Effect of physical exercise on fasting blood glucose level and vital capacity in type 2 diabetic patients

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الخلاصه

شملت هذه الدراسة خمسه وعشرون شخصا من الرجال (13 مريضا مصاب بالنوع الثاني بداء السكري و 12 شخصا سليما). تراوحت أعمارهم من 40 – 60 سنه.تم تشخيص المرضى من قبل أطباء اختصاصيين. جميع الأشخاص المشمولين بالبحث تطوعوا للمشاركة بالبحث في مختبر الفيزياء الطبية / كليه الطب / جامعه بابل/ العراق. أنجز البحث الفترة من آذار إلى أيلول 2009.تم قياس مستوى السكر في الدم بدون فطور، معدل نبضات القلب و السعه الرئوية قبل وبعد التمرين. تم قياس الوزن و الطول لجميع الأشخاص قبل إجراء التمرين. أظهرت نتائج البحث الحالي تناقصا معنويا في مستوى السكر في الدم لجميع مرضى السكري مقداره ($P < 0.001$) بعد 15 دقيقه من الجهد الفيزياوي المتوسط الشدة مع تصاعد معدل نبضات القلب بشكل غير معنوي مقداره ($P > 0.05$) . الأشخاص الأصحاء ابدوا تناقصا في مستوى السكر ولكن بشكل غير معنوي ($P > 0.05$) مع ارتفاع معنوي في السعه الرئوية مقداره ($P < 0.001$).

Abstract

This study was conducted at twenty five male subjects (13 diabetic patients, and 12 normal persons). Their ages ranged from 40 – 60 years old. The patients were diagnosed by specialist physicians. All subjects were recruited to medical Physics' laboratory in the College of Medicine, Babylon University, in Iraq. The study conducted during the period from March 2009 to September 2009. Fasting blood glucose (FBS), heart rate (HR) and vital capacity were measured before and after exercise. The body weight and height were measured for all subjects at rest.

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The results of the present study revealed that all type 2 diabetic patients had decrease level of fasting blood sugar significantly ($P < 0.001$) in comparison to control after 15 minutes of moderate exercise, with non significant increase of HR ($P > 0.05$). The controls group showed non significant ($P > 0.05$) decrease in level of sugar, but they showed significant increase in vital capacity of lungs ($P < 0.001$).
Key word: Exercise, Diabetes Mellitus, Spirometer, glucose level.

Introduction

Diabetes mellitus (DM) type 2 has both genetic and environmental component. It includes reduction in both insulin secretion and action.[1] In type 2 DM, insulin is present but it does not function efficiently to stimulate glucose uptake into cells (insulin resistance).[2] Exercise can regulate blood glucose level through three mechanisms; acute enhancement of muscle glucose transport, enhancement of the insulin signaling pathway, and increase utilization of exogenous glucose in contractile activity skeletal muscles up to 200 fold.[3] Aerobic exercise training increases glucose transport by stimulating glucose transport-4 enzyme which increases in the muscle adenosine mono-phosphate (AMP) and in turn stimulates AMP kinase.[4] In addition to AMP kinase activation suggests that nitric oxide (NO) may induce glucose uptake.[5] Men and women who were physically active had the highest lung function.[6] The vital capacity is the amount of air that can be expired after a maximal inspiratory effort. The vital capacity refers to pulmonary function and strength of respiratory muscles. Any factor reduces the ability of lung to expand, reduces the vital capacity.[7] The diabetic patients are diagnosed according to criteria by new definition from Word Health Organization and American Society of diabetes fast glycaemia > or = 7 mmol/L (126 mg/dl).[8] Body mass index (BMI) is the body weight in kilogram divided by the (height in meter)^2.The normal value for this index is 20 -25 kg/m^2.[9]

Subjects and methods

Subjects:

A study was conducted on twenty five men subjects. Their ages were between 40 to 60 years. They were divided into two groups. Group 1 includes 13 type 2 diabetic patients, their mean ages were 50 ± 7.59 years (mean ± SD). The group 2 includes 12 control subjects (normal individual), their mean ages were 46.08 ± 7.81 years. All subjects (patients and control) were selected randomly and referred to our department for bicycle stress testing. All subjects had no obesity, and they had no history of hypertension, cardiac diseases, smoking or alcohol drinking.

Methods

1- Fasting blood sugar was tested as follow; after overnight fast, a venous blood sample of 2.5 ml was obtained. The blood was centrifuged and the collected plasma was investigated for fasting serum glucose by standard enzymatic method. [10]

2- Vital capacity (VC) of lung test was performed by manual spirometer by method stated in practical clinical medical physiology for second Medical Students.[7] All subjects were tested in resting sitting position before exercise and after exercise.

3- All subjects were tested by computer driven bicycle (Tunturi, K00639E315, made in Finland). At velocity of 7 miles/hour and resistance on degree 5 for 15 minutes.

4- The heart rate (HR) was obtained by computer driven bicycle before of exercise and at end of it.

5- The body mass index (BMI) was calculated from weight and height of both patients and controls in kilogram / meter² (kg/m^2) by common method.[11]

Statistical analysis

All data were expressed as mean ± SD. The differences were assessed by paired Student t-test. Correlation between variables and were computed by Microsoft Excel program, which runs under

window software. A value of P < 0.05 was considered to be statistically significant difference.[12]

Results

1- The fasting blood sugar decreased 1.3 mmol/L in diabetic patients, while it decreased 0.2 mmol/L in control subjects after exercise. So the fasting blood sugar level decreased significant (P < 0.001) in diabetic patients in comparison to decreased fasting blood sugar to control subjects. Figure (1).

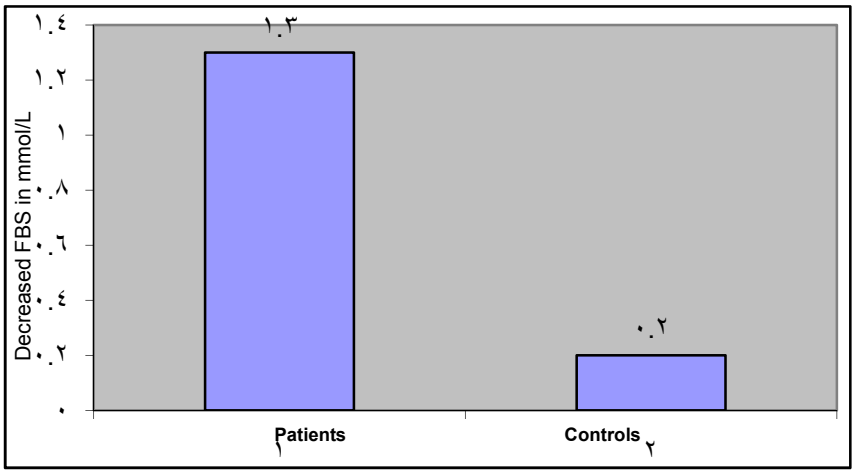

Figure (1): Decreased FBS level (mmol/L) in diabetic patients and control subjects.

2- The vital capacity in control subjects increased 476 ml, while it increased 140 ml in diabetic patients after exercise. So the vital capacity in control subjects increased significant (P < 0.001) in comparison to diabetic patients. Figure (2).

3- The heart rate was not significantly increased (P > 0.05) in diabetic patients (25.5 ± 8.7 beats/minute) in comparison to control subjects (20.3 ± 5.6 beats/minute).

4-The body mass index was not significant (P > 0.05) in diabetic patients (20.4 ± 1 kg/m^2) comparison to control subjects (20.7 ± 1.2 kg/m^2). Table (1).

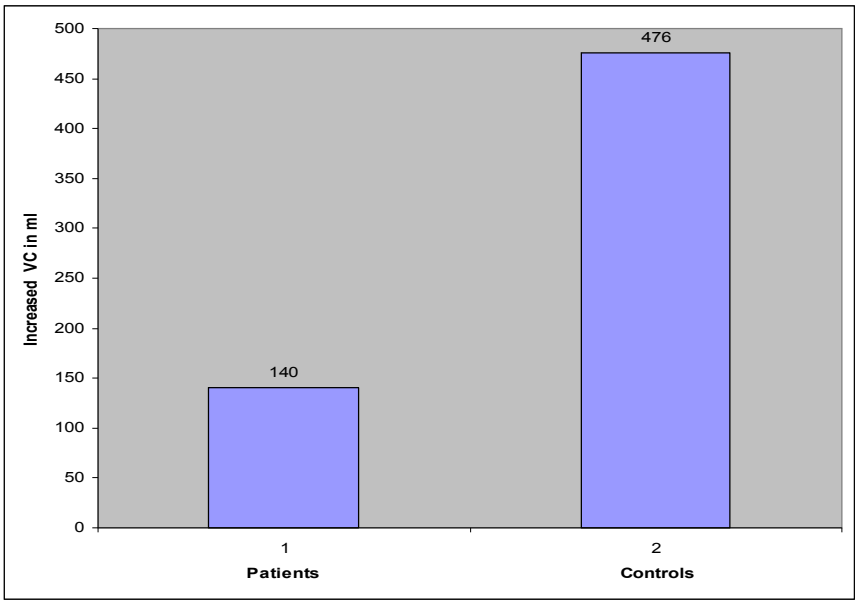

Figure (2): Increased vital capacity (in ml) in diabetic patients and control subjects.

Table (1): Showed measured heart rate (HR), body mass index (BMI) and age of both diabetic patients and control subjects. The data were expressed as a mean ± SD (Standard deviation).

Type of parameter	Control subjects	Diabetic patients	Probability (P)
Increased HR (beats/min.)	± 5.6 20.3	25.5 ± 8.7	> 0.05
BMI (kg/m^2)	20.7 ± 1.2	20.4 ± 1	> 0.05
Age (years)	45.9 ± 8.2	± 7.4 49.6	> 0.05

Discussion

Our study reveals decline in level of fasting blood glucose in diabetic patients significantly ($P < 0.001$) comparison to non diabetic subjects, this result is in agreement with previous study.[13] who noted that a greater decline of glucose in non insulin dependent diabetes mellitus (NIDDM) than in non diabetic subjects during moderate intensity exercise. Exercise increasing glucose uptake by the muscles and enhancing the ability to store glucose. During exercise the level of blood glucose diminished because muscle contraction stimulate glucose uptake into the muscle even when insulin is absent.[4]

Exercise is associated with increase carbohydrates oxidation in the skeletal muscle. [14] This could explain the significant reduction of the fasting blood glucose level in this study. The result of this study was in agreement with previous study.[5] who stated that subjects with NIDDM have higher rate of glucose uptake by skeletal muscle than do healthy control, and with[15] who said that the glycaemia level was decreased by physical activity in male with type 2 DM. The present study showed that the vital capacity (lung function) was increasing in both groups but it increased in control subjects significantly ($P < 0.001$) different from those of diabetic patients. The improvement of the pulmonary function by exercise is well documented in normal persons and subjects with type 2 diabetes.[16] This could be attributed to increased pulmonary ventilation, as the lung can take-in more air with each respiration. Also from increasing efficiency of the external respiration, interchange more efficiency between the lung and capillaries on the alveoli, in addition to increasing efficiency in the absorption oxygen per litter, during exhausting work.[17] While the result of the heart rate was found to increase but not significantly ($P > 0.05$) in diabetic patients. This result might be due to some diabetic patients had autonomic nervous system neuropathy. These abnormalities lead to impaired cardiovascular reflexes.[18] Cardiovascular autonomic function tests are mediated mainly by the parasympathetic system which is typically abnormal before mediated by the sympathetic nerves.[19] There were no previous studies similar in method to our study, so we can not compare our results to other studies.

Conclusion

This study revealed that diabetic patients had decrease level of FBS significantly with increased vital capacity of normal persons significantly in moderate exercise.

Recommendations

1- Exercise training improves the lung function and delay the serious diabetic complication.

2- Exercise has the potential to control the diabetes by non mediated means and reduce severity of disease and significantly reduce the risk of long term complication. So we recommend that physical activity should be apart of treatment of diabetes mellitus.

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