed on 2009 Apr 14].
2. King H, Aubert RE, Herman WH. Global burden of diabetes 1995 to 2025. Prevalence, numerical estimates and projections: Diabetes Care: 1998;21:1414–31.
3. Sandler M. Is the lung is target organ in diabetes mellitus? Arch Intern Med.1990;150 :1385–8)
4. Klein OL, Krishnan JA, Jlick S, Smith LJ. Systematic review of association between lung function and type 2 diabetes mellitus. Diabet Med. 2010;27:977–87.
5. Feldman E, Stevens M, Thomas P, Brown M, Canal N, Greene D: A practical two step quantitative clinical and electrophysiological assessment for the diagnosis and staging of diabetic neuropathy. Diabetes Care 17:1281–1289, 1994
6. Swati H. Shah, PranaliSonawane , Pradeep Nahar et al. Pulmonary function tests in type 2 diabetes mellitus and their association with glycemic control and duration of the disease: Lung India. 2013 Apr-Jun; 30(2): 108–112)
7. NidhiAnand, &Nayyer, P.S. &Rana, Vevek&Verma, Swati. (2016). Changes in pulmonary functions in type 2 diabetes mellitus. Indian Journal of Medical Specialities. 8. 10.1016/j.injms.2016.09.007)
8. (Weynand B, Jonkheree A, Frans A, Rahier J. Diabetes mellitus induces a thickening of the pulmonary basal lamina. Respiration;1999;66(1):14-9).
9. Sinha S, Guleria R, Misra A, Pandey RM, Yadav R, Tiwari S. Pulmonary functions in patients with type 2 diabetes mellitus and correlation with anthropometry and microvascular complications. Indian J Med Res. 2004;119:66–71.
10. Adeyeye et al., Correlates of Abnormal Pulmonary Function Tests in Persons with Type 2 Diabetes Mellitus J PulmRespir Med 2014, 5:1
11. Davis WA, Knuiman M, Kendall P, Grange V, Davis TM. Glycemic exposure is associated with reduced pulmonary function in type 2 diabetes, the fremantle diabetes study. Diabetes Care. 2004;27:752–7.
12. Kaur S, Agarwal N. Pulmonary Function Tests in Type 2 Diabetes Mellitus. Arch Med Health Sci 2016;4:35-9.