Spirometric Changes in Type II Diabetic Patients with Early Stages Diabetic Nephropathy (Micro-albuminuria)

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Abstract

Background: Type II diabetes mellitus is a common disease across the world. It is responsible for the development of various macro- and micro-vascular complications in many organs of the body. The association between lung function and late stages diabetic nephropathy had been illustrated in many previous studies. This study aimed to explore if there was association between early stages diabetic nephropathy and changes in pulmonary function.

Methods: This case-control study was performed on patients who had early stages diabetic nephropathy (micro-albuminuria i.e. urinary albumin=30-300 mg/day), it included 78 patients who had diabetes with micro-albuminuria, 72 patients who had only diabetes without micro-albuminuria and 80 healthy subjects as a control group, full history was taken and physical examination was performed on all the patients, in addition to the following needed investigations: Urine albumin, random blood sugar, blood urea, serum creatinine, pulmonary function tests and pulse oximeter.

Results: This study revealed that there was no significant difference in ages, gender and body mass index (BMI) among groups. Duration of diabetes ranged from 3 to 8 years, all patients had type 2 diabetes mellitus. The levels of random blood sugar, blood urea, and serum creatinine were normal in all subjects. The spirometric changes [forced vital capacity (FVC % predicted) and forced expiratory volume in 1 second (FEV1 % predicted)] were significantly lower in diabetic patients with micro-albuminuria than those who had no micro-albuminuria ($P<0.05$). In addition, there was no significant difference in the spirometric changes between males and females in both groups. This study also revealed that in group of patients with positive micro-albuminuria (MAU), the percentage of those with positive spirometric changes was more in group of patients with increased body mass index than those with normal body mass index ($P<0.05$). Also this study shows that the patients with increased weight and positive micro-albuminuria had positive spirometric changes when compared to those without micro-albuminuria ($P<0.05$). The mean levels of oxygen saturation (SpO_2) was normal in both diabetic groups.

Conclusions: This study showed that there was a disturbance of lung function in patients with early stages diabetic nephropathy (micro-albuminuria). The combination of micro-albuminuria and increased body weight had more effects on lung function than others who had normal body weight.

Keywords: Type II diabetes, micro-albuminuria, pulmonary function tests.

Introduction

Patients with type 2 diabetes mellitus develop micro- and macro-vascular complications during the course of the disease [1]. The explanation for these complications was due to the connective tissue biochemical adjustment and micro-angiopathy which occurs because of protein glycosylation that induced by chronic hyperglycemia [2,3]. The capillary network of lung alveoli represents the largest micro-vascular structure in the body that can be considerably affected by diabetic micro-angiopathy [4]. Pulmonary dysfunction in diabetic patients occurs due to autonomic neuropathy of lung muscles, loss of elastic recoil due to elastin and collagen changes, chronic inflammation, in addition to angiopathy of the alveolar capillaries as shown in some studies [1,5,6]. The issue of pulmonary complications that occurs in diabetes was clinically under- diagnosed [7]. Micro-angiopathic process represents a similar background for pulmonary and other late diabetic complications as illustrated by many studies [8, 9]. Previous studies demonstrated the relation between change of lung function and nephropathy in type I diabetes [10]. In addition to that, there were many studies had explored the effect of type II diabetes on pulmonary function at late stages of diabetic nephropathy. So the aim of this study was to find the relation between the early stage diabetic nephropathy and pulmonary function in type II diabetes.

Patients and methods

This case-control study was performed in Marjan Medical City at diabetic center in the period from November 2015 to July 2016, it includes 150 patients who were divided into two groups: Group (1) included 78 patients who had diabetes with micro-albuminuria, and group (2) which included 72 patients with only diabetes without micro-albuminuria. In addition to 80 healthy subjects as control group. Full history was taken from all subjects which included: Age of patients, gender, duration and type of diabetes, any history of chronic systemic diseases, in addition to physical examination was performed, body mass index was calculated by dividing the weight in kilograms by the square height in meters (kg/m^2). The following investigations were done to all subjects: Urine albumin, random blood sugar, blood urea, serum creatinine and lung function tests. The lung function tests were done by Mir spirometer. The parameters that were involved in the study included: Forced expiratory volume in 1 second (FEV1) as percent predicted, forced vital capacity (FVC) as percent predicted, and the ratio of FEV1 to FVC. The oxygen saturation (spO2) was measured by pulse oximeter.

Excluded criteria included

The following diseases were excluded because they can affect respiratory and/or renal function: Respiratory diseases, hypertension, heart diseases, renal diseases, and connective tissue diseases.

Statistical analysis

Data analyses was performed using SPSS for Windows (version 18). ANOVA test was used for comparison among all groups and chi- square test for categorical variables. P-values <0.05 were considered as statistically significant.

Results

1.Demographic characteristics

The study included 150 patients (83 males and 67 females), the ages ranged from 38 to 65 years old with mean (54±13.2) and 80 control healthy subjects (43 males and 37 females), the ages ranged from 35 to 63 years old with mean (53±8.7), no significant difference in mean ages among patients and control groups. Duration of diabetes in both groups ranged from 3 to 8 years, all patients had type 2 diabetes mellitus. The levels of random blood sugar, blood urea, and serum creatinine were normal in all subjects. The mean levels of oxygen saturation was normal in all groups as shown in table (1).

Table (1): Demographic characteristics of patients and control groups

Characteristics		Group 1 NO.=78	Group 2 NO.=72	Control NO.=80	P-value
Age (mean ± SD)		56±15.3	51±11.9	53±8.7	> 0.05
Gender	Males	45(58%)	38(53%)	43(54%)	> 0.05
	Females	33(42%)	34(47%)	37(46%)	
BMI (mean ± SD)		30±12.4	29±8.5	27±7.6	> 0.05
Oxygen saturation (SpO2)		96±1.2	97.5±0.5	98±1.2	> 0.05

2. Frequency distribution of diabetic patients by micro-albuminuria according to spirometric changes: Table (2) shows the spirometric changes in diabetic patients with and without micro-albuminuria, cases with positive spirometric findings were more prevalent in patients with micro-albuminuria than those who had no micro-albuminuria with significant difference between both groups, P value ≤ 0.05.

Table (2): Frequency distribution of diabetic patients by micro-albuminuria according to spirometric changes

Groups	Spirometric changes		Total
	Positive	Negative	
DM with micro-albuminuria	36 (46%)	42 (54%)	78
DM without micro-albuminuria	4 (6%)	68 (94%)	72
Total	40	110	150
P value ≤ 0.05			

3. Frequency distribution of diabetic patients with positive micro-albuminuria (MAU) by gender according to spirometric changes: Regarding groups of diabetic patients with micro-albuminuria, the numbers and percentages of patients with positive spirometric changes were more in males group than females with no statistical significant difference between them (P value > 0.05) as illustrated in table (3).

Table (3): Frequency distribution of diabetic patients with positive micro-albuminuria (MAU) by gender according to spirometric changes

DM with micro-albuminuria	Spirometric changes		Total
	Positive	Negative	
Males	18 (40%)	27 (60%)	45
Females	13 (39%)	20 (61%)	33
Total	31	47	78
P value > 0.05			

4. Frequency distribution of diabetic patients with positive micro-albuminuria (MAU) by Body mass index according to spirometric changes: The study also revealed that in diabetic patients with positive micro-albuminuria (MAU), the percentage of patients with positive spirometric changes was more in patients with increased body mass index than those with normal body mass index (P value ≤ 0.05) as shown in table (4).

Table (4): Frequency distribution of diabetic patients with positive micro-albuminuria (MAU) by Body mass index according to spirometric changes

DM with micro-albuminuria		Spirometric changes		Total
		Positive	Negative	
Body mass index	Normal	7 (39%)	11 (61%)	18
	Increased	37 (62%)	23 (38%)	60
Total		44	34	78
P value ≤ 0.05				

5. Frequency distribution of diabetic patients with increased weight and positive micro-albuminuria according to spirometric changes: This study also shows that the patients with increased weight and positive micro-albuminuria had positive spirometric changes when compared to those without micro-albuminuria (P<0.05) as shown in table (5).

Table (5): Frequency distribution of diabetic patients with increased weight and positive micro-albuminuria according to spirometric changes

Patients with increased weight	Spirometric changes		Total
	Positive	Negative	
DM with micro-albuminuria	37 (62%)	23 (38%)	60
DM without micro-albuminuria	16 (36%)	29 (64%)	45
Total	53	52	105
P value ≤ 0.05			

Discussion

In this study, we found more disturbances in pulmonary function in diabetics patients with micro-albuminuria than patients with diabetes only. This result was consistent with a study performed by Klein *et al.,* 2010 (1). The explanation of this finding was as follow: Diabetic patients have more risk for micro-vascular complications. The main reasons of these complications was due to the changes in connective tissue in patients with chronic hyperglycemia which is caused by glucosylation of proteins which lead to micro-angiopathy [11]. The duration and control of diabetes represent the most important risk factors [10,12]. In addition, a similar micro-angiopathic background has been demonstrated to happen in the lungs and other systems of the body in patients with diabetes. Many studies showed decreased lung function in diabetic patients with micro-vascular changes in comparison to patients who had no micro-vascular changes [10]. In our study, presence of increased weight together with micro-albuminuria affect the pulmonary function in a higher percentage of diabetic patients than those who had only micro-albuminuria and this could be due to that micro-albuminuria indicates micro-angiopathic process had occurred in the renal tissues in synchronization with the same process had occurred in the lung tissues [13] and presence of increased weight cause more morbidity on the lung tissue [14], so presence of both those factors causes more disturbance in lung function.

Conclusions

Our study illustrated that there was an alteration of lung function in patients with early stages diabetic nephropathy (micro-albuminuria). The combination of micro-albuminuria and increased body weight had more effects on lung function than others who had normal body weight.

Recommendations

Pulmonary function test should be performed for every patient with micro-albuminuria. These tests should be regarded as a marker for micro-vascular process in diabetic subjects.

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الخلاصة

المقدمة: يعتبر مرض السكر النوع الثاني من الامراض الشائعة على مستوى العالم. هذا المرض يعتبر هو المسؤول عن حدوث مضاعفات متنوعة من النوع الكبير والصغير للأوعية الدموية في مختلف اعضاء الجسم. هناك عدة دراسات اثبتت وجود ارتباط بين وظيفة الرئة وبين المراحل المتأخرة لاعتلال الكلى بسبب مرض السكر. ان هذه الدراسة كان الهدف منها هو استكشاف فيما اذا كانت هناك علاقة بين المراحل المبكرة لاعتلال الكلى الناتج عن مرض السكر وبين التغيرات في وظائف الرئة.

طرق العمل: هذه الدراسة والتي كانت من نوع الحالة المرضية–الضابطة تم انجازها على المرضى الذين لديهم حالات مبكرة من اعتلال الكلى بسبب مرض السكر (البروتين البولي المجهري والذي يعني نسبة الالبومين في الادرار يساوي 30 الى 300 مغم/في اليوم الواحد) , تضمنت الدراسة 78 مريضا والذين كان لديهم مرض السكر مع وجود البروتين البولي المجهري, 72 مريضا والذين كانوا مصابين بمرض السكر بدون وجود البروتين البولي المجهري وكذلك 80 شخصا وكانوا اصحاء وتم اخذهم كمجموعة ضابطة , تم اخذ التاريخ المرضي مع الفحص الفيزياوي للمرضى, بالإضافة الى التحاليل التالية: البومين الادرار, سكر الدم العشوائي, يوريا الدم, كرياتينين مصل الدم , فحوصات وظائف الرئة وقياس الاوكسجين النبضي.

النتائج: كشفت هذه الدراسة عدم وجود علاقة معنوية في الاعمار, الجنس, ومؤشر كتلة الجسم بين مجاميع الدراسة. تراوحت مدة الاصابة بمرض السكر من 3 الى 8 سنوات, كل المرضى كان لديهم مرض السكر النوع الثاني. مستويات سكر الدم العشوائي, يوريا الدم, وكرياتينين مصل الدم كانت طبيعية في جميع الاشخاص. التغيرات التي حصلت عن طريق جهاز السبايرومتر وهي السعة الحيوية الاجبارية والحجم الزفيري الاجباري في الثانية الاولى كانت اقل بصورة معنوية في مرضى السكر مع وجود البروتين البولي المجهري عن المرضى الذين لديهم مرض السكر بدون وجود البروتين البولي المجهري. بالإضافة الى ذلك كانت هناك علاقة غير معنوية بين الذكور والاناث في كلتا المجموعتين. كذلك بينت الدراسة انه في مجموعة المرضى الذين لديهم البروتين البولي المجهري, نسبة المرضى الذين لديهم تغيرات سبايرومترية كانت اكثر في مجموعة المرضى الذين لديهم زيادة في مؤشر كتلة الجسم عن اولئك المرضى الذين لديهم مستويات طبيعية في مؤشر كتلة الجسم. كما بينت الدراسة ان المرضى الذين لديهم زيادة في الوزن مع وجود البروتين البولي المجهري كانت لديهم تغيرات سبايرومترية موجبة بالمقارنة مع اولئك المرضى الذين ليس لديهم البروتين البولي المجهري. كما كان متوسط مستويات نسبة تشبع الاوكسجين طبيعية في كلتا المجموعتين المصابتين بمرض السكر.

الاستنتاج: بينت الدراسة وجود اضطراب في عمل الرئة في المرضى المصابين بالمراحل المبكرة من الاعتلال الكلوي بسبب مرض السكر. كما كشفت الدراسة ان وجود البروتين البولي المجهري مع زيادة الوزن لديها تأثير اكبر فيما اذا قورنت بحالة المرضى الذين لديهم مستويات طبيعية في وزن الجسم.

الكلمات المفتاحية: مرض السكر النوع الثاني, البروتين البولي المجهري, اختبارات وظائف الرئة.