ORIGINAL ARTICLE

Assessment of Pulmonary Functions in Patients With Diabetes Mellitus

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Abstract

The present study was carried out on already diagnosed 150 subjects, comprising of 50 patients each of Type 1 and 2 and 50 healthy controls. The subjects were made to undergo pulmonary function assessment by comupterized spirometer. The study revealed a significant decrease in FEV in patients with Type 1 and Type 2 compared with normal healthy controls. However, FEV1 showed a significant decrease only in male patients on oral medication. The ratio of FEV1 / FVC was found to be statistically insignificant. The findings suggest that alterations in pulmonary functions are a consistent feature in patients with DM.

Key Words

Diabetes Mellitus, Pulmonary Functions, FEV, FEV1

Introduction

Diabetes mellitus is a public health problem in developing and developed world, according to WHO, India will be world diabetic capital in 2025 (1).Diabetes is a complex medical syndrome comprising of heterogenous group of diseases resulting from diverse aetiologies predominantly of genetic and environmental origin.DM affects almost all the organ systems in the body producing biochemical, morphological and functional abnormalities mainly of collagen and elastin. The alterations in these scleroproteins in turn affect the mechanical behaviour of the lungs manifesting in altered lung volumes measured by pulmonary function tests (2).The underlying mechanism seem to be microangiopathy brought in by the nonenzymatic glycosylation of various scleroproteins in lungs and elsewhere. Since collagen is the most abundant tissue protein in major bronchi, vessels and interstitium, the alterations in pulmonary functions occur as a rule. These alterations are reversible to start with & can be delayed by keeping the blood sugar levels in the normal range. Similar changes have been observed with advancing age though progression & intensity of changes are less marked than seen in patients with DM (3).

In the context of rising prevalence of DM, particularly in developing countries and in younger age groups and since these changes can potentially incapacitate the patients, it is of utmost importance to not only define these changes but also find ways of retarding the progression of disease so that they do not become irreversible thus allowing millions of patients to be economically productive.

Hence, the present study was carried out to assess the lung functions in patients with DM taking oral medication and insulin administration.

Material and Methods

The study was carried out in the Department of Physiology in collaboration with Department of Endocrinology in a tertiary care hospital in Jammu. The study subjects were selected from those attending the Endocrinology OPD. A written informed consent was obtained from the study subjects prior to their participation in the study. All the patients who were diagnosed as suffering from DM for atleast 5 years were eligible for recruitment in the study. Patients who smoked, consumed tobacco in any form or suffered from COPD and occupational diseases such pneumoconiosis, were

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excluded from the study. A total of 150 patients were enrolled and studied in the stated period. Of 150 patients, 50 patients each were suffering from Type 1(Group 1) and Type 2 (Group 2) as per the documented records. Fifty healthy controls (Group 3) were also studied to seek comparisons with Type 1 and Type 2 groups. Some patients who were initially stated on oral drugs and lateron switched on to insulin were analysed in the insulin group.

Procedure : All the patients were subjected to undergo pulmonary function tests after initial history and physical examination. Physical examination included anthropometric measurements such as weight and height according to the standardised methodology recommended by WHO. Body surface area was calculated by Dubois Nomogram. PFT was performed with the help of computerized Medspiror (Records and Medicare Systems, Chandigarh).

FVC Test : Used as a surrogate to assess structural changes in the lungs. Before performing the measurements the subjects were detailed about the maneovre to be performed and were thoroughly familiarised with the apparatus. Subjects were asked to close the nostrils with thumb and finger and exhale through the mouthpiece with full force after forceful inspiration. A long beep from the beeper supplied with the instrument signalled the completion of the test. The decrease in FVC, FEV1 and normal value of (FEV1/FVC) shows restrictive pattern of lung disease.

Statistical Analysis

Analysis was performed by using statistical software Microsoft Excel and SPSS 10.0 for Windows. For quantitative variables, mean and standard deviations were calcualted. Statistical significance in lung volumes was assessed by the use of One Way Analysis of Variance (ANOVA) followed by Bonferroni 't' to evaluate intergroup comparisons. A p value of < 0.008 was used to reject null hypothesis.

Results

Results of anthropometry, pulmonary functions overall and in gender are presented in Tables 1 to 5. The tables also show the comparison between Group I vs Group II, Group I vs Group III and Group II vs Group III

Discussion

DM is an important non-communicable chronic disease of global importance. It is characterized by hyperglycaemia due to absolute or relative deficiency of insulin (4). The major long-term complications are currently thought to involve both microangiopathic process and non-enzymatic glycosylation of tissue proteins (3).

Non-enzymatic glycosylation is the process by which glucose chemically attaches to free amino group of proteins without the aid of enzymes. Lysine and valine residues are the primary site of glucose addition (5).

Diabetes and Physical Parameters : In the present study, the mean values of anthropometric parameters - height, weight, body surface area did not show significant difference between male and female subjects. Sreeja *et al*.(4) reported that there was no statistically significant difference in the anthropometric profiles of patients.

Asanuma *et al*. (6) also observed that there was no significant difference in the anthropometric profiles between male diabetes and control.Diabetes and Pulmonary Function Parameters : In the present study, the mean values of FVC were 2.16 liters, 2.46 liters, 2.76 liters in males and 1.65 liters, 1.61 liters, 1.99 liters in females of Group I, II, III, respectively and were

Table 1 Showing Comparison of Anthropometric Profiles Among DM and Healthy Controls

Anthropometric variables	Mean ± SD (Range)			'p' value		
	Group I n = 50	Group II n = 50	Group III n = 50	Group I vs Group II	Group I vs Group III	Group II vs Group III
Age (in years)	52 ± 7.73 (40-70)	50.16 ± 8.71 (40-78)	49.32 ± 7.21 (40-71)	NS	NS	NS
Height (in cms)	159.26 ± 9.52 (138-179)	162.64 ± 9.93 (147-185)	159.66 ± 8.86 (143-147)	NS	NS	NS
Weight (in kgs)	64.76 ± 7.92 (45-82)	66.60 ± 14.50 (40-115)	63.72 ± 12.20 (35-96)	NS	NS	NS
Body Surface Area (m^2)	1.671 ± 0.12 (1.33-1.96)	1.71 ± 0.21 (1.35-2.38)	1.672 ± 0.20 (1.22-2.40)	NS	NS	NS

Table 2 Showing Overall Comparison of Lung Volume Among Group I& II and Group III

Parameters	Mean ± SD (Range)			'p' value (<)		
	Group I (n = 50)	Group II (n = 50)	Group III (n = 50)	Group I vs Group II	Group I vs Group III	Group II vs Group III
Restrictive Parameters						
FVC (L)	1.95 ± 0.43 (0.7-2.87)	2.12 ± 0.67 (1.03-4.63)	2.45 ± 0.54 (1.51-3.66)	NS	0.008**	0.008**
FEV_1 (L)	1.70 ± 0.51 (0.13-2.55)	1.93 ± 0.53 (0.77-3.40)	2.20 ± 0.49 (1.48-3.49)	NS	0.008**	0.008**
FEV_1/FVC (%)	86.41 ± 15.54 (7.47-100.74)	90.96 ± 9.36 (57.46-100.72)	90.19 ± 5.86 (79.8-100.37)	NS	NS	NS
Obstructive Parameter						
PEFR (L/sec)	5.01 ± 2.03 (1.91-9.45)	5.19 ± 1.68 (1.45-10.49)	5.56 ± 1.68 (3.43-10.98)	NS	NS	NS
FEF_{25-75} (L/sec)	2.32 ± 1.12 (0.4-5.36)	2.79 ± 1.23 (0.39-6.32)	2.80 ± 0.78 (1.44-4.79)	NS	NS	NS

*NS Non Significant, ** Highly Significant*

Table 3 Showing Comparison of Mean FVC among Group I, II & III in Males and Females

Sex	FVC (L) Mean ± SD (Range)			'p' value (<)		
	Group I	Group II	Group III	Group I vs Group II	Group I vs Group III	Group II vs Group III
Males (n = 30)	2.16 ± 0.35 (1.39-2.87)	2.46 ± 0.60 (1.30-4.63)	2.76 ± 0.45 (1.59-3.66)	0.008**	0.008**	0.008**
Females (n = 20)	1.65 ± 0.37 (0.7-2.33)	1.61 ± 0.39 (1.03-2.65)	1.99 ± 0.28 (1.51-2.67)	NS	0.008**	0.008**

*NS Non Significant, ** Highly Significant*

Table 4 Showing Comparison of Mean FEV_1 among Group I, II & III in Males and Females

Sex	FEV_1 (L) Mean ± SD (Range)			'p' value (<)		
	Group I	Group II	Group III	Group I vs Group II	Group I vs Group III	Group II vs Group III
Males (n = 30)	1.88 ± 0.53 (0.13-2.55)	2.19 ± 0.45 (0.77-3.40)	2.49 ± 0.40 (1.52-3.49)	0.008**	0.008**	0.008**
Females (n = 20)	1.43 ± 0.33 (0.65-2.13)	1.54 ± 0.39 (0.87-2.61)	1.77 ± 0.024 (1.48-2.28)	NS	0.008**	0.008**

*NS Non Significant, ** Highly Significant*

Table 5 Showing Comparison of Mean FEV_1/FVC among Group I, II & III in Males and Females

Sex	FEV_1/FVC (%) Mean ± SD (Range)			'p' value (<)		
	Group I	Group II	Group III	Group I vs Group II	Group I vs Group III	Group II vs Group III
Males (n = 30)	85.72 ± 18.82 (7.47-100)	87.84 ± 9.95 (57.46-100.4)	90.51 ± 5.35 (79.8-100.37)	NS	NS	NS
Females (n = 20)	87.44 ± 8.97 (64.08-100.74)	95.65 ± 6.03 (83.57-100.72)	89.72 ± 6.67 (80.1-100)	0.008**	NS	NS

*NS Non Significant, ** Highly Significant*

significantly lower ($p < 0.008$) in both th groups of diabetic patients as compared to controls (*Table 3*).Our observations are in agreement with Lange *et al*.(7) who reported that both IDDM and NIDDM are associated with slight reduction in FVC. The reduction was more pronounced in diabetic subjects treated with insulin. Similar observations were quoted in all age groups by Lange *et al*.(8) in Copenhagen city heart study. The newly developed diabetes mellitus patients had twice as high decline in ventilatory functions and this according to authors might be due to cross-linking of pulmonary collagen. Asanuma *et al*. (6) reported that FVC was significantly lower in diabetics, this was because of impaired defense against environmental challenges such as smoking and airway infections. Ramirez *et al*. (9) reported that there were significant difference in FVC between the standard treatment (an oral hypoglycaemic drugs) and intensive (on insulin) treatment groups.

However, Benbassat (2) observed that FVC were within predicted value which is in quite diagreement with our observations.Review of literature suggested that there was increased cross-linkage formation between polypeptides of collagen in pulmonary connective tissue which decrease in FVC and hence responsible for restrictive respiratory defects.From the present study, it was concluded that there was significant reduction in mean FVC in all the diabetic patients. The mean FEV1 was reduced in all the male diabetics whereas in female group the decrease was observed in patients taking oral medication.No significant change was observed in FEV1/FVC, PEFR and FEF25-75 in both male and female diabetic patients. The aforesaid observations clearly establish that diabetics on either oral treatment or on insulin treatment, show restrictive type of pulmonary ventilatory impairment as evidenced by significant reduction in FVC, FEV1 and normal FEV1/FVC. Recently studies conducted by Femognari *et al* (10) showed that the restrictive but not obstructive dysfunction as reported by significant decrease in FVC, FEV1 and normal FEV1/FVC is associated with increased risk of developing type 2 diabetes mellitus. Similarly more recently Nakajima *et al* (11) reported reduced FVC and normal FEV1/FVC and concluded that impaired restrictive pulmonary function but not the obstructive pattern might be associated with metabolic disorders and metabolic syndrome in a severity dependant manner.The possible explanation of restrictive type of pulmonary impairment is non-enzymatic glycosylation of pulmonary collagen leading to accumulation of advanced glycosylation end products and resulting in increased cross-link formation.Similarly, another indian study suggested impairment of pulmonary functions (diffusion capacity for carbon monoxide) type DM Asian Indians (12).

Conclusion

The findings of the present study are in agreement with most of the studies undertaken by different workers as detailed in Review of Literature. Thus patents with restrictive pattern should be considered at risk of and screened for diabetes mellitus.

References

1. King H, Aubert RE, Herman WH. Global burden of diabetes 1995-2025 Prevalence, Numerical estimates and projections *Diabetes Care* 1998; 21(9): 1414-31.
2. Benbassat CA, Stern E, Kramer M,*et al*.Pulmonary function in patients with diabetes mellitus. *Am J Med Sci* 2001; 322 (3) : 127-32.
3. Sandler M. Is the lung a target organ in diabetes mellitus? *Arch Intern Med* 1990; 150 : 1385-88.
4. Sreeja CK, Samuel E, Kesavachandran C, Shashidhar S. Pulmonary function in patients with diabetes mellitus. *Ind J Physiol Pharmacol* 2003; 47 (1) : 87-93.
5. Wilson JD, Foster, DW, Kronenberg HM, Larsen PR. Diabetes mellitus.William's Textbook of Endocrinology, 9th Edition : 1998 .pp. 973-1059.
6. Asanuma YS, Fujiya S, Ide H, Agishi Y.Characteristics of pulmonary function in patients with diabetes mellitus. *Diabetes Res Clin Pract* 1985; 1 : 95-101.
7. Lange P, Groth S, Kastrup J, *et al*.Diabetes mellitus, plasma glucose and lung function in a cross-sectional population study. *Eur Respir J* 1989; 2 : 14-19.
8. Lange P, Groth, S, Kastrup J, *et al*. Diabetes mellitus and ventilatory capacity : a five year follow-up study. *Eur Respir J* 1990; 3 : 288-92.
9. Marvisi M, Bartolini L, del Borrello P, *et al*. Pulmonary function in non-insulin dependent diabetes mellitus.*Tunis Med* 2000; 80 (9) :524-30.
10. Fimognari FL, Pasqualetti P, Moro L, *et al* .The association between metabolic syndrome and restrictive ventilatory dysfunction in older persons. *J Gerontology Med Sci* 2007; 62 A (7) : 760-65.
11. Nakagima K, Kubouchi Y, Muneyuki T, *et al*. A possible association between suspected restrictive pattern as assessed by ordinary pulmonary function test and the metabolic syndrome. *Chest* 2008 ; 134 (4): 712-18.
12. Sina S, Guleria R, Misra A *et al*. Pulmonary functions in patients with Type 2 DM and correlation with anthropometry and microvascular complications. *Ind J Med Res* 2004; 119 (2) : 66-71