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LUNG FUNCTION IN TYPE 2 DIABETES MELLITUS PATIENTS: ROLE OF GLYCAEMIC CONTROL

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ABSTRACT

Context: Type 2 diabetes mellitus is associated with the number of chronic complication. As a result of this, lung function may also be affected. Aims: To study the effects of type 2 diabetes mellitus on lung function and to determine its severity in relation to duration of disease. Setting and design: this was the cross sectional study done on diabetic patient with different duration but the proper glycaemic control. Material and method: Five groups were made depending on the duration of disease, their pulmonary function test was done and it was compared. Result: Significant reduction was seen in the FEV1 (Forced expiratory volume in 1 sec), FVC (forced vital capacity) in diabetic patients with duration more than 5 years. Flow rates i.e. FEF25-75%, PEFR and PIFR also decreased significantly in the diabetic patients with duration more than 10 years. Conclusion: Lung function impairment may occur in type 2 diabetic patients, especially over long duration even if it is controlled. Lung function impairment is suggestive of the restrictive lung disease. It is advisable, therefore, that diabetic patients must undergo periodic spirometry test to assess the severity of lung function impairment. Spirometry will identifymore susceptible diabetic patients so they can take additional preventive measures to prevent the lung damage in initial stage.

Keywords: Diabetes mellitus, FEV1, FVC, PEFR.

INTRODUCTION

Today, India has a primary position in the global diabetes epidemiology map as it is the home of nearly 33 million diabetic subjects which is the highest number in the world. This is both, due to a rising prevalence of the disease and the large population in the country [1]. Diabetes mellitus is a group of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both. The chronic hyperglycemia of diabetes is associated with long-term damage, dysfunction, and failure of various organs, especially the eyes, kidneys, nerves, heart, and blood vessels. A great attention is centered for the complications of diabetes include cardiovascular disease, nephropathy, diabetic retinopathy, neuropathy, though, the pulmonary complications of diabetes mellitus has been poorly characterized. Although, some authors have reported normal pulmonary function others found abnormalities in lung volumes, pulmonary mechanics, and diffusing capacity [2-5]. In our country, specially in this part of world, we have not come across a reference of study in diabetic patients, hence we endeavoured to undertake this study to assess the lung function in type 2 diabetic patients.

SUBJECTS AND METHODS

Study groups were taken from the diabetic OPD. They were divided into four groups depending on the duration of Diabetes. Then they were compared with age matched healthy non smoker (control group). Thus five group were made which were compared. Control group was taken from paramedical staff from LN Medical College, Bhopal.

History, examination and lung function test was done during visit to OPD. An informed written consent was taken after explaining the procedure to the subjects.

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History was asked about any cardiac or respiratory disease. History regarding total duration of Diabete mellitus was enquired .Examination was done and then pulmonary function test was performed.

Inclusion criteria

- Diagnosed case of diabetes whose blood sugar were controlled with oral hyglycaemic agent
- Diabetic patient were advised fasting, postprandial blood sugar level and HBA1c in diabetic OPD. Only those patient were included which were having proper glycaemic control.

Exclusion criteria

- Smokers
- H/o chronic respiratory disease
- H/o cardiac disease
- Examination finding suggestive of respiratory or cardiac disease
- Body mass index more than 30
- Acute complication of diabetes mellitus
- Patient with the known complication of diabetes mellitus such as diabetic neuropathy nephropathy, and retinopathy

Five group were made depending upon the duration of diabetes mellitus. These groups were control group (non diabetic) [Male (n=33, age ± S.D. 38.12±7.16 yrs),], recently diagnosed (0-1 yr) [Male (n=29, age ± S.D. 39.15±8.18 yrs], diabetes with duration 1-5 year [Male (n=29, age ± S.D. 38.16±8.14 yrs)], diabetes with duration 5-10 year [Male (n= 30, age ± S.D. 40.12±6.16 yrs)], diabetes with more than 10 years duration [Male(n=31 , age ± S.D. 39.99±7.66 yrs)].

The control group comprises of the subject from medical college staff who were healthy male, non smoker. For pulmonary function test:- MIR Spirolab II(Via Del Maggiolino, 125, 00153, Rome, Italy) was used. Pulmonary function test was recorded at the visit to diabetic OPD. All the subjects were made familiar with the instrument and the procedure for performing the test. The data of the subject as regards to name, age, height, weight, sex, date of performing the test, atmospheric temperature was fed to the computerized MIR Spirolab. The tests were performed in sitting position. The subject was asked to take full inspiration which was followed by as much rapid and forceful expiration as possible in the mouthpiece of MIR Spirolab. Three consecutive readings were taken and the best reading amongst the three was selected. We have followed the guidelines of American Thoracic Society [6].

Lung function parameters studied were forced vital capacity (FVC), Forced expiratory volume in 1 sec (FEV1), FEV1 as percentage of FVC in % (FEV1 (%)), Peak expiratory flow rate in liters / sec (PEFR), Peak inspiratory flow rate in liters / sec (PIFR) Forced expiratory flow rate in liters / sec in 25% of FVC (FEF25%), Forced expiratory flow rate in liters / sec in 50% of FVC (FEF50%), Forced expiratory flow rate in liters / sec in 75% of FVC (FEF75%), Forced expiratory flow rate during 25 to 75% of expiration (FEF25-75%), maximum voluntary ventilation (MVV). Diabetic patient were advised fasting, postprandial blood sugar level and HBA1c in diabetic OPD. Only those patient were included which were having proper glycaemic control.

Then the data of the observation for all parameters were statistically analyzed by calculating mean and standard deviation. The data was analyzed using Graph pad prism5 software. These readings were compared using one way Anova and Bonferroni's post test and P values < 0.05 were taken as significant.

RESULT

There were total five groups in the study. Anthropometric parameter of the subjects is shown in the figure I. All five groups were matched in all anthropometric parameters. Five groups didn't differ significantly in these parameters. Out of 119 patients, 69 were on biguanides, Thirty patient were taking sulphonylurea drugs 2nd generation. Rest of the patients were on combination therapy.

Lung function parameters along with their mean duration of diabetes are shown in table 1. FVC was significantly decreased in the patient with the history of diabetes for more than 5 years. It further deteriorated with increased duration i.e. more than 10 years.

Another parameter which also showed a significant decrease with more than 5 years is FEV1. FEF25-75%, PEFR and PIFR also decreased significantly in the workers exposed more than 10 years. No significant change was seen in the other parameters which were studied.

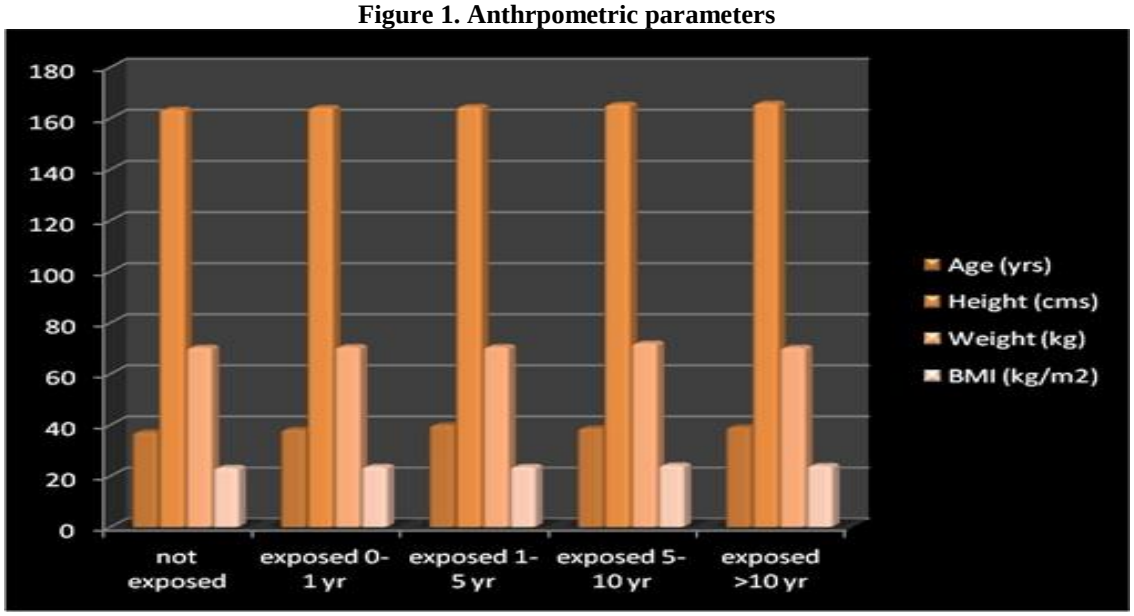
Table 1. Lung function parameter in diabetic (male) patient with different duration

Parameters	non diabetic (n=33)	diabetes For 0 to 1 year(n=29)	diabetes For 1 to 5 year(n=29)	diabetes For 5 to 10 year (n=30)	diabetes For more than 10 year(n=31)
FVC(L)	4.120 ±0.56	4.120 ±0.56	3.89 ±0.50	3.840* ±0.56	3.810**#±0.55
FEV1(L)	3.677±0.64	3.588±0.64	3.422±0.63	3.340*±0.51	3.33*±0.59
FEV1 (%)	85.780±5.54	85.58±5.14	84.580±4.98	83.450±5.15	84.14±4.99
PEFR (L/SEC)	8.136±1.34	7.880±1.335	7.8±1.322	7.3458±1.314	7.01*±1.33
PIFR(L/SEC)	3.121±1.11	3.11±1.23	3.11±0.94	3.01±0.81	3.1*±0.75

FEF25-75%	4.211±1.01	4.150±0.94	4.050±0.98	3.980±1.11	3.91*±1.08
FEF25%	6.568±2.34	6.450±2.14	6.120±1.89	6.080±1.9	5.598±2.44
FEF50%	5.78±1.04	5.490±1.33	5.510±1.34	5.480±1.41	5.51±1.25
FEF75%	3.125±1.01	3.444±1.1	3.460±0.84	3.451±0.91	3.120±0.86
MVV	131.250±25.54	130.250±23.34	129.120±22.54	130.250±23.54	129.21±26.54
Duration	0	5 m±1.13	4.11 yr±2.133	7.184 yrs±3.68	15.45 yrs± 3.66

*:= p<0.05 significant change, **:= p<0.01 very significant change (comparison between not exposed and other group)#:= p<0.05 significant change (comparison between exposed {0 to 1 yr} and other group).

Figure 1. Anthrpometric parameters



No significant difference between five groups

DISCUSSION

In the present study, significant reduction was seen in the FEV1 (Forced expiratory volume in 1 sec), FVC (forced vital capacity) in diabetic patients with duration more than 5 years. Flow rates i.e. FEF25-75%, PEFR and PIFR also decreased significantly in the diabetic patients with duration more than 10 years. However in this study, FEV1 (%) showed non-significant change. Thus it suggests restrictive type of lung disease.

Similar result were also found by authors. Cazzato et al [7] conducted a cross sectional study to assess the pulmonary function in diabetic children and reported that the FVC, FEV1 were found to be significantly lower in diabetics than controls. On contrary, Benbassat et al [8] showed that the FVC, FEV1, FEF and FEF25-75% were within the predicted values. In Addition, comparison by diabetes type showed non-significant differences in FEV1, FEF, FEF25-75%. The most probable reason for the contradiction is that Benbassat et al [8] studied pulmonary function among a group of diabetic patients by considering their predicted values but they did not compare their results with the matched control group. Matsubara and Hara [9] studied the pulmonary function and microscopic change of the lungs of diabetic patients compared with those of non-diabetic patients and reported that the FVC, total lung capacity (TLC), residual volume (RV), and maximal expiratory flow rate (MEFR) were significantly decreased in the diabetic group than in the control group.

Why there is reduction in lung function? In our patient glucose level was under the control, however before the diagnosis of diabetes mellitus, their sugar was not under control. So this hyperglycaemia may lead to glycosylation of proteins such as collagen in the lungs and chest wall [10] the postulated process by which hyperglycemia leads to development of long-term diabetic complications in other organs [11]. This glycosylation results in irreversible collagen cross-linking, rendering the collagen less susceptible to proteolysis than native collagen, and leading to accumulation of collagen in lung connective tissue.[11] thus elastic structure which support intrathoracic airways may become stiff which may cause decrement in lung function, however in present study no significant change was found in recently diagnosed diabetic patient. This may be because glycosylation process over long duration may be responsible for decrement in lung function. Though in our patients sugar were under the control over long duration, still glycosylation process may had continued which had

resulted decreased lung function parameters. Davis WA et al [12] suggested that the reduced lung volumes and airflow limitation are likely to be chronic complications of type 2 diabetes.

Fuso L et al [2]concluded that, In type 2 DM, respiratory muscle strength was reduced and significantly related to lung volumes and quality of metabolic control, whereas impaired endurance of respiratory muscles prevailed in patients with microvascular complications. This decreased in muscle strength may be responsible for reduced chest wall and lung compliance.[13] Insulin resistance was also responsible for lung function impairment insulin resistance may be as result of leptin and resistin [14,15].

Other cause which may result in decreased lung function, may be decreased diffusion capacity which assessed by carbon monoxide diffusion. Decreased CO transfer capacity has also been correlated with the prevalence and/or severity of retinopathy and renal microangiopathy in patients with type 2 diabetes [16,17], supporting the concept of the lung as a target organ for diabetic microangiopathy. Sandler et al [18] concluded that the lung should be considered a target organ in diabetes, but noted that the documented physiological abnormalties were modest in degree, and clinical implications of those findings were not clearly defined in terms of respiratory disease at that time. Subsequent studies demonstrated further evidence of pulmonary microangiopathy, including thickening in alveolar capillary and pulmonary arteriolar walls in human post-mortem studies of patients with diabetes and decreased lung capillary blood volume in patients with type 1 diabetes.

CONCLUSION

Thus to conclude, Lung function impairment may occur in type 2 diabetic patients, especially over long duration. This impairment may result from glycosylation process which may affect lung elasticity, decreased muscle weakness, insulin resistance and pulmonary microangiopathy.

It is advisable, therefore, that diabetic patients must undergo periodic spirometry test to assess the severity of lung function impairment. Spirometry will identify more susceptible diabetic patients so they can take additional preventive measures to prevent the lung damage in initial stage.

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CONFLICT OF INTEREST:

The authors declare that they have no conflict of interest.

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