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Original Research Paper

General Medicine

STUDY OF PULMONARY FUNCTION TEST IN PATIENTS OF TYPE 2 DIABETES MELLITUS AND ITS CORRELATION WITH DURATION OF DIABETES

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ABSTRACT

Aim-Pulmonary complications of diabetes mellitus (DM) have been poorly characterized. The study was undertaken to analyze the pulmonary function parameters in type 2 diabetic patients. We correlated forced vital capacity (FVC) and FEV1/FVC in diabetic patients with duration of the disease and Glycosylated hemoglobin (HbA1c) and fundoscopic changes.

Subjects and methods-Pulmonary function tests (PFTs) were recorded in 70 type 2 diabetic patients, who were divided into two groups, depending upon duration of diabetes. Group I 5 to 10 years and group II 11 to 15 years .Using easy one flow spirometer, PFT parameters were recorded. The PFTs recorded were – FVC, FEV1, FEV1/FVC, and peak expiratory flow rate (PEFR). In addition HbA1c,FBS and PPBS and fundoscopic changes of all the patients was estimated.

Results -In our study Restrictive lung function defect was more commonly found among patients of type 2 diabetes mellitus.
Poor lung functions are in correlation with longer duration of T2DM.

Conclusion -DM being a systemic disease, which also affects lungs causing restrictive type of ventilator changes probably because of glycosylation of connective tissues, reduced pulmonary elastic recoil and inflammatory changes in lungs.
Lung function parameters are negatively correlated to glycemic status and duration of diabetes. Hence strict glycemic control may improve pulmonary functions

KEYWORDS : Pulmonary Function Test; Type II Diabetes Mellitus; HbA1C; Spiro meter.

INTRODUCTION

Diabetes mellitus is a metabolic disorder characterized by hyperglycemia resulting from defects in insulin secretion, action or both.Diabetes mellitus is accompanied by wide spread biochemical, morphological and functional abnormalities which may precipitate certain complications that affect the renal, cardio-vascular, neural systems and also skin, liver, collagen and elastic fibres. Thus diabetes is a multisystem disorder that affects many organs of the body.[1]

The incidence of Type 2 diabetes has been steadily increasing in urban areas to 8.4% [.2]The rapid urbanization, change in the lifestyle coupled with ethnic susceptibility has increased the incidence of diabetes mellitus.

There are histopathological changes seen in lungs of diabetics such as thickened alveolar epithelial and pulmonary capillary basal lamina leading to reduced pulmonary elastic recoil and lung volume. There is impaired diffusion due to reduced pulmonary capillary blood volume and thickening at the basement membrane. Non- enzymatic glycosylation induced alteration of lung connective tissue is the most likely mechanism underlying the mechanical pulmonary dysfunction in diabetic subjects. This suggests that lung is also a target organ [3]

Spirometry is a widely used pulmonary function test (PFT), ideally suited to describing the effects of obstruction or restriction of lung function. It is a powerful diagnostic tool that plays a significant role in the early diagnosis of lung damage and its associated structures. It is also used to monitor the therapeutic efficacy of various treatment regimens and the course of the disease

In spite of this, spirometry is not used routinely as part of a management system in diabetic patients. The aim of the present study is to highlight the evidence based significance of spirometry. It may serve as a brief reference for diabetes management teams to enable spirometry to be included in the algorithm of the routine assessment of diabetic patients.

The normal lung mechanics and gas exchange are influenced by the integrity of the pulmonary connective tissue and microvasculature. Diabetes mellitus causes abnormalities in either of these two structural components leading to the development of abnormalities in the pulmonary function such as a reduction in the vital capacity, Total lung capacity, lung compliance.It also results in reduction of central and peripheral airflows, acceleration of the aging process, alteration in the pulmonary connective tissue, thickening the alveolar and capillary endothelial basement membranes, modification of the alveolar surfactant and altering its functions, pulmonary microangiopathy ,which brings about reduction in diffusing capacity and the muscle endurance.[1]

The diabetic lungs are also prone to infections and complications such as Pneumothorax, pluging of airways, pulmonary edema, pulmonary effusion and respiratory failure.[4]

AIMS AND OBJECTIVES

1) To study the pulmonary function pattern (spirometric variables) in patients of type 2 diabetes mellitus,
2) To study the effect of glycemic control on spirometric variables in patients of type 2 diabetes mellitus
3) To study the effect of duration of type 2 diabetes on spirometric variables

MATERIALS AND METHODS

SOURCE OF DATA

Patients visiting Medicine OPD and patients admitted in medical wards of SDM medical college hospital , Dharwad
during the period of Nov 2016 to oct 2017 were taken for study considering the inclusion and exclusion criteria.

METHOD OF COLLECTION OF DATA:

Information was collected through prepared proforma for each patient
Sample Size: 70 diabetic subjects meeting the criteria for the present study

Inclusion Criteria

1. Previously diagnosed type 2 Diabetic patients
2. Type 2 Diabetes mellitus with age group of 30 – 60 years.
3. Who gives written informed consent.

Exclusion Criteria

Bronchial Asthma. , COPD . History of Pulmonary Tuberculosis. History of cardiovascular disease , Smokers , ILD

METHODOLOGY

Information was collected through a pre tested and structured proforma for each patient

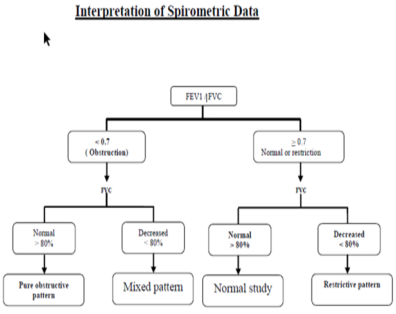
Qualifying patients underwent detailed history, clinical examination, routine investigations like FBS, PPBS, HBA1c, Fundus evaluation and spirometric evaluation using a easy one flow spirometer.

Glycemic control is taken as HBA1C below 7.5 and HBA1C more than 7.5 is considered as uncontrolled diabetes

Diabetic patients of different durations are selected Using criteria laid down

Group I: Type 2 diabetes mellitus of 5-10 year duration
Group II: Type 2 diabetes mellitus of 11-15 year duration

Using the spirometric variables like FEV1, FVC and FEV1/FVC ratio and PEFR, results are interpreted as restriction/obstruction or mixed pattern or normal .



STUDY DESIGN :

Hospital based cross sectional study

STATISTICAL ANALYSIS :

Chi square test and correlation with duration of type 2 DM and other parameters by Karl Pearson's correlation coefficient method

RESULTS

Table1: Distribution of male and females in two study groups

Gender	Group 1	%	Group 2	%	Total	%
Male	21	60.0	25	71.4	46	65.7
Female	14	40.0	10	28.6	24	34.3
Total	35	100.0	35	100.0	70	100.0
Chi-square=1.0142 P = 0.3143						

Group 1 consisted of 21 males and 14 females whereas group 2 also had majority of males (25) than females (10)

Table2 : Distribution of patients in two study groups by age groups

Age groups	Group 1	%	Group 2	%	Total	%
31-40yrs	12	34.3	0	0.0	12	17.1
41-50yrs	14	40.0	5	14.3	19	27.1
51-60yrs	9	25.7	30	85.7	39	55.7
Total	35	100.0	35	100.0	70	100.0
Chi-square=22.3747 P = 0.0001*						
Mean age	46.11		55.03		50.57	
SD age	7.57		3.91		7.48	

Group 1 had majority of patients between age of 41- 50 years and group 2 had majority of patient between 51 to 60 years

Table2 : Distribution of patients in two study groups by age groups

Age groups	Group 1	%	Group 2	%	Total	%
31-40yrs	12	34.3	0	0.0	12	17.1
41-50yrs	14	40.0	5	14.3	19	27.1
51-60yrs	9	25.7	30	85.7	39	55.7
Total	35	100.0	35	100.0	70	100.0
Chi-square=22.3747 P = 0.0001*						
Mean age	46.11		55.03		50.57	
SD age	7.57		3.91		7.48	

Group 1 had majority of patients between age of 41- 50 years and group 2 had majority of patient between 51 to 60 years

Fig 1:Comparison of two study groups with status of HBA1c

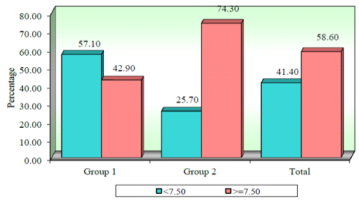


Table 4 : Comparison of two study groups with Fundoscopic changes

Fundoscopy	Group 1	%	Group 2	%	Total	%
Mild NPDR	15	42.9	35	100.0	50	71.4
Moderate NPDR	1	2.9	0	0.0	1	1.4
Normal	19	54.3	0	0.0	19	27.1
Total	35	100.0	35	100.0	70	100.0
Chi-square= 26.0784 P = 0.0001*						

*p<0.05

In group 1, 15(71.4%) patient had mild NPDR whereas all patient in group 2 had mild NPDR, only 1 patient in group 1 had moderate NPDR and none of the patient in group 2 had moderate NPDR change

Table5 : Comparison of two study groups with Spirometry result

Spirometry result	Group 1	%	Group 2	%	Total	%
Obstruction	2	5.7	5	14.3	7	10.0
Restriction	12	34.3	27	77.1	39	55.7
Normal	21	60.0	3	8.6	24	34.3
Total	35	100.0	35	100.0	70	100.0
Chi-square=20.5555 P = 0.0001*						

*p<0.05

In group I out of 35 patients, 2(5.7%) patients had obstructive pattern and 12(34.3%) patients had restrictive pattern

In group II, 5(14.3%) patients had obstructive pattern whereas 27(77.1%) patients had restrictive pattern on spirometry which reflects effect of duration of type 2 DM .

Out of total 70 patients, 7(10%) patients had obstructive pattern and 39(55.7%) patient had restrictive pattern on spirometry with p value of 0.0001 which significantly correlates with duration of diabetes in type 2 patients.

Fig 2 : Comparison of two study groups with Spirometry result

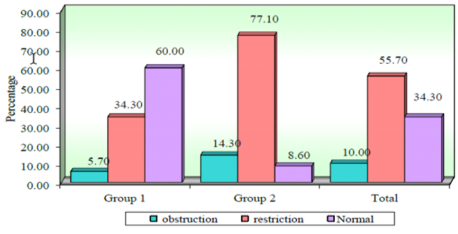


Table 6 Comparison of two study groups with HBA1c scores by t test

Group	Mean	SD	SE	t-value	p-value
Group 1	7.73	1.35	0.23	-0.4970	0.6208
Group 2	7.88	1.08	0.18		

Mean HBA1c level in group 1 was 7.73 and in group 2 was 7.88

Table 7 : Comparison of two study groups with FVC scores by t test

Group	Mean	SD	SE	t-value	p-value
Group 1	77.91	9.64	1.63	2.5923	0.0117*
Group 2	72.20	8.79	1.49		

*p<0.05

In our study mean FVC value was 77.91 in group 1 whereas 72.20 in group 2 suggesting a more decrease in FVC in group 2 with increased duration of type 2 DM

Fig 3 : Comparison of two study groups with FVC scores

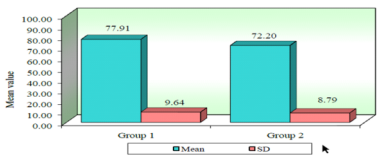


Fig 4 :Comparison of two study groups with FEV1/FVC scores by t test

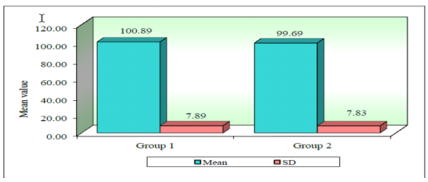


Table 8 HBA1c Vs Spirometry result in two groups

Groups by duration	HBA1c	Spirometry result						
		obstruction	%	restriction	%	Normal	%	Total
Group 1	<7.50	0	0.00	2	10.00	18	90.00	20
	>=7.50	2	13.33	10	66.67	3	20.00	15
	Total	2	5.71	12	34.29	21	60.00	35
	Chi-square=17.6941 P = 0.0001*							
Group 2	<7.50	1	11.11	6	66.67	2	22.22	9
	>=7.50	4	15.38	21	80.77	1	3.85	26
	Total	5	14.29	27	77.14	3	8.57	35
	Chi-square=2.8921 P = 0.2362							

*p<0.05

In our study in group I ,2(10%)patients with HBA1C <7.5 had restrictive pattern

Out of 15 patients with HBA1C of more than 7.5, 10(20%) patients had restrictive pattern

Where as in group II, 6 patients with HBA1C < 7.5 had restrictive pattern

Out of 26 patients with HBA1C >7.5, restrictive pattern was seen in 21 patients.

Table 9 Fundoscopy Vs Spirometry result in two groups

Groups by duration	Fundoscopy	Spirometry result						
		Obstruction	%	Restriction	%	Normal	%	Total
Group 1	Mild NPDR	1	6.67	10	66.67	4	26.67	15
	Moderate NPDR	0	0.00	0	0.00	1	100.00	1
	Normal	1	5.26	2	10.53	16	84.21	19
	Total	2	5.71	12	34.29	21	60.00	35
Group 2	Mild NPDR	5	14.29	27	77.14	3	8.57	35
	Moderate NPDR	0	0.00	0	0.00	0	0.00	0
	Normal	0	0.00	0	0.00	0	0.00	0
	Total	5	14.29	27	77.14	3	8.57	35

In group I among 15 patients with mild NPDR, 10(66.67%) patients had restriction pattern on spirometry whereas 1 patient with moderate NPDR had normal spirometry.

In group II among 35 patients with mild NPDR 27(77.14%) patients had restriction pattern on spirometry.

Table 10 Correlation between duration with different parameters by Karl Pearson's correlation coefficient method

Parameters	Correlation between duration with		
	r-value	t-value	p-value
FBS	0.1090	0.9044	0.3690
PPBS	0.0205	0.1688	0.8665
HBA1c	0.0580	0.4794	0.6332
FVC	-0.2783	-2.3895	0.0196*
FEV1/FVC	-0.0283	-0.2337	0.8159

*p<0.05

FVC had negative correlation with duration of diabetes among patients with type 2 DM with p value of 0.0196

Table 11 Correlation between HBA1c Vs FEV1/FVC in group 1, group 2 and total samples by Karl Pearson's correlation method

Groups	Correlation between HBA1c vs FEV1/FVC in		
	r-value	t-value	p-value
Group 1	0.0347	0.1997	0.8429
Group 2	0.2528	1.5007	0.1429
Total	0.0347	0.1997	0.8429

Table 12 Correlation between HBA1c vs FVC in group 1, group 2 and total samples by Karl Pearson's correlation method

Groups	Correlation between HBA1c vs FVC in		
	r-value	t-value	p-value
Group 1	-0.4384	-2.8021	0.0084*
Group 2	-0.4630	-3.0008	0.0051*
Total	-0.4384	-2.8021	0.0084*

*p<0.05

In both group 1 and group 2 HBA1C has negative correlation with FVC, suggesting patients with poor glycemic control has decrease in FVC

DISCUSSION

The present study involved a total of 70 patients who were divided into two groups according to duration of type 2 diabetes mellitus.

Group I consists of type 2 diabetics of 5 to 10 year duration
Group II consists of type 2 diabetics of 11 to 15 years duration.
In our study out of 70 patients majority were males 65% (46). The male is to female ratio in our study is 1.9

The Group I had majority of patients between age of 41- 50 years 40%(14)

Group II had majority of patient between 51 to 60 years 85.7% [30]
In our study, Group I had 42.9%(15) patients with uncontrolled sugars as suggested by increased HBA1c levels i.e more than 7.5 and group II had 74.3%(26) patients with HBA1c levels of more than 7.5
Mean HBA1c level in group I was 7.73 and in group II was 7.88

In our study fundus examination was carried out in all the patients to look for retinopathy changes and to correlate with duration of diabetes and also its relation with spirometric changes .

In Group I, 42.9%(15) patients had mild NPDR changes and only 2.9%(1) patient had moderate NPDR and 54.3%(19) patients had normal fundus whereas in Group II all the patient had mild NPDR In our study, out of total 70 patients 55.7% (39)of patient had restrictive pattern on spirometry, 10%(7) patients had obstruction and 34.3%(24) had normal study.

In group I, 34.3%(12) patients had restrictive pattern on spirometry and 5.7%(2) patients had obstructive pattern and 60%(21) patients had normal spirometry.

In group II, 77.1%(27) patients had restrictive pattern on spirometry and 14.3%(5) showed obstructive pattern whereas only 8.6%(3) showed normal study.

In a study by Dharwadkar AR et al done on 40 Type-2 diabetic patients, aged 30-60 years, with diabetic duration of 1-20 years showed reduction in dynamic lung functions like FEV1, FEV1% & MEP and its negative correlation to glycemic status [8]

In another study by Aparna et al showed a statistically significant reduction in FVC, FEV1, PEFR in type 2 DM [14]

In a study by Hsin-ChiehYeh Et al conducted cross-sectional and prospective analyses of diabetes status and and the associated decline in lung function . Adults with diabetes had significantly lower predicted FVC and predicted FEV1 than those without diabetes as compared to those in the controls.[13]

A cross sectional study by Rodolfo J Dennis suggests inadequate glucose control may be simultaneously associated with inflammation and decreased lung function in type 2 diabetes[15]

In our study mean FVC value was 77 .91 in group I whereas 72.20 in group II.

In our study the mean FEV1/FVC in group I was 100.89 and in group II it was 99.69. Walter.E.Robert et al who studied the relationship between diabetes mellitus and pulmonary function and showed a

decrease in FVC by 109ml in diabetes mellitus[5]

Davis M.E. Timothy studied the pulmonary function and its association with Type-2 diabetes mellitus and showed an average decrease of 9.5% in FVC of diabetics [6]

The present study is in agreement with the previous studies in comparing FEV1 among diabetic. The mean values of FEV1 are low in diabetic group of subjects.

The present study is in agreement with Walter.E.Robert et al who studied the relationship between diabetes mellitus and pulmonary function and showed a decrease in FEV1 by 27ml in diabetic subjects [5].

Asanuma et al.[7] Lange et al [8] reported that FVC and FEV1 were reduced in subjects with diabetes when compared to control subjects

Our observations are in agreement with Lange et al [9] who reported that both IDDM and NIDDM are associated with slight reduction in FVC.

Similar observations were quoted in all age groups by Lange et al [9] in Copenhagen city heart study.

Masmoudi and Zouari concluded that pulmonary volumes impairments are slightly more marked with diabetes mellitus duration especially after 10 years.[12]

The hypothesis that relative stable respiratory function may be explained by a better metabolic control.[10]

Barrette-Connor E etcoll [11] who found that pulmonary function in older adults is altered in subjects with diabetes mellitus with duration more than 10 years.

In our study out of 15 patients with HBA1c of more than 7.5, 12 patients had restrictive pattern in group 1 where as in group 2 out of 26 patients with HBA1c more than 7.5, restrictive pattern was seen in 21 patients

In group I among 15 patients with mild NPDR, 10(66.67%) patients had restriction pattern on spirometry whereas 1 patient with moderate NPDR had normal spirometry

In group II, among 35 patients with mild NPDR ,27(77.14%) patients had restriction pattern on spirometry reflecting the diabetic changes with increased duration of type 2 DM in both eyes and the lungs

Conclusion

The relationship between diabetes mellitus and pulmonary function tests [PFT] remains important because of potential clinical implication. The loss of pulmonary reserve may become clinically important.

The involvement of respiratory system has been proved by many researchers, with changes in pulmonary volume, diffusion and elastic properties of lungs as well as the performances of the respiratory muscles leading to restrictive pattern in pulmonary functions.

Diabetes being systemic disease,also affects lungs causing restrictive type of ventilator changes due to glycosylation of connective

Even though Type2 diabetic patients did not have any respiratory symptoms they did have underlying subclinical restrictive patterns of lung functions.

Type 2 Diabetes mellitus is associated with restrictive pattern of lung function with increase in duration of diabetes mellitus .

As the duration of diabetes increases the restrictive profile is more prominent.

Poor glycemic control did have impact on changes in spirometric variables but not statistically significant

whereas increased duration of type 2 diabetes mellitus had impact on both eyes and lungs as reflected by fundoscopic changes and pulmonary function changes as evident by restrictive pattern of spirometry with increased duration

Spirometry remains a cost effective, a simple non-invasive diagnostic tool and its judicious use can give warning signal for patients to take early preventive measures.

Pulmonary dysfunction should be regarded as specific derangement induced by diabetes mellitus. Should it be considered as long term complication is debatable and role of strict glycemic control on pulmonary function in diabetes needs further clarification.

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