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## To Study Pulmonary Dysfunction in Diabetes Mellitus Patients and Its Assessment by Spirometry and 6 Minute Walk Test

**Dharmendra Dwivedi, Bhupendra Singh Bhalavi, Venugopal Margekar, Archana Gupta**

### Abstract

**Background** – We studied to find out pulmonary dysfunction in diabetes mellitus patients by spirometry and 6 minute walk test.

**Material and Methods** – This study was carried out in GR Medical College Gwalior, Department of Medicine. A total 100 patients of Diabetes Mellitus were taken with specific inclusion and exclusion criteria and with ethical clearance.

**Results** – Females of age group 41-70 years are more affected during 6-10 years of diagnosis of Diabetes Mellitus type II. Pulmonary function abnormality increases with increase in duration of diabetes. Diabetic retinopathy and nephropathy is more common in these patients. Pulmonary dysfunction was present in 45% of diabetic patients. Mixed type of abnormality was more common than pure restrictive and obstructive abnormality. The study showed increased pulmonary dysfunction with decreased 6 minute walking distance.

**Conclusion** – Pulmonary dysfunction was found with increasing duration of diabetes with poor glycemic control.

**Keywords:** Pulmonary Dysfunction, Diabetes Mellitus, Spirometry, 6 minute walk test

### 1. Introduction

Diabetes Mellitus refers to a group of common metabolic disorders that shares the phenotype of hyperglycemia.<sup>1</sup> India with its dubious distinction of being called “the diabetic capital of world” is presently estimated to have 41 million individual affected by this deadly disease, with every fifth diabetic in the world being an Indian.<sup>2</sup> Diabetes mellitus is accepted as a worldwide epidemic with an estimated increasing prevalence from 2.8% in 2000 to 4.4% by 2030.<sup>3</sup> The magnitude of problem is further compounded by various catastrophic macro and microvascular complication targeting the vital organs in the body. Lung is a target organ to damage in diabetes in which the transfer capacity of CO is decreased. The association between diabetes and impaired lung function has been frequently observed. Various respiratory disorders have been described in patients with either type 1 and type 2 diabetes.<sup>4</sup> There is mitochondrial dysfunction occur in insulin resistance individual than insulin control subjects which leads to pulmonary dysfunction. Cellular and molecular mechanisms responsible for insulin resistance, these studies provide potential new targets for the treatment and prevention of type 2 diabetes.<sup>5</sup> Spirometry is a well-established method used in everyday clinical practice to assess ventilator (pulmonary) function in both health and disease. While 6 minute walk test evaluates the global and integrated responses of all the systems involved during exercise, including the pulmonary and cardiovascular systems, systemic circulation, peripheral circulation, blood, neuromuscular units and muscle metabolism.<sup>6</sup> In this study we tried to find out and correlate pulmonary dysfunction with Diabetes Mellitus.

**2. Aims and objectives :-** 1-To study the lung function test and six minute walk test in patient with diabetes mellitus. 2- To study the lung function test and six minute walk test in patient with diabetes mellitus. 3- To study the correlation of lung function test with various complications of diabetes mellitus. 4- To study the correlation of lung function test with risk factors like Hypertension, Dyslipidemia, Smoking.

**3. Materials and methods** - This is a prospective study conducted in the department of medicine, G.R. Medical College, Gwalior (M.P.) from August 2012 to October 2013. 100

patients of DM (newly diagnosed and old) attending OPD and IPD were subjected to spirometry first and then six minute walk test. **Inclusion criteria-** All patients of diabetes mellitus. **Exclusion criteria-** Gestational diabetes mellitus, All patients with acute and chronic lung disease, Patients with recent MI and stroke and Hemoglobin level <10gm/dl.

#### 4. Results

In our study of 100 patients 47 were males and 53 were females (table 1). According to the age wise distribution most of the patients (52%) falls in 51-70 years of age group followed by 41-50 of age group (21%) table 2. On the basis of types of diabetes mellitus, 90% of patients were type II DM and only 10 % were type I DM (table 3). These 100 patients were also categorized on the basis of duration of diabetes. Most of the patients fall in 1-10 years of duration of diabetes (73%), on further classification 37% belongs to 1-5 years and 36% belongs to 6-10 years of duration of diabetes (table 4). Total 45 patients of DM were found to have abnormal pulmonary function test (PFT), out of 45 patients, 41 patients belongs to 1-10 years duration of diabetes (table 5). Complications of diabetes found in 54 patients out of 100, diabetic retinopathy was more common (20%) followed by diabetic nephropathy (18%) table 6. PFT abnormality was seen in 6 out of 18 (33%) of patients of diabetic nephropathy and 28.57% of patients of coronary artery disease (4 out of 14) table 7. Distribution according to HBA1c level 47 % patient fall into 6.5-7.5 value followed by 27% patients between 7.6-8.5 value while only 12% patient in 9.6-10.5 value (table 8). Maximum (75%) abnormality in PFT occurred in patients with HBA1c level 8.6-9.5 and Minimum (39.13%)

abnormality in PFT occurred in patient with HBA1c level 6.5-7.5. It shows that increasing value of HBA1c (poor glycemic control) is responsible for more pulmonary dysfunction (table 9). Distribution of patients with respect to risk factors, 32%, 16% of diabetic patients had HTN, dyslipidemia as risk factor respectively. 17% were tobacco smokers (table 10). Distribution of 100 patients on the basis of pattern of PFT abnormality, 55% (normal), obstructive (4%), restrictive (10%) and mixed (31%) table 12. Spirometric abnormality with respect to risk factors, smoking was predominant risk factor which was associated with abnormal PFT in 70.58% of patients (odd ratio-3.63, confidence interval-1.05-13.2 and p value-0.03). p value= 0.03 is statistically significant (table 13). Patient's distribution on the basis of 6 minute walk test, 84% of patients achieved distance of 101-500 meters in which maximum 34% of patients achieved distance of 301-400 meters (table 14). In correlation of 6 minute walk distance with pulmonary function abnormality, study showed increased PFT abnormality with decrease 6 minute walking distance. Patients with walking distance of 601-700 meters 3 were PFT abnormality out of total 5 patients (60%) while in the patients walking 101-200 meters 17 patients having PFT abnormality out of total 22 patients (77%) in table 15.

#### 5. Tables

**Table 1:** Sex wise distribution of patients (n= 100)

SEX	NO. OF PATIENTS	% OF PATIENTS
Males	47	47%
Female	53	53%

**Table 2:** Age and sex wise distribution of patients (n=100)

AGE (YRS)	MALES	FEMALES	TOTAL	% OF PATIENTS
< 20	2	1	3	3 %
21 – 30	3	4	7	7%
31 – 40	5	3	8	8 %
41 – 50	13	8	21	21 %
51 -60	9	17	26	26%
61 – 70	14	12	26	26 %
> 71	2	7	9	9%

**Table 3:** Distribution of patients according to types of diabetes mellitus (n=100)

TYPE OF DIABETES	NO OF PATIENTS	% OF PATIENTS
DM TYPE I	10	10 %
DM TYPE II	90	90 %

**Table 4:** No. of patients distributed according to duration of diabetes mellitus (n = 100)

DURATION OF DIABETES	NO. OF PATIENTS	% OF PATIENTS
NEWLY DIAGNOSED	4	4 %
1 – 5 Yrs	37	37 %
6 – 10 Yrs	36	36 %
11 – 15 Yrs	22	22 %
> 16 Yrs	1	1 %

**Table 5:** PFT of patients according to duration of diabetes mellitus (n =100)

Duration of diabetes	PFT		TOTAL	% OF ABNORMALITY
	NORMAL	ABNORMAL		
Newly diagnosed	4	0	4	0 %
1-5 YRS	18	19	37	51.35 %
6-10 YRS	14	22	36	61.11 %
11-15 YRS	19	3	22	13.63 %
> 16 YRS	0	1	1	100 %

**Table 6:** Distribution of patients according to complication of diabetes mellitus

COMPLICATION OF DIABETES	NO. OF PATIENTS	% OF PATIENTS
Diabetic retinopathy	20	20%
Diabetic nephropathy	18	18 %
Diabetic neuropathy	2	2 %
Coronary artery disease	14	14 %

**Table 7:** Spirometric abnormalities with respect to diabetes mellitus complications

Diabetic complications	Obstructive abnormality	Restrictive abnormality	Mixed abnormality	Normal	Total	Odds Ratio		
						ODDS ratio	C.I.	P = Value
Nephropathy	0	0	6	12	18	0.55	1.65-1.78	0.307
Neuropathy	0	0	0	2	2	-	-	-
Retinopathy	0	0	1	19	20	0.043	0.002-0.331	0.0
CAD	0	0	4	10	14	0.43	0.106-1.69	0.25

**Table 8:** Distribution of patients according to hba1c level

HBA1c value	NO. OF PATIENTS	% OF PATIENTS
6.5 – 7.5	47	47 %
7.6 – 8.5	27	27 %
8.6 – 9.5	12	12 %
9.6 – 10.5	11	11 %
> 10.6	3	3%

**Table 9:** Table showing spirometric abnormalities with respect to hba1c level

Hba1c value	Obstructive abnormality	Restrictive abnormality	Mixed abnormality	Normal	Abnormal (%)	Total
6.5 – 7.5	2	0	16	29	18(39.13)	46
7.6 – 8.5	2	0	6	19	08(66.66)	27
8.6 – 9.5	0	0	9	3	09(75)	12
9.6-10.5	0	8	0	3	08(72.72)	11
> 10.6	0	2	0	1	02(66.66)	3

**Table 10:** Distribution of patients with respect to risk factor

RISK FACTOR	NO. OF PATIENTS	% OF PATIENTS
HYPERTENSION	32	32 %
DYSLIPIDEMIA	16	16 %
TOBACCO SMOKING	17	17 %

**Table 11:** Pulmonary dysfunction in diabetic patients (n = 100)

PULMONARY DYSFUNCTION	NO OF PATIENTS	% OF PATIENTS
yes/present	45	45 %
NO/absent	55	55%

**Table 12:** distribution of patients according to pft (n = 100)

PFT	NO. OF PATIENTS	% OF PATIENTS
Normal	55	55 %
Obstructive	4	4 %
Restrictive	10	10 %
Mixed	31	31 %

**Table 13:** spirometric abnormalities with respect to risk factors

Risk factors	Obstructive abnormality	Restrictive abnormality	Mixed abnormality	Normal	Total	% of abnormality	ODDS Ratio		
							ODDS Ratio	CI	P value
HTN	1	4	7	20	32	37.50%	0.63	0.24-1.63	0.39
Dyslipidemia	1	0	6	9	16	43.75%	0.94	0.28-3.12	1.0
Smoking	2	3	7	5	17	70.58%	3.63	1.05-13.2	0.03

**Table 14:** Patients distribution on the basis of six minutes walking distance

DISTANCE (METERS)	NO. OF PATIENTS	% OF PATIENTS
0 – 100	3	3%
101 – 200	22	22%
201 – 300	11	11%
301 – 400	34	34%
401 – 500	17	17 %
501 – 600	8	8 %
601 – 700	5	5%
>701	0	0 %

**Table 15:** Correlation of 6mwd with pulmonary function abnormality

6 min walk distance(meters)	Obstructive abnormality	Restrictive abnormality	Mixed abnormality	Normal	Total
0 – 100	0	2	1	0	3
101 – 200	1	6	10	5	22
201 – 300	0	0	0	11	11
301 – 400	1	0	7	26	34
401 – 500	2	1	6	8	17
501 – 600	0	1	4	3	8
601 – 700	0	0	3	2	5

## 6. Discussion

This open prospective study conducted in department of medicine, G.R. Medical College, Gwalior (M.P.) from august 2012 to October 2013. As per inclusion and exclusion criteria, 100 patients of DM (newly diagnosed and old) attending OPD and IPD were subjected to spirometry first and then six minute walk test.

**Sex wise distribution of patients-** Type 2 diabetes mellitus showed pronounce female access in the first half of the last century but is now equally prevalent among man and woman. In most population according to our study conducted by Gale E.A.-Gillespi K.M. *et al* (2001).<sup>7</sup> Our study showed preponderance of female population which was similar to study of them.

**Age wise distribution of patients-** In present study maximum number of patients is in age group 41-70yrs (73%), this correlation with a study conducted by Myoclinic Staff (2013)<sup>8</sup> according to which the risk of type 2 diabetes mellitus increases as you get older especially after age of 45.

**Types of Diabetes mellitus-** According to International Diabetes Federation, 2013,<sup>9</sup> type 2 diabetes mellitus account for at least 90% of all cases of diabetes mellitus. This is very similar to the present study in which 90% of patients had diabetes mellitus type 2. In diabetes mellitus type 1 30% of patients showed pulmonary function abnormality. Similarly WHO (2015)<sup>10</sup> also studied that type 2 diabetes mellitus comprises 90% of people with diabetes around the world and is largely the result of excess body weight and physical inactivity.

**Pulmonary function test and duration of diabetes mellitus-** Bhavneesh Sharma et al (2003)<sup>11</sup> conducted a study and concluded that a mixed restrictive and obstructive pattern of pulmonary dysfunction is seen in patient with type 2 diabetes mellitus which is more severe in longer duration of disease and poor glycemic control. In our study we got maximum number of abnormal pulmonary test. In patients group of between 6-10 yrs duration of diabetes followed by 1-5 yrs duration of diabetes. Which may be because the incidence of the patient reported on this duration is maximum. Because duration of diabetes (11-15yrs) with sum of the patients of diabetes mellitus being more than 10 years showed a normal pulmonary function test because of most of them did not have any co-morbid diseases and less risk factors more over they showed good glycemic control.

**Pulmonary dysfunction in diabetes mellitus patients-** In present study 45% of diabetic patient develop pulmonary dysfunction in which mix pattern was most common followed by restrictive pattern, least common was obstructive pattern. In mixed pattern severity of restrictive pattern was more. In a study conducted by Irfan *et al* (2011)<sup>12</sup> diabetes mellitus showed impaired lung function is dependent of smoking. This reduced lung function in a study due to chronic complication of diabetes mellitus. In spirometry diabetes patient showed significant reduction in the FVC [mean difference (95% CI) - 0.36 (-0.64, 0.07) P < 0.01], FEV<sub>1</sub> [mean difference (95% CI) - 0.25 (-0.50, -0.003) p < 0.04].

**Pulmonary function abnormality with diabetes mellitus complication-** In a study conducted by Gita Shafee et al (2013)<sup>13</sup> FVC, FEV<sub>1</sub> were significantly lower in subject with diabetic nephropathy compared to healthy controls (P < 0.05)

i.e. FEV<sub>1</sub>/FVC was significantly higher in diabetic mellitus patients with nephropathy, in present study 33% of patients diabetic nephropathy had abnormal pulmonary function present in which mixed pattern was predominant. In present study 28.57% patients of CAD is diabetes mellitus showed pulmonary function abnormality. No standard comparable data is available.

**Spirometry abnormality and HbA1c level-** In present study as with the increase in HbA1c level, pulmonary function abnormality was also increased in HbA1c level 8.6-9.5 with further increase in HbA1c level, pulmonary function abnormality decreased. This showed that there is no correlation of HbA1c level with pulmonary function abnormality. This result is very similar to a study conducted by Pinar Celik et al (1999)<sup>14</sup> in which HbA1c level were normal in 11 patients (37.9%) and high in 19 patients (62.1%). No significant difference between pulmonary function parameter of these two groups was found.

**Distribution of patients according to pulmonary function test-** In present study most common pulmonary function abnormality mixed pattern it means that is 31% in which it is restrictive predominant. This correlates with the study conducted by Bhavneesh Sharma et al (2003)<sup>11</sup> were states that a mixed pattern of pulmonary dysfunction is seen in patients with type 2 diabetes mellitus.

**Diabetes mellitus with 6 minute walk test-** According to present study 51% of diabetic patients were able to walk 301-500 meters distance. This correlates with the study conducted by Adeniyi A.F. et al (2010)<sup>15</sup> which states that the exercise capacity (assessed by 6min. walk distance) of the diabetic patient was found to be for below what was documented as reference values for apparently healthy adults above 20yrs which ranged from 474 to 1040 with an average of 698±96 mtrs [Gibbons W.J., N. Frushter S. Sloan, 2001].<sup>16</sup>

**Correlation of 6 minute walk distance with HbA1c level-** In present study there is decreased in 6min. walk distance with increase in HbA1c level there is no standard comparative data available but according to a study by Adeniyi A.R. et al (2011)<sup>15</sup>. It was found that high fasting blood glucose was relative to lower exercise capacity in type 2 diabetes mellitus patients based on 6 min. walk distance.

**Correlation of 6min. walk distance with pulmonary function abnormality-** Present study showed that with increase in pulmonary function abnormality 6min walk distance decreases there is no standard comparative data available.

## 7. Conclusion

Pulmonary function abnormality is seen in 45% of patients with diabetes mellitus. Exercise capacity of diabetic patients as assessed by 6 min. walk distance was found to be far below then reference value for apparently healthy adults. Smoking was found to be predominant risk factor associated with abnormal pulmonary function test (70.58%) followed by dyslipidemia. In 35.50% of patients hypertension was associated with abnormal pulmonary function test. With increasing duration of diabetes the microvascular complication go on increasing which were demonstrated by the abnormal pulmonary function test and six minute walk test for the asymptomatic diabetic patients. This study is modest

attempt by evaluating pulmonary function in diabetes patients as a predictor and explaining prognosis. So that patients can live better life by avoiding risk factors and complications.

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