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Study of Spirometric Evaluation in Type 2 Diabetes Mellitus

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Abstract: ***Background and Objective: Diabetes affects many organs of the body, present with microvascular pathologies. lungs of diabetic shows thickening of alveolar epithelial and pulmonary capillary basal lamina leading to reduced pulmonary elastic recoil and lung volume. Pulmonary function tests are employed to access the functional capacity of lungs. Present study shows spirometric changes in patients with diabetes mellitus. Materials and Methods: A total of 64 patients with type 2 diabetes mellitus visiting Medicine OPD and patients admitted in Medical wards of Meenakshi Medical College Hospital and Research Institute, Enathur, Kanchipuram were taken for study considering the inclusion and exclusion criteria. Results: Effect of diabetes mellitus on spirometric values explored a reduction in FVC, FEV1. There was a restrictive pattern of Pulmonary abnormality though patients were asymptomatic. There was a correlation between reduced Pulmonary function values, duration of diabetes mellitus, glycemic control. Conclusion: Reduction in lung diffusion capacity is common in diabetic patients with signs of microangiopathy.***

Keywords: Diabetes mellitus**,** forced vital capacity (FVC), forced expiratory volume in one second (FEV 1), **(**FEV1/FVC) FEV1 Expressed as a Percentage of the FVC, spirometry

1. Introduction

There are 150 million diabetics worldwide. India has more than 3 crores of persons with DM or one-fifth of the global burden earning ignominy diabetic capital.[1]

The incidence of Type 2 diabetes has been steadily increasing in urban areas to 8.4%.[2]. Diabetes mellitus common metabolic disorders that share the phenotype of hyperglycemia. Include reduced insulin secretion, increased insulin resistance, decreased glucose utilization, and increased glucose production.[3]

This metabolic disorder precipitating micro vascular pathologies leading to autonomic, peripheral neuropathy, nephropathy, retinopathy, macrovascular pathologies leading to coronary artery disease, cerebrovascular accidents and peripheral vascular disease. The micro vascular complications appear early, within 5 to 10 years and macro vascular complications appear within 15 to 20yrs from the onset of diabetes. [4]

Histopathological changes in lungs of diabetics shows 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 of the basement membrane. Nonenzymatic 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. [5] .

Spirometry is a widely used pulmonary function test (PFT), ideally suited to describing the effects of obstruction or restriction of lung function.

2. Objectives

- To document results of pulmonary function tests in patients with type 2 diabetes mellitus.
- To correlate the abnormalities of spirometry with duration of diabetes mellitus.

3. Materials and Methods

Sample Size: 64 patients with Type 2 Diabetes mellitus attending Medicine OPD and patients admitted in MMCH & RI who fulfill inclusion exclusion criteria.

Sampling Method: Simple random sampling.

Study Design: Exploratory and descriptive study

Inclusion Criteria:
1) Type 2 Diabetes mellitus persons in age 30 – 80 years.
2) Males and females are included.
3) Patients give written informed consent

Exclusion Criteria:
1) COPD.
2) Bronchial Asthma.
3) Pulmonary Tuberculosis.
4) Smokers

Ethical Issues: No

Methodology

Investigations
Complete Hemogram, FBS, PPBS, HbA1c, Urine Routine, Renal function test, ECG, Chest X-Ray, Pulmonary function measured by spirometry.

Protocol
Diabetic patients were selected as per the criteria .CONSENT Obtained. history, Age, height, weight, body mass index were recorded. 6 hrs of fasting, the blood samples [3ml volume] was drawn for FBS and glycated hemoglobin. Subjects were made to undergo pulmonary function test using the KOKO LEGEND 2 computerized Spirometer, for three times at every 15 minutes interval. The FVC, FEV1, FEV1/FVC were recorded. best of the three was taken into account. After 2 hrs of breakfast blood sample was drawn for PPBS..

Statistical Analysis
The statistical analysis according to
1) SPSS- Version 21.
2) Tabulation and charts as per variables considered.

4. Results

Sex Distribution:
Among 64 subjects 27 were males and other 37 were females.Males forming 42.2% and females 57.8%.

Age Wise Distribution of Subjects:
Highest number of subjects were in age group 45-50 years making 32.8% of total and least number of subjects belonged to age group >65 years about 9.4% of total. Mean age was 55.88 years. Oldest subject among the group was 75 years and youngest was 45 years old.

Comparison of BMI among the Subjects
The range of BMI in subjects was 18.86 to 36.44 with mean value of 26.02. Standard deviation was 3.51.

Age Wise Distribution of BMI (Body Mass Index):
Out of 64 subjects most of the patients i.e. 36 are having BMI between 25-29.9(Over weight).

Comparison of duration of diabetes among the subjects
The duration of diabetes ranged from 6 months to 180 months (15 years), with mean duration of 72 months(6 years).FBS in subjects ranged from 96mg/dL to 288mg/dL with mean value of 174.78mg/dL and Standard deviation of 47.61mg/dL.PPBS in subjects ranged from 158mg/dL to 398mg/dL with mean value of 284.86mg/dL and Standard deviation of 64.62mg/dL. Overall, the glycemic control is poor among the subjects.

Comparison of FBS and PPBS among the subjects:
FBS in subjects ranged from 96mg/dL to 288mg/dL with mean value of 174.78mg/dL and Standard deviation of 47.61mg/dL. PPBS in subjects ranged from 158mg/dL to 398mg/dL with mean value of 284.86mg/dL and Standard deviation of 64.62mg/dL. Overall, the glycemic control is poor among the subjects.

Comparison of HbA1C among the subjects:
Minimum HbA1c among the subjects was 6.1% and maximum was 9.2% with mean value of 7.98% and standard deviation of 0.72.

Sex Distribution of FVC%:
Out of 64 subjects, total of 28 subjects have reduced FVC% with males comprising of 12(42.9%) and females 16(57.1%).

Sex Distribution of FEV1/FVC %
Among 64 subjects, a total of 5 subjects have FEV1/FVC% of <70% and 59 subjects have have FEV1/FVC% of >70%.

Age Wise Distribution of FVC%
As the P-value is 0.002 it is statistically significant. There is reduction in FVC% as the age increases.

Age Wise Distribution of FEV1/FVC%
As the P-value is 0.000 it is statistically significant. As the age progresses, there is reduction in FEV1/FVC%.

Comparison of FVC% with duration of diabetes mellitus
As the duration of diabetes increases there is increasing trend in number patients with reduced FVC% and also as the duration of diabetes increases there is reduction in FVC%. Hence there is correlation between duration of diabetes and FVC%. Also as the P-value is <0.05 it is statistically significant.

Comparison of FEV1/FVC% with Duration of Diabetes Mellitus:
As the duration of diabetes increases there is increasing trend in number patients with reduced FEV1/FVC%. Hence there is correlation between duration of diabetes and FEV1/FVC%. Also as the P-value is <0.05 it is statistically significant.

Comparison of HbA1c level with FVC%:
Out of 10 patients of well controlled group 6 patients had reduction in FVC%. In moderately controlled group 11 out of 21 patients had reduced FVC%. In poorly controlled group 11 out of 33 patients had reduced FVC%. (P-value: 0.21).

Comparison of HbA1c level with FEV1/FVC%:
Out of 21 patients in moderately controlled group, 2 had reduction in FEV1/FVC%. In poorly controlled group 3 out of 33 patients had reduced FEV1/FVC%.

Comparison of BMI and FVC%:
Out of 22 patients in the BMI (18-25) group, 9 (40.9%) had reduction in FVC%. In BMI(>25) group, 19 (45.2%) out of 42 patients had reduction in FVC%.

Comparison of BMI and FEV1/FVC%
Out of the 22 patients in BMI (18-25) group, 2(9.1%) had reduction in FEV1/FVC%. In BMI(>25) group, 3(7.1%) out of 42 patients had reduction in FEV1/FVC%.

Sex Distribution of FVC%, FEV1/ FVC%

Sex	Total	%	FVC Reduced	FVC Normal	FEV1/FVC% Reduced	FEV1/FVC% Normal
			<80%	>80%	<70%	>70%
FEMALE	37	57.8%	16(57.1%)	21	2	35
MALE	27	42.2%	12(42.9%)	15	3	24
TOTAL	64	100%	28	36	5	59

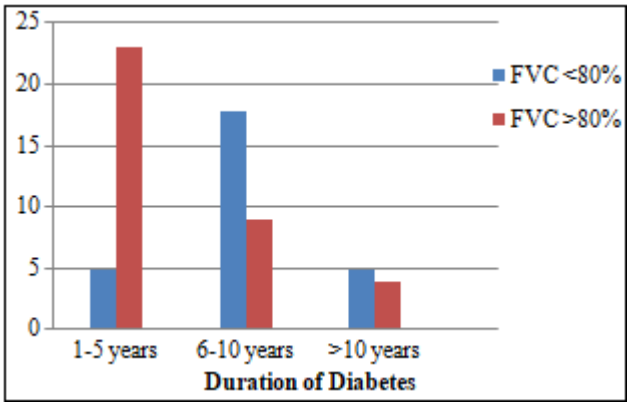
Age Wise Distribution of F FVC%, FEV1/FVC%

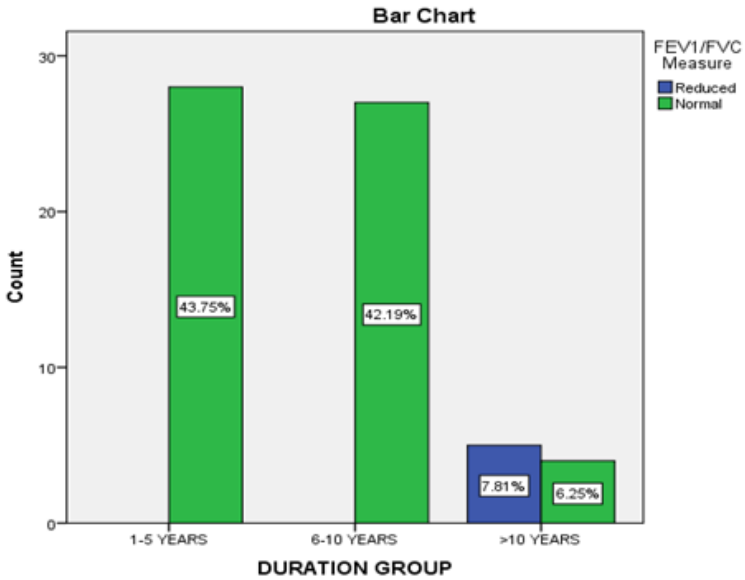
Age	Total	%	FVC Reduced	FVC Normal	FEV1/FVC% Reduced	FEV1/FVC% Normal
			<80%	>80%	<70%	>70%
45-50	21(Highest)	32.8%	2(9.5%)	19(90.5%)	0	21
51-55	12	18.8%	6(50.0%)	6(50.0%)	0	12
56-60	16	25.0%	10(62.5%)	6(37.5%)	0	16
61-65	9	14.1%	7(77.8%)	2(22.2%)	1	8
>65	6 (Least)	9.4%	3(50.0)%)	3(50.0%)	4	2
Total	64	100%	28(43.8%)	36(56.3%)	5	59

Comparison of FVC%, FEV1/FVC% WITH DURATION OF DIABETES MELLITUS:

Duration of diabetes	FVC % reduced	FVC % Normal	total	FEV1/FVC% reduced	FEV1/FVC% normal	total
	<80%	>80%		<70%	>70%	
1-5	5(17.9%)	23(82.1%)	28(100%)	0	28	28
6-10	18(66.7%)	9(33.3%)	27(100%)	0	27	27
>10	5(55.6%)	4(44.4%)	99100%)	5	4	9
total	28(43.8%)	36(56.2%)	64(100%)	5	59	64

FVC% with Duration of Diabetes mellitus





FEV1/FVC% DURATION OF DIABETES MELLITUS

Comparison of HbA1c LEVEL WITH FVC%, FEV1/FVC%:

HBA1c	FVC <80% Reduced	FVC >80% Normal	TOTAL	FEV1/FVC <70% Reduced	FEV1/FVC >70% Normal	total
<6.9 Well Controlled	6	4	10	0	10	10
7.0-7.9 (Moderately Controlled)	11	10	21	2	19	21
>8.0(poorly controlled)	11	22	33	3	30	33
total	28	36	64	5	59	64

Comparison of BMI with FVC%, FEV1/FVC%

BMI	FVC >80%	FVC < 80%	FEV1/FVC > 70%	FEV1/FVC < 70%	Total
18-25	13	9 (40.9%)	20	2(9.1%)	22(34.4%)
>25	23	19(45.2%)	39	3(7.1%)	42(65.8%)
Total	36	28	59	5	64(100%)

Comparison of FBS, PPBS, HbA1C, BMI, Duration of Diabetes

Variables	Minimum	Maximum	Mean	Standard Deviation
FBS	96	288	174.78	47.61
PPBS	158	398	284.86	64.62
HbA1c	6.1%	9.2%	7.9%	0.72
BMI	18.86	36.44	26.02	3.51
Duration Of Diabetes	6 Months	180 Months	72 Months	

5. Discussion

This study includes 64 patients with type 2 diabetes mellitus, out of which there is a large number of female subjects 37(57.8%) compared to males 27(42.2%). The probable cause for this female preponderance were non-smokers, many males were excluded for smoking history. When duration of diseases was compared with all parameters the following was observed:

1) There was a tendency of all parameters to fall with longer duration of diabetes.
2) Poor glycemic control was associated with reducing pulmonary functions.

This study assess the presence of pulmonary complications in patients with Type 2 DM the possible correlations between glycemic control and duration of diabetes. The number of subjects in present study is 64. Total of 27 males and 37 females were included. The mean BMI was 26.02, mean duration of diabetes was 6 years and mean HbA1c level was 7.9% which is in moderately controlled range.In this study, among 64 patients 27(42.2%) had restrictive pattern, 3(4.7%) had restrictive pattern, 2(3.1%) had mixed pattern and 32(50%) had normal spirometric pattern. As the duration of diabetes increases there was reduction in spirometric values and also patients with poor glycemic control had reduced

6. Limitations of the Study

1) The study population was small.
2) Age group was not limited and geriatric population were not excluded which could have given a poor spirometric function.
3) Subjects declaration of being non-smokers was accepted at face value; we were not able to confidently exclude previous smoking or other irritant fume exposure, unless declared by our subjects.
4) Cardiac failure was excluded only by history and examination, and not by echocardiography. It is known that congestive heart failure can cause spirometric abnormalities. We could not exclude the possibility that mild pulmonary congestion was present in some diabetics, especially given the higher prevalence of silent ischaemia in diabetics.
5) Pulmonary diffusion capacity (DLCO) study could not be done.

7. Conclusion

The present study has explored the relation between the diabetes mellitus and spirometry values .This study has considered comparison in relation to FVC, FEV1 and FEV1/FVC and concludes that restrictive pattern is seen in diabetics and spirometry values were low with diabetics. The effect on the FVC was even more pronounced in diabetics who had duration of disease longer than 5 years, and the effect was not explained by the difference in age alone.Subjects with poorer diabetic control have worse spirometric function.

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