Spirometric Changes in Patients with Diabetes Mellitus

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Abstract

Objective: Complications of D.M. affect many organ systems and are responsible for majority of morbidity and mortality associated with this disease. Pulmonary complications of D.M have been poorly characterized, although some authors had reported normal pulmonary function, others found abnormalities in lung volumes, pulmonary mechanics, and diffusing capacity.

Material and Methods: Fifty patients with Diabetes mellitus (DM) were included in this study that had been conducted at Al-Sader teaching hospital in Al-Najaf, 17 had DM type 1 (9 males and 8 females), and 33 patients had DM type 2(19 male and 14 female), 20 age and sex matched person were included as a control group (11 were male and 9 female). Spirometric tests were done for the two groups by flowmeter and computerized Spirometry with six parameters {(Vital capacity (VC), Forced vital capacity (FVC), Force expiratory volume in first second (FEV1) , Force expiratory volume in first second percent (FEV1%) , Force expiratory volume in first second to force volume capacity (FEV1/FVC) ,and Peak expiratory flow rate (FEFR)} .

Results: Spirometric tests were found to be significantly lower in the first (Diabetic)as compared to nondiabetic.Sex and duration of DM were not associated with any of the parameter that were considered, the duration of DM was recorded to affect the Spirometric tests , however these differences were not significant statistically. Type 1 diabetics had more significant deterioration of Spirometric results as compared to type 2 DM.

Conclusion: Spirometric results were lower in diabetics as compared to nondiabetic, and type 1 had more frequent and severe disturbance in Spirometric tests as compared to type 2, on the other hand, sex and duration had no significant effect on Spirometric tests in both types.

الخلاصة

تمت دراسة (٥٠) مريضا مصابا بداء السكري، (١٧) منهم من النوع الأول (المعتمد على الأنسولين) (٩) من الذكور و(٨) من الإناث، (٣٣) منهم من النوع الثاني (الغير معتمد على الأنسولين) (١٩) من الذكور و(١٤)من الإناث. كذلك تم اختيار (٢٠) شخصا سليما غير مصاب بداء السكري كمجموعة اختبار للمقارنة مع مرضى السكري (١١)من الذكور و (٩) من الإناث.

تمت دراسة اختبار فحص وظائف الرئة على جميع مرضى السكري ومجموعة الاختبار ودراسة النتائج إحصائيا بالمقارنة بين مرضى السكري ومجموعة الاختبار، المقارنة بين المرضى من النوع الأول والثاني، المقارنة من حيث الجنس ومدة المرض في نفس النوع من المرض.و عند مقارنة نتائج فحص وظائف الرئة بين مرضى السكري كمجموعة واحدة ومجموعة الاختبار ظهر هبوط واضح في وظائف الرئة لدى مرضى السكري مقارنة بمجموعة الاختبار (جدول رقم ١)، وكان فحص وظائف الرئة أكثر هبوطا لدى النوع الأول من النوع الثاني لدى مرضى السكري بصورة عامة (جدول رقم ٢)ولم تظهر الدراسة أي تأثر لاختبار فحص وظائف الرئة بالجنس لدى مرضى السكري لكلا النوعين (جدول رقم ٣،٤) و كذلك لم يكن هنالك أي تأثير لمدة المرض على نتيجة الاختبار لدى مرضى السكري من النوع الأول. (جدول رقم ٥)، بينما أظهر طول مدة المرض تأثيرا على نتائج الاختبار على احد معامل اختبار فحص وظائف الرئة لدى مرضى السكري من النوع الثاني. (جدول رقم٦).

Introduction

Diabetes mellitus is a clinical syndrome characterized by hyperglycemia due to relative or absolute deficiency of insulin [1]. In 1998, United States center for disease control and prevention estimated that six percent of population fulfilled the diagnostic criteria of D.M. in U.S.A. [2].

Complications of D.M. affect many organ systems and are responsible for majority of morbidity and mortality associated with this disease [1]. Pulmonary complications of D.M have been poorly characterized, although some authors had reported normal pulmonary function, others found abnormalities in lung volumes , pulmonary mechanics , and diffusing capacity. [2]

Early investigations of lung function in type 1 diabetes suggested that the lung is a target organ for diabetes [3,4], subsequent reports of lung transfer capacity for CO and postmortem histopathology studies support the notion that the lung is indeed a target organ for diabetic microangiopathy , in both type 1 and type 2 D.M., additional evidence documented peripheral airway dysfunction in type 1 diabetes in the absence of cigarette consumption , allergies , or other common causes of airflow obstruction .[5, 6]

Common simple lung function tests alone are likely to underestimate the prevalence and degree of lung dysfunction in diabetes, [7] but newer noninvasive tests of lung mechanical function provide a more sensitive assessment of peripheral airway function.[8]

Questions related to inhalational delivery of medications add to the motivation to explore these issues in more detail. It appears useful to remain circumspect toward conclusions drawn from the use of hitherto routine clinical lung function tests; this may be especially important in further studies of inhaled insulin. However, the clinical impact of measured decrements in lung function is still unproven, and will be defined only with long –term monitoring of pulmonary function changes in association with the presence or absence of overt lung disease [9, 10]

A major unresolved question about lung dysfunction in diabetes concerns the issue of a possible inflammatory pulmonary infrastructure and whether this increases the risk of adverse reactions to otherwise innocuous vehicles or agents [11]

It appears that cigarette smoking in patients will poses an increased risk of chronic obstructive lung disease, as compared with nondiabetic subjects.[12]

Materials and Methods

This study had been conducted at Al-Sader Teaching Hospital in Al-Najaf at the period from May to September 2006 whereby fifty diabetic patients attending Al-Hakeem Diabetic Center were assessed.

Seventeen of these patients had type 1 D.M their ages range between 20 and 36 years (mean age 27±8) with duration since diagnosis of DM of three to 14 years (mean duration 7±4).

Thirty three patients with type 2 D.M were included, their ages range between 41 and 65 years (mean age 49±6) with duration since diagnosis of DM of two to 16years (mean duration 9±9).

All these patients had no previous history of smoking, pulmonary disease, cardiac disease, and allergic disease.

Twenty normal individuals where included as control group these had no history of D.M confirmed by normal fasting and postprandial blood sugar and urine for sugar. These persons had identical characters for those of D. M regarding age, sex,and body mass index, they had no smoking history and no cardiac, pulmonary or allergic diseases. Thorough examination, chest X ray, electrocardiography, and echocardiography were done to all diabetics and the control group to

exclude any hidden pulmonary or cardiac diseases.

Spirometric tests was applied to all diabetics and control by flowmeter and computerized Spirometer (MIR Spirolab 11) studies with six parameters {(Vital capacity (VC), Forced vital capacity (FVC), Force expiratory volume in first second (FEV1), Force expiratory volume in first second percent (FEV1%) , Force expiratory volume in first second to force volume capacity (FEV1/FVC), and Peak expiratory flow rate (FEFR)}, assessment of diffusion capacity was not available at the time of the study.

The percent of the predicted value for each of these six parameters for every one of these seventy samples were obtained and all values are categorized as groups for comparison and analysis of data between the diabetics and control group and between the diabetics according to the type of diabetes, duration of disease and sex distribution.

Results

Of the fifty diabetic patients who were included, 17 patients had type 1 DM with mean duration of disease (7.4 years), eight of them were females and nine were males, 33 patients had DM type 2 with mean duration of disease was (9.9 years), 19 of them were females and 14 were males.

Spirometric results show significant reduction in diabetic patients in comparison with control group (VC, FVC, FEV1/VC, PEFR) with P value < 0.05, (Table 1).

The results of spirometric tests show significant reduction in patients with DM type 1 compared with patients with type 2 DM (VC, FVC, FEV1/VC) with P value < 0.05, (Table 2).

There is no significant difference in Spirometric results between males and females in both type 1and type 2 diabetic patients with P value >0.05, (Table 3, Table 4),and so also the duration of DM disease, showed no significant effect on the results of spirometric tests in type 1 DM. (Table 5), the only parameter of spirometric tests affected by the duration of disease in patients with type 2 DM was FEV1/VC with P value < 0.05, (Table 6).

Table 1 Spirometric results in comparison between Diabetic patients and the Control group

Spirometric tests (Total : 70)	Diabetics (50)	Control (20)	P. value
V.C	60.5000	69.0500	<0.05*
F.V.C	66.6143	77.0200	<0.05*
F.E.V1	87.6776	86.9550	>0.05
F.E.V1%	111.8837	113.2500	>0.05
FEV1/VC	58.8959	67.6150	<0.05*
P.E.F.R	425.8367	481.5000	<0.05*

*P value < 0.05 is significant statistically

Table 2 Spirometric results in comparison between type 1 and type 2 Diabetes mellitus

Spirometric tests (Total 50)	D.M. TYPE 1 17	D.M.Type 2 33	P. Value
V.C	54.4706	63.2545	<0.05*
FVC	59.4235	69.1273	<0.05*
FEV1	66.0353	97.8424	>0.05
FEV1%	110.2176	113.0758	>0.05
FEV1/ VC	53.6000	61.2000	<0.05*
FEFR	442.4912	418.6667	>0.05

***P value < 0.05 is significant statistically**

Table 3 Spirometric results **in Diabetes mellitus type 1 according to sex**

Spirometric tests (Total 33)	Female (14)	Male (19)	P. Value
V C	54.4706	63.2545	<0.05*
F V C	59.4235	69.1273	>0.05
F E V 1	66.0353	97.8424	>0.05
F E V 1%	110.2176	113.0758	>0.05
FEV1/VC	53.6000	61.2000	>0.05
P E F R	442.9412	418.6667	>0.05

*P value < 0.05 is significant statistically

Table 4 Spirometric results in Diabetes mellitus type 2 according to sex

Spirometric tests Test (Total : 17)	Female(8)	Male(9)	P value
V C	53.6375	55.2111	>0.05
F V C	57.0625	61.5222	>0.05
F E V 1	64.4125	67.4778	>0.05
FEV1 %	110.025	110.4000	>0.05
FEV1/ VC	54.3625	52.9222	>0.05
P E F R	410.0000	472.2222	>0.05

*P value < 0.05 is significant statistically

Table 5 Spirometric results in Diabetes mellitus type 1 according to the duration of the disease

Spirometric tests (total no :17)	<5 years :5	5-10 years :6	>5 years :6	P value
VC	58.5400	59.1333	46.4167	>0.05
FVC	66.4800	56.6833	56.3000	>0.05
FEV1	72.6800	64.4833	62.0590	>0.05
FEV1%	106.6400	110.9167	112.5000	>0.05
FEV1/VC	49.6333	50.8500	49.6333	>0.05
PEFR	444.0000	465.0000	416.6667	>0.05

***P value < 0.05 is significant statistically**

Table 6 Spirometric results in Diabetes mellitus type 11 according to the duration of the disease

Spirometric tests (total no :33)	<5 years :14	5-10 years :12	>5 years :7	P value
VC	73.0143	54.9750	56.7571	>0.05
FVC	77.3286	60.6083	621571	>0.05
FEV1	84.3143	71.6667	74.1000	>0.05
FEV1%	108.0857	118.6083	114.1000	>0.05
FEV1/VC	63.7836	55.8083	55.8000	<0.05
PEFR	427.1429	415.8333	440.000	>0.05

***P value < 0.05 is significant statistically**

Discussion

In this study, diabetics in general had low performance in respiratory function tests, as compared with the control healthy group, the lowest values were that of VC and PEFR, pointing to possible multiple defects, the air flow as well as lung elasticity and so restrictive and obstructive elements were observed. Schuyler et al.[13] investigated lung function in 11 young (21–28 years old) patients with type 1 diabetes and age-matched normal control subjects, their finding that lung elastic recoil was decreased in these young patients with diabetes was interpreted to reflect effects of diabetes on lung elastic proteins. This was the first suggestion in the literature that the lung may be a target organ of diabetes, and because the elastic structure of the lung supports the intrathoracic airways and helps to maintain their patency, the authors suggested that patients with diabetes were at risk for developing chronic airflow obstruction, Sandler et

al.[14] did find decreased lung elasticity. In addition, they found decreased CO transfer capacity with decreased pulmonary capillary blood volume in 40 patients (15–60 years of age) with insulin-dependent diabetes compared with age-matched control subjects, all lifelong nonsmokers.

An early study by Asanuma et al [15] showed decreased spirometric PFTs in patients with diabetes and this was confirmed by Schnack et al.[16], who also documented a clear relationship between spirometric PFTs and long-term metabolic control. Recent large epidemiologic studies(17-20) had studied the relation between simple spirometric PFTs and either complications or duration of diabetes to determine statistical significance after controlling for height, sex, age, BMI, and cigarette smoking. Davis et al.[17] found reduced spirometric pulmonary function (in comparison with normal population-predicted values) in patients with type 2 diabetes. Obesity, vascular disease, and duration of diabetes also contributed significantly to a reduction in lung function, the results of the current study supported this concept , and although there was no significant differences regarding the duration of DM , there was a clear decline in PFTs results with the increase in duration of DM, the small sample number was possibly the reason of low significance.

In patients with type 1 diabetes, decreased lung transfer capacity for CO has been documented in association with evidence of other diabetic microangiopathy. 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, supporting the concept of the lung as a target organ for diabetic microangiopathy. Sandler [14] 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 postmortem studies of patients with diabetes [21] and decreased lung capillary blood volume in patients with type 1 diabetes, and as long as mucroangiopathy occurred earlier and more extensively in DM type 1, pulmonopathy seems to be reported more frequently in this type, and in this study there were many significant alteration in PFTs results in DM type1 as compared to DM type2.

Conclusions and Recommendations

1-DM of both types adversely affect the spirometric tests even in asymptomatic patients.

2-Sex had no effect on spirometric tests results in both types of DM.

3-DM type 1 affects lung function more than DM type2.

4-Controling other factors like smoking and hypereactivity that affect the lung function is crucially important in diabetic patients.

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