

Original Article

A Study of Pulmonary Function Test in Type 2 Diabetes Mellitus

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ABSTRACT

Introduction: Type 2 Diabetes mellitus is a metabolic disorder that is characterized by high blood glucose in the context of insulin resistance and relative insulin deficiency. These processes play the main role in causing impairments of collagen & elastin cross linkage, which thereby causes reduced elasticity of connective tissue. The presence of abundant connective tissue and micro-vascular circulation in lung raises the possibility that in diabetic patients, lung could also be a “target organ”. Pulmonary function test is a useful test to assess involvement of lung connective tissues and micro vascular bed in diabetic patients.

Methods: In this study, which was conducted in a tertiary care hospital of South Gujarat, we enrolled 65 subjects who were known cases diabetes mellitus.

Result: Diabetes Mellitus in patients alters Various parameters of PFT like FVC, FEV1 which are reduced while FEV1/FVC increased showed restrictive pattern compared to normal individual.

Conclusion: Diabetes mellitus patients have positive correlation with interpretation of PFT as with HbA1c increases a greater number of patients develop abnormal PFT in which Restrictive pattern is seen more commonly.

Key words: PFT, Pulmonary function test, HbA1C, Glycosylated hemoglobin, BMI, Body mass index, FVC, Forced vital capacity, FEV1, Forced expiratory volume in 1 second, PEFR, Peak expiratory flow rate.

INTRODUCTION

Type 2 Diabetes mellitus is a metabolic disorder that is characterized by high blood glucose in the context of insulin resistance and relative insulin deficiency. These processes play the main role in causing impairments of collagen & elastin cross linkage, which thereby causes reduced elasticity of connective tissue ^{1,2}. The presence of abundant connective tissue and micro-vascular circulation in lung raises the possibility that in diabetic patients, lung could also be a “target organ”³. Pulmonary function test is a useful test to assess involvement of lung connective tissues and micro vascular bed in diabetic patients.

AIMS AND OBJECTIVES

Aim of the study is to find out the effect of diabetes mellitus on pulmonary functions in type 2 DM and abnormalities seen in PFT in type 2 diabetic patients.

MATERIAL & METHOD

The study was conducted amongst outdoor & indoor patients of a tertiary care hospital of South Gujarat. Patients included Newly detected type 2 diabetic patients of a tertiary care hospital with FBG ≥ 126 mg/dl, 2h glucose level after oral glucose tolerance test ≥ 200 mg/dl, HbA1c $\geq 6.5\%$, Random blood sugar ≥ 200 with sign and symptoms of diabetes and known case of type 2 diabetes mellitus. Patients having extreme limit of age, history of lung

diseases, decompensated heart diseases, recent surgery of eye, thorax or abdomen, with chest wall deformities or neuromuscular diseases. Patients with history of smoking, Patient with any other type of diabetes, Patient having BMI >30 kg/m² and Patient not willing to participate in the study and Pregnancy are excluded.

Approval for this study has been taken in institutional ethical committee and informed consent of all the participants has been taken.

The study has been done at SMIMER Hospital, Surat with 65 Cases and the study is cross sectional with informed written consent detailed history has been taken and recorded in the Patient's proforma, PFT is carried out, studied and data is analyzed in all cases.

RESULTS

This study, conducted in a tertiary care hospital of South Gujarat, on enrolled 65 subjects. Maximum number of patients, that is 56.92% in study group were in age group of 30-50 years, 4.6% population were in age group of <30 years and 38.46% population were in age group of >50 years. Mean age in the study group was 47.12 ± 10.473 years. Among table patients shows that 58.46% patients were Male, 41.54% patients were Female. Maximum number of patients, that is 61.53% patients were in group of duration of diabetes <5 years, 27.69% patients were in group of duration of diabetes 5-10 years and 10.76% patients were in group of duration of diabetes ≥ 10 years.

Table 1. Age, Sex Distribution and Duration of Diabetic patients

Variables	Cases in % (n=65)
Age group	
<30 years	4.6
30-50 years	56.92
>50 years	38.46
Sex	
Male	58.46
Female	41.54
Duration of DM	
<5 Years	61.53
5-10 Years	27.69
≥10 Years	10.76

Table 2. Cases according to level of glycated hemoglobin (HbA1c), BMI and Modality of Treatment.

Variables	Cases % (n=65)
HbA1c	
<8 %	35.38
≥8 %	64.61
Body Mass Index (BMI)	
<25 kg/m ²	56.92
25-30 kg/m ²	43.07
Modality of treatment	
Oral Hypoglycemic Agents (OHA)	83.08
Insulin	16.92

Table 3. Distribution according to interpretation of Pulmonary Function Test (PFT)

Interpretation of PFT	Patients	%
Normal	38	58.46
Restrictive	18	27.69
Obstructive	9	13.84

Table 4. Correlation between duration of diabetes with interpretation of PFT

Duration of Diabetes	Interpretation of PFT (No. of patients)			Total (%)
	Normal (%)	Restrictive (%)	Obstructive (%)	
<5 Years	25 (62.50%)	10 (25%)	5 (12.50%)	40
5 to 10 Years	6 (50%)	4 (33.33%)	2 (16.67%)	12
≥10 years	7 (53.85%)	4 (30.77%)	2 (15.38%)	13
Total	38 (58.46%)	18 (27.69%)	9 (13.84%)	65
P- value	0.931			

Table 5. Correlation between level of HbA1c with interpretation of PFT

Level of HbA1c	Interpretation of PFT (No. of patients)			Total
	Normal	Restrictive	Obstructive	
<8 %	18 (78.26%)	4 (17.39%)	1 (4.35%)	23
≥8 %	20 (47.62%)	14 (33.33%)	8 (19.05%)	42
Total	38 (58.46%)	18 (27.69%)	9 (13.84%)	65
P value	0.04			

Post Hoc Tests Bonferroni applied

PFT	N	Mean	Std. Deviation	Std. Error	95% CI for Mean		Min	Max	P -Value
					Lower Bound	Upper Bound			
Normal	38	7.9211	.69210	.11227	7.6936	8.1485	6.20	9.70	.009
Restrictive	18	8.7944	1.49842	.35318	8.0493	9.5396	7.20	14.10	
Obstructive	9	8.2444	.38766	.12922	7.9465	8.5424	7.60	9.10	
Total	65	8.2077	1.01878	.12636	7.9553	8.4601	6.20	14.10	

Mean duration of diabetes in this study was 4.98 ± 5.602 years.

Maximum number of patients, that is 64.61% of patients had HbA1c of $\geq 8\%$ and 35.38% of patients had HbA1c of $< 8\%$. Mean HbA1c level in this study was $8.20 \pm 1.018\%$. Above table suggested that 56.92% of patients had body mass index (BMI) of < 25 and 43.07% of patients had body mass index (BMI) of 25 to 30. Mean BMI in this study was $24.87 \pm 2.781 \text{ kg/m}^2$. In our study, 83.08% of patients were on oral hypoglycemic agents and 16.92% of patients were on insulin treatment.

Among diabetic patients, Interpretation of Pulmonary Function Test (PFT) were normal, restrictive and obstructive pattern in 58.46%, 27.69% and 13.84% of patients respectively.

Interpretation of PFT in patients, when duration of diabetes < 5 years (out of 40 patients), 25(62.50%) patients have normal pattern, 10(25%) patients have restrictive pattern and 5(12.50%) patients have obstructive pattern. When duration of diabetes between 5 to 10 years (out of 12 patients), 6(50%) patients have normal pattern, 4(33.33%) patients have restrictive pattern and 2(16.67%) patients have obstructive pattern. When duration of diabetes ≥ 10 years (out of 13 patients), 7(53.85%) patients have normal pattern, 4(30.77%) patients have restrictive pattern and 2(15.38%) patients have obstructive pattern.

ANOVA applied to know the mean significance difference of HbA1c among the normal, restrictive and obstructive which was statistically significant ($p < 0.05$) whereas post-hoc test (Bonferroni) applied for multiple comparison which showed significance between normal and restrictive pattern as restrictive pattern showed higher mean HbA1c. Interpretation of PFT in patients,

Table 6. Correlation of duration of diabetes with different parameters of PFT

Duration of Diabetes (years)	FVC (%Pred.)	FEV1 (%Pred.)	FEV1/FVC (%Pred.)	PEFR (%Pred.)	FEF 25-75% (%Pred.)
<5(N=40)	0.81±0.18	0.76±0.23	0.94±0.15	0.50±0.20	0.55±0.23
5-10(N=12)	0.70±0.25	0.65±0.25	0.93±0.12	0.44±0.17	0.44±0.22
≥10(N=13)	0.81 ±0.12	0.72±0.15	0.93±0.12	0.51±0.20	0.53±0.19
P -value	0.205	0.346	0.949	0.620	0.341

Table 7. Correlation of level of HbA1c with different parameters of PFT

HbA1c	FVC (%Pred.)	FEV1 (%Pred.)	FEV1/FVC (%Pred.)	PEFR (%Pred.)	FEF 25-75% (%Pred.)
<8%(N=23)	0.75±0.21	0.69±0.22	0.92±0.15	0.46±0.19	0.46±0.20
≥8%(N=42)	0.86±0.10	0.81±0.19	0.96±0.10	0.55±0.18	0.64±0.21
p- VALUE	0.00004	0.408	0.024	0.744	0.826

Table 8. Correlation of BMI with different parameters of PFT

BMI (kg/m ²)	FVC (%Pred.)	FEV1 (%Pred.)	FEV1/FVC (%Pred.)	PEFR (%Pred.)	FEF 25-75% (%Pred.)
<25(N=37)	0.80±0.19	0.74±0.22	0.92±0.15	0.48±0.20	0.49±0.22
25-30(N=28)	0.77±0.19	0.72±0.23	0.96±0.11	0.49±0.19	0.57±0.22
p -value	1.01	0.792	0.097	0.7913	1.01

When HbA1c level <8% (out of 23 patients), 18(78.26%) patients have normal pattern, 4(17.39%) patients have restrictive pattern and 1(4.35%) patient have obstructive pattern. When HbA1c level ≥8% (out of 42 patients), 20(47.62%) patients have normal pattern, 14(33.33%) patients have restrictive pattern and 8(19.05%) patient have obstructive pattern. As the level of HbA1c increases, more no. of patients developed abnormal pattern in PFT.

Table 6 shows, in patients with <5 years of diabetes, mean value of FVC, FEV1, FEV1/FVC, PEFR and EFR25-75% was 0.81±0.18, 0.76±0.23, 0.94±0.15, 0.50±0.20 and 0.55±0.23 respectively. In patients with 5-10 years of diabetes, mean value of FVC, FEV1, FEV1/FVC, PEFR and EFR25-75% was 0.70±0.25, 0.65±0.25, 0.93±0.12, 0.44±0.17 and 0.44±0.22 respectively. In patients with 10 years of diabetes, mean value of FVC, FEV1, FEV1/FVC, PEFR and EFR25-75% was 0.81±0.12, 0.72±0.15, 0.93±0.12, 0.51±0.20 and 0.53±0.19 respectively.

Table 7 shows, in patients with HbA1c <8%, Mean value of FVC, FEV1, FEV1/FVC, PEFR and EFR25-75% was 0.75±0.21, 0.69±0.22, 0.92±0.15, 0.46±0.19 and 0.46±0.20 respectively. In patients with HbA1c ≥8%, Mean value of FVC, FEV1, FEV1/FVC, PEFR and EFR25-75% was 0.86±0.10, 0.81±0.19, 0.96±0.10, 0.55±0.18 and 0.64±0.21 respectively.

Table 8 shows, in patients with BMI <25, Mean value of FVC, FEV1, FEV1/FVC, PEFR and EFR25-75% was 0.80±0.19, 0.74±0.22, 0.92±0.15, 0.48±0.20 and 0.49±0.22 respectively. In patients with BMI between 25 to 30, Mean value of FVC, FEV1, FEV1/FVC, PEFR and EFR25-75% was -0.77±0.19, 0.72±0.23, 0.96±0.11, 0.49±0.19 and 0.57±0.22 respectively.

DISCUSSION

Diabetes mellitus is a systemic disorder which affects many organs by causing pathological changes in them.

Many theories have been suggested to explain the end organ damage induced by hyperglycemia.

Chronic hyperglycemia causes many histo-pathological changes in the lungs of diabetics. These are thickening of alveolar epithelium and the basal lamina of pulmonary capillaries. These changes ultimately result in reduction in elastic recoiling capacity and the lung volume. The reason would probably be the non-enzymatic glycosylation induced connective tissue alteration in lung parenchyma.

Pulmonary function test is a useful test to assess involvement of lung connective tissues and micro vascular bed in diabetic patients. Different parameters of PFT like FVC, FEV1, FEV1/FVC ratio, FEF 25-75% and PEFR are affected in diabetic patients up to varying extent.

This study was undertaken to assess and find out impact of type 2 DM on the pulmonary Functions. PFT done in 65 patients having type 2 DM to find out the type of abnormalities seen in PFT in type 2 diabetes mellitus.

Age distribution in two groups with mean standard deviation was 47.12±10.47 in which 56.92% belongs to age group of 30-50 years and least being in age group of <30 years. There was large no. of males than female (58% vs 42%).

Mean Duration of diabetes of study population was 4.98±5.60 in this majority (61.53%) were in group of duration of diabetes <5 years. We compared this with other studies like Acharya, et al.⁷ and M.A.F. Zineldin et al.⁸ showed mean duration of diabetes around 7.6 years. Compared to other study, our study had mean duration of diabetes on lower side. We correlate duration of diabetes with interpretation of PFT showed no such correlation found (p-value 0.931). Studies like Acharya et al. and mori et al.¹⁰ failed to showed correlation between duration of diabetes with different parameters of PFT like FVC, FEV1 and FEV1/FVC.

Mean HbA1c of study population was 8.20 ± 1.01 in this majority (64.61%) were in group of HbA1c $\geq 8\%$. We compared this with other studies like Acharya et al. and M.A.F. Zineldin et al. showed mean HbA1c also around 8%. We correlate level of HbA1c with PFT showed statistically significant correlation (p-value 0.04) signify that as level of HbA1c increases more patients develop abnormal PFT. Dennis et al.¹¹ and McKeever et al.¹² in their studies have reported that diabetics with inadequate glucose control have a lower pulmonary function as compared to those with adequate control showed that level of HbA1c significantly affect Pulmonary functions.

Mean BMI of study population was 24.87 ± 2.78 in this majority (56.92%) had < 25 of BMI. We compared this with other studies like Acharya et al. and M.A.F. Zineldin et al. showed mean BMI also around 25. Study shows that obesity independently affects the pulmonary functions. In our study 56.92% patients' BMI was below 25 by this means at certain level we could eliminate the confounding effect of BMI on PFT and more relevant result for effect of type 2 DM on PFT we get.

We correlate different Parameters of PFT with duration of diabetes, level of HbA1c and BMI showed no such correlation found. Compared to other study like Acharya et al. also found no such correlation between them which was statistically proven.

CONCLUSION

Most no. of patients were male and in age around 50 years with Mean duration of diabetes was around 5 years which was lower and not significant with PFT result. Mean HbA1c was 8.2% had positive correlation with interpretation of PFT as HbA1c increases more no. of patient develop abnormal PFT in which Restrictive pattern seen more commonly. Mean BMI was around 25 had no correlation with PFT. After excluding obesity (BMI > 30). Various parameters of PFT like FVC, FEV1 reduced while FEV1/FVC increased showed restrictive pattern in type 2 DM compared to normal individual. Various parameters of PFT like FVC, FEV1, FEV1/FVC, PEFR and

FEF 25-75% with duration of diabetes and level of HbA1c failed to show any correlation.

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