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PULMONARY FUNCTION TEST ANALYSIS IN ASYMPTOMATIC DIABETIC PATIENTS

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ABSTRACT

Introduction: Diabetes mellitus is the most common endocrine disease worldwide. Though this disease affects each and every organ system of the body, pulmonary function abnormalities are less commonly observed and rarely studied. This study was undertaken to assess for any association between pulmonary function test and diabetes mellitus with respect to age, sex, duration, and type of diabetes and glycaemic control in a normal asymptomatic individual. Methods: A cross sectional study, where the cases were analysed pulmonary function assessed using Fukuda Sangyo spirometer with age, sex, duration and type of diabetes mellitus and also with glycaemic control. Results: This study strongly suggested the existence of restrictive pattern in Diabetics and it's directly related to control of diabetes. Conclusion: Spirometry remains a cost - effective and a simple non - invasive diagnostic tool and its judicious use can give a warning signal for patients to take early preventive measures by an effective glycemic control.

KEYWORDS: Diabetes mellitus, pulmonary function test, spirometry.

INTRODUCTION

Diabetes mellitus is an endocrinal disorder which happens due to improper metabolism and inappropriate hyperglycaemia due to either a deficiency of insulin secretion from beta cells of pancreas or due to a combination of insulin resistance and inadequate insulin secretion to compensate. It is classified clinically as Type 1 and Type 2 previously called as Insulin dependent diabetes mellitus (IDDM) and Non - insulin dependent diabetes mellitus (NIDDM) respectively where Type 1 is mainly due to insulin deficiency and Type 2 is due to insulin resistance. It is associated with various metabolic abnormalities and long term complications involving the eyes, kidneys, nerves and blood vessels like retinopathy, nephropathy and atherosclerosis.[1,2] Though this disease affects each and every organ system of the human body in the long run, pulmonary function abnormalities are less commonly observed and rarely studied. As they are clinically asymptomatic they are easily overlooked or less recognised.

Diabetes mellitus affects the respiratory system by producing various functional and organic abnormalities. They are mainly due to various factors like (i) reduced lung volumes, (ii) reduced total lung capacity, (iii) reduced elastic recoil of the lung (iv) reduced diffusing capacity of the lung for carbon monoxide (DLCO) (v) diminished bronchial reactivity (vi) reduced respiratory muscle endurance. Apart from these factors some patients manifests with pathological features like Pulmonary parenchymal fibrosis, pleural disease like pleuritis, pleural effusion, pneumothorax also some complications due to autonomic dysfunction like aspiration pneumonia, obstructive sleep apnoea and central hypoventilation. In patients with DKA respiratory alkalosis, non - cardiogenic pulmonary oedema may happens occasionally. Comparatively Type 1 DM has a earlier manifestation of lung complication then Type 2 diabetics.

Pathophysiologically all these changes happens due to biochemical alteration of connective tissue constituents particularly collagen and elastin due to which accelerated aging occurs. In Diabetes mellitus particularly the two major mechanisms affecting connective tissue cross links are the presence of increased non enzymatic glycosylation (NEG) and increased lysyl oxidase activity. Also endogenous opioid system does not respond to stress leading to inspiratory muscle fatigue in diabetic patients. Hence this study was undertaken to assess for any association between pulmonary function test and diabetes mellitus with respect to age, sex, duration, and type of diabetes and glycaemic control in a normal asymptomatic individual. Our aim is to evaluate the pulmonary function parameters in asymptomatic Type 1 and Type 2 diabetic patients by spirometry.

MATERIALS AND METHODS

This study was done in Tirunelveli medical college hospital as a cross sectional study with 50 patients previously diagnosed with Diabetes (both Type 1 and Type 2) attending the Diabetology out patients department, Tirunelveli Medical College, Tirunelveli. Patients who had age between 20-60 years of both sex with duration of diabetes more than five years, body mass index less than 28 and patient with normal x ray and cardiac status were included in our study. Whereas patients who had history of smoking, bronchial Asthma, COPD, Allergic rhinitis, occupational lung disorders, cardiac, renal, ocular and neurological complication and Pulmonary Tuberculosis and abnormal x ray chest were excluded from study. Similarly patients were included in study only after getting informed consent from them. All the patients included in the study were subjected to detailed history and clinical examination. Also biochemical and radiological investigations were done. After the above investigations have been done the patients were subjected to spirometry at Thoracic Medicine Department, Tirunelveli Medical College Hospital using FUKUDA SANGYO spirometer and the results were recorded and analysed. The readings were calculated according to the Indian population by a formula devised by Udwadia et al.[3]

The spirometry readings are useful in the interpretation of the pattern of pulmonary dysfunction based on their FEV1 and FVC values. In case of restrictive pattern FEV1/FVC is > 80% whereas in case of obstructive pattern it is less than 70%. All data obtained were statistically analysed and the values were considered significant if the p value is less than 0.05 ($p<0.05$). The software used was SPSS Version 21.

RESULTS

As previously explained, the study population consisted of 50 cases of previously diagnosed diabetic patients (both Type1 & Type 2) attending the Diabetology outpatient department, Tirunelveli Medical College Hospital

Table. 1: Sex and Age distribution.

Group	**Diabetic Cases**			
Male	27		54%	
Female	23		46%	
Total	50		100%	
Among Diabetic Patients				
Age Group	**Male**		**Female**	
15-30	7	26%	6	26%
31-45	11	41%	12	52%
46-60	9	33%	5	22%
TOTAL	27	100%	23	100%

Among our study group 27 were males and 23 were females and the sex ratio was 1.17:1.Agewise most of the patients fell in 31-45 year age group, this distribution was similar in both male and female population.

Table. 2: Type, Duration And glycaemic control in patients.

Type of Diabetes	**Male**	**Female**	**Total**
Type 1	11	9	20
Type 2	16	14	30
Total	27	23	50
Duration of Diabetes	**Male**	**Female**	**Total**
5-10 years	19	17	36
11-15 years	8	6	14
Total	27	23	50
Glycemic Control	**Male**	**Female**	**Total**
Good	13	5	18
Moderate	8	13	21
Poor	6	5	11
Total	27	23	50

Among patients in our study group 20 (40%) patients had type 1 diabetes and rest had type 2. Most of the patients in our study group had duration of diabetes between 5-10 years. Coming to glycaemic control only 18 patients had good control and rest had either moderate or poor control.

We did spirometry for above 50 patients and among them restrictive pattern was seen in 23 patients among which mild restriction was seen in 14 patients and moderate restriction in 9 patients. Severe restriction was not seen in any patients

Table. 3: Influence of Sex, Age, Duration of Diabetes on Restrictive Pattern.

Sex			
Factors	**Mild**	**Moderate**	**Severe**
Male	2	5	0
Female	12	4	0
Age			
15-30	2	1	0
31-45	7	4	0
46-60	5	4	0
Duration of Diabetes			
5-10 YRS	11	3	0
11-15 YRS	3	6	0

The above data signifies that females show more restrictive pattern (66%) when compared with that of males (34%).This restriction pattern in males and females show statistical significance difference with P value of 0.002.Similarly restrictive pattern was more significant in age group above 31 years (87%) as compared to less than 30 years which is only 13% ($p=0.007$).

In diabetic patients with a duration of 5 to 10 years showed 52% mild restriction pattern as against 9% moderate restriction, whereas as the duration of diabetes is increasing (11 to 15 years) moderate restriction pattern (26%) supervenes when compared to mild restriction

(13%) (p=0.006).This shows as duration increases there is worsening in severity of restriction.

Table. 4: Influence of type and control of diabetes on restrictive pattern.

Type of diabetes	**No. of Cases**	**%**
Type 1	7	31
Type 2	16	69
Glycemic Control	**No. of Cases**	**%**
Good	4	17
Moderate	11	48
Severe	8	35

Among our study group most patients with type 2 had restrictive pattern compared to type 1.Also 83% of the total restrictive cases show moderate to poor glycaemic control whereas only 17% of restriction pattern was seen in patients with good glycaemic control (p = 0.022).This statistical significance prove that as control of diabetes worsens there is worsening of restrictive pattern in spirometry.

DISCUSSION

In this study, 50 non - smoking, asymptomatic Diabetic patients (both Type I and Type 2) who are regularly attending the Diabetology outpatient Department, Tirunelveli Medical College Hospital were subjected to pulmonary function test by spirometry.

The spirometry evaluation of the Diabetic patient's revealed features of restrictive pattern in 46% of them, which is out of 50 cases, 23 cases showed restrictive pattern. Out of these 23 cases 14 cases (61%) showed mild restriction and 9 cases (39%) showed moderate restriction and no patients had severe restriction.

The restrictive pattern observed is consistent with the study conducted by Schnapf et al.[4] It was done in small group of 20 type I patients whose spirometry profile revealed a predominant restrictive pattern. This restrictive pattern was attributed to the abnormalities in elastic lung recoil or decreased chest wall compliance. Increased collagen cross - link content leading to increased lung stiffness already demonstrated in experimental Diabetes was proposed as the exact mechanism producing restrictive pattern. Similarly a study done by Barta et al[5] also showed restrictive spirometric profile in Diabetic patients. Malcolm et al[6].,in their study attempted to establish the relationship of pulmonary dysfunction particularly restrictive pattern to age and duration of both Type I and Type 2 Diabetes. They concluded that there were duration related abnormalities of lung elastic recoil, reduction in pulmonary capillary blood flow leading to restrictive pattern in Diabetics where prolonged duration of diabetes had more pulmonary changes.

In the present study, females showed more restriction (66%) when compared with that of the males (34%) which has got a statistical significance (p = 0.002). Also restrictive pattern was more significant in the age group above 30 years (87%) as compared to age group less than 30 years (13%). These results were in line with studies done by Derek B et al[7]., who measured lung volumes by spirometry in 28 Type I Diabetic patients. Reduced values for FRC, VC and TLC were found in Diabetics with increasing duration of Diabetes. Also Rancho Bernardo et al[8] based on a community based study between 1988 and 1991, has reported that FEVI and FVC were each independently reduced in patients with Diabetes (both Type 1 and Type 2) of 10 years or more in duration.

Correspondingly in the present study Diabetic patients with a duration of 5 to 10 years showed 52% mild restriction pattern as against 9% moderate restriction, whereas as the duration of Diabetes is increasingly (11 to 15 years) moderate restriction pattern (26%) supervenes when compared to mild restriction (13%). This restrictive profile with respect to the duration of Diabetes shows significance statistically (p= 0.006). Innocenti et al.[9] in 1994, compared 24 non-smoking Type 1 Diabetics with 24 non - smoking health controls and observed that FVC and FEV, were significantly reduced in Diabetics. Tantucci et al[10]., demonstrated that lung volumes, FEVI and forced expiratory flows were lower in Type I Diabetics.

Scchnack et al[11]., reported restrictive pulmonary defects with reduction in TLC and DLCO predominantly in patients with poor glycemic control. More H et al., in 1992, studied 80 patients of Type 2 Diabetes Mellitus without overt lung or heart disease. Restrictive pattern was observed and was concluded that Diabetic microangiopathy plays an important role in patients with poor glycemic control. In the present study 83% of the total restrictive cases showed moderate to poor glycemic control whereas only 17% of restriction pattern was seen in patients with good glycemic control which has a statistical significant (p=0.02).

On the other hand, studies have also been reported normal spirometry in Diabetes Mellitus like Schernthener et al.[12], in 1977, found normal spirometry in 20 Type I Diabetics as that of controls; Maccioni et al[13]., in 1991, conducted a study on 21 non - smoking Type 1 Diabetics and found that the mean values for TLC, FRC, VC and FEV1 were similar to predicted values; Pinar Celik et al[14]., in a multicentric study of 30 patients both Type 1 and Type 2 Diabetics and reported that the possible association between Diabetic microvascular pathology and pulmonary function changes were not detected.

The present study is most consistent with the studies conducted by Indian authors Agrawal et al.[15] in 1999 and Shaikh et al[16]., in 2000. Both these studies strongly suggested the existence of restrictive pattern in Diabetics. They were able to correlate poor glycaemic control with the severity of impairment. The various

proposed hypothesis by the Indian authors are destruction of lung parenchyma, premature aging of the lungs, Glycosylated end products induced functional alterations in the connective tissues of the lung, modification of the surfactant by high blood glucose levels, pulmonary microangiopathy.

Accelerated aging occurs in the collagen of human subjects with Diabetes Mellitus, resulting in loss of elastic lung recoil and other connective tissue changes. Modification of surfactant as a result of chronic hyperglycaemia leads to thickening of alveolar epithelial basal lamina causing derangement of pulmonary function. In view of above mentioned findings in the spirometric evaluation of asymptomatic diabetics, the possibility of a diabetic pneumopathy may be considered and looked for.

CONCLUSION

Even though Diabetic patients did not have any respiratory symptoms they did have underlying subclinical restrictive pattern of lung function. Where females showed more restriction than the males. Age group above 30 years showed significant restrictive pattern. As the duration of Diabetes increases the restrictive profile is more prominent. Poor glycemic control is associated with increased restrictive pattern. Since lung is one of the target organs in Diabetes, the possibility of a diabetic pneumopathy should be considered in all asymptomatic diabetics. Hence a regular assessment of pulmonary function is needed in these patients. But still more studies are needed to recognize the early derangement of pulmonary function in Diabetic patients. Also spirometry remains a cost - effective and a simple non - invasive diagnostic tool and its judicious use can give a warning signal for patients to take early preventive measures by an effective glycemic control.

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