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Original Research Article

To Study Pulmonary Function in Patients of Type 2 Diabetes Mellitus

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Abstract:

Background: The aim of the study is to study pulmonary function in patients of type 2 diabetes mellitus. Various studies have demonstrated abnormalities in lung volumes in patients of type 2 DM and corresponding reduction in lung diffusion capacity (DLCO).

Method: In the present study, 60 patients with a diagnosis of type 2 DM were taken after due consent and their pulmonary function test was done and compared with 30 age and sex matched healthy controls. Patients detailed clinical history including age, sex, height, weight, occupation along with personal history and symptomatology was taken. Association between type 2 diabetes mellitus and pulmonary function was assessed.

Result: In the study group mean age of subjects was 49.41±10.77 years while in control group it was 51.97±12.77 years. PFT parameters mainly mean FVC% and mean FEV1% was significantly lower in cases group as compared to control group (p value < 0.05). Significant number of patients 25(41.67%) had abnormal FVC% and 26(43.33%) had abnormal FEV1% in the study group as compared to control group (p value < 0.05). Significant correlation was found between mean FVC% and microvascular complications of type-2 DM namely diabetic neuropathy, nephropathy and retinopathy (p<0.05). Significant correlation was also found between mean FEV1% and fasting blood sugar level and diabetic neuropathy (p<0.05). Though results were statistically insignificant, inverse association was found between mean FVC% and mean FEV1% and various markers of glycemic status namely fasting sugar levels and HbA1C and non-compliance of subjects.

Conclusion: Mean FVC% and mean FEV1% were significantly reduced in cases group as compared to controls. The observations in present study suggest that pulmonary functions are adversely affected by type-2 DM and lung may be a target organ for its microvascular complications.

Keywords: pulmonary function tests, spirometry& diabetes mellitus

Study Designed: Comparative Study.

Introduction

Diabetes Mellitus is a heterogenous disorder with a complex etiology that develops in response to genetic and environmental factors and share the phenotype of hyperglycemia[1].

Worldwide prevalence of DM greatly increased over past 2 decades. The International Diabetes Federation (IDF) estimated that 194 million people had diabetes in 2003. It is expected to reach 333 million by the year 2025 due to doubling of the prevalence of diabetes in the Middle East, North Africa, South Asia and Sub-Saharan Africa[2]. The problem is grave in developing countries where the majority of cases occurs. India being one of them where illiteracy, poor health education and scarcity of resources continue to be a problem, diabetes remains an area of active research[3,4]. The underlying cause of diabetes is defective production or action of insulin, a hormone that controls glucose, fat and amino acid metabolism. Of all types of diabetes, type-2 DM is most common. Chronic hyperglycemia, which is hallmark of diabetes is responsible for majority of complications seen in type-2 DM[5].

Diabetes is a systemic disease that produces changes in the structure and function of several tissues, particularly connective tissues, with complications that affect the eyes, kidneys, blood vessels, heart and nerves system. The pathogenesis of diabetes complications is still a matter of debate and is thought to involve both, a microangiopathic process and non ezymatic glycosylation of tissue proteins. This process results in impaired collagen and elastin cross linkage with a reduction in strength and elasticity of connective tissue. The

presence in the lung of an abundant connective tissue and systemic microvascular circulation, raises the possibility that lung may be a target organ in diabetes patients[6]. Additionally, diabetes related oxidative stress and increased susceptibility to respiratory infections have been shown to induce muscle dysfunction. Impaired lung function has attracted growing interest as a potential complication of diabetes.

Various studies have demonstrated abnormalities in lung volumes in patients of type 2 DM and corresponding reduction in lung diffusion capacity (DL_{CO}). There was graded, inverse association between hyperglycemia, severity of diabetes and FVC and FEV_1.

Material & Method

In the present study, 60 patients with a diagnosis of type 2 DM admitted in J.A. Group of Hospitals, and those who attended medicine OPD were taken after due consent and their pulmonary function test was done and compared with 30 age and sex matched healthy controls. Association between type 2 diabetes mellitus and pulmonary function was assessed.

Patients detailed clinical history including age, sex, height, weight, occupation alongwith personal history and symptomatology was taken. They were undergone thorough physical examination.

All required investigations were done. The computerized spirometer- was used for assessment of lung functions. It is a low cost high performance instrument with capable results and represents a major advancement in computerized pulmonary function testing. Testing procedures are quite simple from the patient point of view. Full series of tests and related printout usually take four to five minutes. The computer stores and calculates all the necessary flow and volume data.

Inclusion criteria

- Patients of type-2 diabetes mellitus who are under treatment with OHA or insulin or its combination or dietary control.
- All newly diagnosed case of type-2 diabetes mellitus.

Exclusion criteria

- Patients with H/o smoking and associated secondary lung diseases including pulmonary tuberculosis, asthma, interstitial lung disease, occupational diseases, chronic obstructive pulmonary disease and pneumonitis.
- All patients of type I diabetes mellitus.
- Patients with impaired fasting glucose tolerance.

Results

Table 1: Gender wise distribution of cases & control

Sex	Cases (n=60)	(%)	Control (n=30)	(%)
Male	37	61.67	18	60
Female	23	38.33	12	40

Out of 60 patients of type-2 DM, 37 (61.67%) were males and 23 (38.33%) were females, where as in control group 18(60%) subjects were males and 12(40%) were females.

Table 2: Showing distribution of cases as per symptomatology

S.No.	Symptoms	Case (n=60)	%
	Cough	5	8.33
	Exertional breathlessness	3	5
	Paresthesias	10	16.67
	Polyuria/polydipsia/ polyphagia	5	8.33
	Fatigue/weakness	16	26.67

Out of 60 patients of type-2 DM, 5(8.33%) and 3(5%) presented with complains of cough and exertional breathlessness respectively.

16 (26.67%) of patients had complains of fatigue and weakness and 10 (16.67%) had complains of paresthesias.

5 (8.33%) of cases had characteristic symptoms of type-2 DM consisting of polyuria, polydipsia and polyphagia.

Table 3: Comparison of PFT parameters in cases & control group

No. of patients	Mean FVC %	Mean FEV_1 %	Mean FEV_1/FVC%
Cases (n=60)	85.216±13.519	85.889±15.551	103.687±10.536
Control (n=30)	94.21±11.913	97.76±13.561	108.39±9.569
P value	0.0027	<0.002	0.043

Mean FVC % in cases and control group was 85.216±13.519 and 94.21±11.913 respectively and was statistically significant (p value 0.0027). Mean FEV_1% in cases and control group was 85.889±15.551 and 97.76±13.561 respectively and was statistically significant (p value <0.002). Mean FEV_1/FVC% in cases and control group was 103.687±10.536 and 108.39±9.569 respectively and was statistically significant (p value 0.043).

Table 4: Prevalence of abnormal PFT in cases & control group

Subject type	FVC %		FEV_1%		FEV_1/FVC %	
	Normal	Abnormal	Normal	Abnormal	Normal	Abnormal
Cases (n=60)	35 (58.33%)	25 (41.67%)	34 (56.67%)	26 (43.33%)	59 (98.33%)	1 (1.67%)
Control (n=30)	28 (93.33%)	2 (6.67%)	29 (96.67%)	1(3.33%)	30 (100%)	-
P value	<0.01		<0.01		0.477	

FVC% was abnormal in 25(41.67%) subjects in cases group and 2 (6.67%) subjects in control group and was statistically significant (p value <0.01).
FEV_1 % was abnormal in 26(43.33%) subjects in cases group and 1 (3.33%) subject in control group and was statistically significant (p value <0.01).

Table 5: Correlation of duration of diabetes with abnormalities in PFT

Duration of diabetes (in yrs)	FVC %		FEV_1%		FEV_1/FVC %	
	Normal	Abnormal	Normal	Abnormal	Normal	Abnormal
<5 (n=33)	22 (66.67%)	11 (33.33%)	19 (57.58%)	14 (42.42%)	32 (96.97%)	1 (3.03%)
5-10 (n=21)	10 (47.62%)	11 (52.38%)	11 (52.38%)	10 (47.62%)	21 (100%)	-
>10 (n=06)	3 (50%)	3 (50%)	4(66.67%)	2 (33.33%)	6 (100%)	-
P value	0.35		0.814		0.66	

FVC% was abnormal in 11(33.33%), 11(52.38%) and 3(50%) subjects respectively, in three groups divided on basis of duration of diabetes (in yrs.) with disease duration <5, 5-10 and >10 yrs and was statistically not significant (p value 0.35).

FEV_1% was abnormal in 14(42.42%), 10(47.62%) and 2(33.33%) subjects respectively, in three groups divided on basis of duration of diabetes (in yrs.) with disease duration <5, 5-10 and >10 yrs and was statistically not significant (p value 0.814).

Although statistically not significant abnormalities in FVC% was higher in patients with diabetes duration >5 years.

Table 6: Correlation of HbA_1C levels with abnormalities in PFT

HbA_1C	FVC %		FEV_1%		FEV_1/FVC %	
	Normal	Abnormal	Normal	Abnormal	Normal	Abnormal
<7 (n=4)	4 (100%)	-	4 (100%)	-	4 (100%)	-
7-10 (n=34)	19 (55.88%)	15 (44.12%)	19 (55.88%)	15 (44.12%)	33 (97.06%)	1 (2.94%)
>10 (n=22)	12 (54.55%)	10 (45.45%)	11 (50%)	11 (50%)	22 (100%)	-
P value	0.215		0.177		0.68	

FVC% was normal in all the subjects in the first group with HbA_1C <7. FVC % was abnormal in 15(44.12%) and 10(45.45%) subjects respectively, in the other two groups with HbA_1C between 7-10 and >10 and was statistically not significant (p value 0.215).

FEV_1% was normal in all the subjects in the first group with HbA_1C <7. FEV_1 % was abnormal in 15(44.12%) and 11(50%) subjects respectively, in the other two groups with HbA_1C between 7-10 and >10 and was statistically not significant (p value 0.177).

Table 7: Correlation of abnormalities in PFT with microvascular complications of Diabetes

Microvascular complications	FVC %		FEV_1%		FEV_1/FVC %	
	Normal	Abnormal	Normal	Abnormal	Normal	Abnormal
Patients with diabetic retinopathy (n=27)	12 (44.44%)	15 (55.56%)	12 (44.44%)	15 (55.56%)	27 (100%)	-
Patients with diabetic nephropathy (n=23)	10 (43.48%)	13 (56.52%)	9 (39.13%)	14 (60.87%)	22 (95.65%)	1 (4.35%)
Patient with diabetic neuropathy (n=16)	6 (37.5%)	10 (62.5%)	8 (50%)	8 (50%)	16 (100%)	-

FVC% was abnormal in 15(55.56%), 13(56.52%) and 10(62.5%) subjects respectively, in three groups with associated retinopathy, nephropathy and neuropathy. FEV_1% was abnormal in 15(55.56%), 14(60.87%) and 8(50%) subjects respectively, in three groups with associated retinopathy, nephropathy and neuropathy.

Discussion

In the study group out of 60 subjects 37 (61.67%) were males and 23 (38.33%) females as compared

to 18 (60%) males and 12(40%) females in 30 controls.

Mean FVC% in cases & control group was 85.216±13.519 and 94.21±11.913 respectively, and was statistically significant (p value 0.0027). Mean FEV_1% in cases & control group was 85.889±15.551 and 97.76±13.561 respectively, and was statistically significant (p value <0.002). Mean FEV_1/FVC% was 103.687±10.536 and 108.39±9.569 respectively, and was statistically significant (p value 0.043).

In study by Yeh et al[7], mean FVC% was 96.5±13.2 and 103.1±13.6 respectively, and mean FEV_1% was 92.5±14.1 and 96.4±14.6 respectively, in cases and control group and was statistically significant (p value <0.001). In study by Walter E et al[8], mean FVC was 3.66±0.98 and 3.95±0.97 respectively, and mean FEV_1 was 2.70±0.77 and 2.92±0.79 respectively, in cases and control group and was statistically significant (p value <0.001). Similar, significant difference between mean FVC and mean FEV_1 in cases and control group was found in study by Meo SA et al[9].

FVC% was abnormal in 25(41.67%) cases and 2(6.67%) controls and FEV_1% was abnormal in 26(43.33%) cases and 1(3.33%) control. In study by Davis A. et al[10] 23.2% of subjects had abnormal FEV_1% and FVC% values.

Diabetes mellitus being incurable lifelong disease involving multiple systems, its complications increase with duration of illness and lung may be one of them. Mean FVC% was 86.855±13.926, 83.591±13.398 and 81.883±12.459 respectively, in three groups with diabetes duration <5, 5-10 and >10yrs. Mean FEV_1% was 87.885±16.069, 82.889±16.316 and 85.412±8.477 respectively, in three groups with diabetes duration <5, 5-10 and >10 yrs. Mean FEV_1/FVC% was 103.633±12.0, 103.27±9.50 and 105.43±4.34 respectively, in three groups with diabetes duration <5, 5-10 and >10yrs. FVC% was abnormal in 11(33.33%), 11(52.38%) and 3(50%) study subjects in the three groups. FEV_1% was abnormal in 14(42.42%), 10(47.62%) and 2(33.33%) study subjects in the three groups. All these parameters were statistically not significant (p value >0.05).

In study by Meo SA et al[9] there was persistent reduction in FVC% and FEV_1% with disease duration and a statistically significant reduction in FVC% and FEV_1% was found in diabetic patients with disease duration >10yrs as compared to matched controls (p value <0.001). In study by Yeh et al[7] and Davis A. et al[10] significant reduction in FVC% and FEV_1% was found with increasing duration of diabetes. In the present study we found reduction of mean FVC% with diabetes duration and slight decrease in FEV_1% with duration of diabetes but the association was not statistically significant. This may be due to presence of small number of subjects in the study group.

HbA_1C being one of the indicators of glycemic status it is also inversely related with pulmonary functions. Mean FVC% was 96.445±8.628, 84.579±13.052 and 84.158±14.466 respectively, in the three groups with HbA_1C <7, 7-10 and >10. Mean FEV_1% was 97.625±4.93, 85.042±14.544 and 85.064±17.77 respectively, in the three groups with HbA_1C <7, 7-10 and >10. Mean FEV_1/FVC% was 105.9±12.227, 103.717±10.711 and 103.24±10.4 respectively, in the three groups with HbA_1C <7, 7-10 and >10. FVC% was abnormal in 15(44.12%) and 10(45.45%) subjects respectively, with HbA_1C between 7-10 and >10. FEV_1% was abnormal in 15(44.12%) and 11(50%) subjects respectively, with HbA_1C between 7-10 and >10. All these parameters were statistically not significant (p value >0.05).

In study by Mckeever M. Tricia et al[11] they found reduction in FVC% & FEV_1% with elevated HbA_1C level. Similarly Yeh et al & Davis A et al found a graded inverse association between HbA_1C & lung function parameters.

In the present study, we found significant reduction in FVC% & FEV_1% with increase in HbA_1C level in accordance with previous studies but the results were statistically not significant.

Diabetes mellitus involves multiple organ systems with rich microvascular circulation and abundant connective tissue affecting lungs, kidneys, eyes and nerves. In the present study, PFT parameters were correlated with various other microvascular complications of diabetes. Mean FVC% was 79.284±12.965 and 87.372±13.201 respectively, in the two groups with neuropathy and without neuropathy and was statistically significant (p value 0.039). Mean FEV_1% was 79.184±9.857 and 88.327±16.587 respectively, in the two groups with neuropathy and without neuropathy and was statistically significant (p value 0.043). Mean FEV_1/FVC% was 103.223±8.762 and 103.885±11.2 respectively, in the two groups with neuropathy and without neuropathy and was statistically not significant (p value 0.84).

Mean FVC% was 80.861±12.886 and 87.922±13.360 respectively, in the two groups with nephropathy and without nephropathy and was statistically significant (p value 0.048). Mean FEV_1 was 82.253±17.563 and 88.149±13.933 respectively, in the two groups with nephropathy and without nephropathy and was statistically not significant (p value 0.155). Mean FEV_1/FVC% was 103.704±10.071 and 103.675±10.952 respectively, in the two groups with nephropathy and without nephropathy and was statistically not significant (p value 0.99).

Mean FVC% was 80.172±13.449 and 89.342±12.287 respectively, in the two groups with retinopathy and without retinopathy and was statistically significant (p value 0.0078). Mean FEV_1% was 82.013±14.149 and 89.060±16.13 respectively, in the two groups with retinopathy and without retinopathy and was statistically not significant (p value 0.08). Mean FEV_1/FVC% was 106.14±9.929 and 101.68±10.74 respectively, in the two groups with retinopathy and without retinopathy and was statistically not significant (p value 0.103).

Conclusion

The present study included 60 subjects of type-2 DM (37 males and 23 females) and 30 healthy controls (18 males and 12 females). Mean FVC% and mean FEV_1% were significantly reduced in cases group as compared to controls. PFT parameters were also significantly correlated with microvascular complications namely neuropathy, nephropathy and retinopathy. Thought statistically insignificant, an inverse association was found between PFT parameters and duration of diabetes and poor glycemic control. The observations in present study suggest that pulmonary functions are adversely affected by type-2 DM and lung may be a target organ for its microvascular complications. Further studies with larger sample size may be required for its confirmation.

Also pulmonary function test being cheap and easily available one may detect involvement of lungs in type-2 DM at an early stage. PFT may be advised in those patients who present with complaints of exertional breathlessness and normal left ventricular ejection fraction as suggested by normal echocardiography. These measures will help to prevent lung damage in initial stage, which often, over time, contributes to morbidity and mortality in diabetic patients.

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