



ORIGINAL RESEARCH PAPER

Physiology

COMPARATIVE STUDY OF EXERCISE RESPONSE IN UNCOMPLICATED TYPE 2 DIABETICS

KEY WORDS: Submaximal exercise, work done, Type 2 diabetes

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ABSTRACT

A case control study was conducted to check the exercise response of type 2 diabetics to submaximal exercise. Time taken and work done to reach the desired sub maximal heart rate was recorded in 40 type 2 diabetic subjects and compared age and BMI matched normal controls. Subjects were asked to do submaximal aerobic steady state exercise till they reached 70% of calculated maximum heart rate. Our results show that time taken to reach 70% maximal heart rate in diabetics is significantly faster with p value <0.01 and the work done for the target heart rate is lesser in diabetics (p=<0.01) compared to controls. It also shows that work done (p=0.04) for target heart rate is significantly reducing as the duration of disease is increasing. Findings of our study prove our hypothesis that there is exercise intolerance in type 2 diabetics even without cardio vascular disease. It also shows that exercise intolerance is progressive with duration of disease. It is advisable for life style changes which include proper diet with regular aerobic exercise. This will be of major help to the diabetics by reducing the progression of the disease as such and by reducing other causes of mortality.

INTRODUCTION

Diabetes is one of the major causes of premature illness and death worldwide. According to WHO, 346 million people worldwide suffer from diabetes. (1) Almost 4 million deaths per year across the globe are attributable to diabetes. (2)

In Asia, the prevalence of diabetes is increasing rapidly. It was estimated that 50 million Indians were diabetic in 2010, and this number is expected to cross 87 million in 2030 (3)

Exercise intolerance is a major complication of type 2 diabetes, which is associated with increased mortality. (3) Abnormal hemodynamic responses to exercise have been observed in diabetic subjects. (4)

Studies have shown that limitation in exercise capacity is a strong predictor of cardiovascular dysfunction and all other causes of mortality in diabetic patient. Underlying pathophysiology is multifactorial (5)

There are many computerized systems for data collection and analysis available. In our study we have considered simple parameters like time taken and work done calculation which can be easily used on a daily basis without need of any expensive equipment.

Keeping in view cardiac and respiratory effects in diabetics it is important to study their exercise tolerance. Considering the fact that there is an increasing trend of diabetes in urban population, an attempt is made to evaluate exercise response to submaximal exercise in type 2 diabetics using Ergospirometer and to test the hypothesis that "Type2 Diabetes mellitus reduces exercise tolerance".

If exercise intolerance is identified early, required intervention and lifestyle modification can be recommended, which can be of major help to diabetics.

Objectives Of The Study

- (a) To determine time taken to reach 70% of maximal heart rate in Type2 diabetes and normal controls using Ergo spirometer.
- (b) To calculate the work done to reach 70% of maximal heart rate in Type2 diabetes and normal controls and compare the results obtained between type 2 diabetics and healthy controls

- (c) To compare work done and time taken according to duration of diabetes

Methodology

The study is a case control study intending to record responses to sub maximal exercise carried out on 40 Type 2 diabetic subjects and 40 normal individuals who were taken as controls. Selection was based on inclusion and exclusion criteria.

Inclusion Criteria:

- 1. Age group – 35 to 50yrs.
- 2. Patient diagnosed of uncomplicated Type 2 diabetes.
- 3. Informed consent

Exclusion Criteria:

Subjects With The Following Conditions Are Excluded:

- 1. Hypertension.
- 2. Severe obesity (BMI >35).
- 3. Arthritis.
- 4. Neuromuscular skeletal deformity.
- 5. Pregnancy.
- 6. Retinopathy
- 7. neuropathies.
- 8. Nephropathy.
- 9. History of cardio respiratory illness
- 10. Peripheral vascular disease

Treadmill model – PC ECG12 DE 55 has been used for the study. The belt moves to the rear requiring the user to walk or run at a speed matching that of the belt. The rate at which the belt moves is the rate of walking or running.

Institutional ethical committee clearance was obtained before starting the study. Cases were diagnosed type 2 diabetics at medicine department of Victoria hospital.

Subject's complete history was taken to exclude any other medical illness. Subjects were explained the complete procedure and they were familiarized with the instrument. Written informed consent was taken. If subject fulfills the selection criteria then their general physical examination was carried out. Height and weight were recorded to calculate their BMI. Blood pressure was recorded. 12 lead ECG was connected which is read throughout the procedure and to get heart rate which is calculated by RR interval. Now subject was

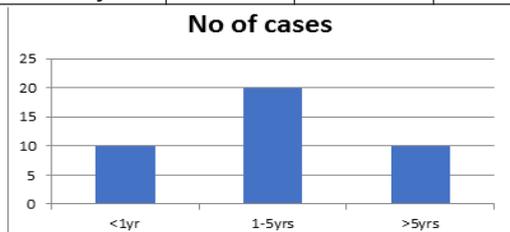
asked to do submaximal exercise on treadmill ergospirometer . Subjects performed steady state aerobic exercise to reach 70% of their maximal heart rate. Maximal heart rate was calculated by 220-age. The exercise protocol used was a warm up at 3 km/hr speed for 2min followed by 5 km/hr with 0% elevation till 70% of maximal heart rate is reached. This speed was selected to mimic the daily normal walking speed of the subjects. Time taken to reach desired heart rate was recorded. Age, sex and BMI matched controls who were healthy individuals were selected and same exercise protocol was followed and the recordings were taken. Work done to reach sub maximal heart rate was calculated in all subjects. Later results were compared between cases and controls.

RESULTS

This study intended to check the exercise response of type 2 diabetics to submaximal exercise. Time taken and work done to reach the desired sub maximal heart rate was recorded. The results were tabulated in master chart and statistically analysed. Results on continuous measurements are presented on Mean SD (Min-Max). Significance is assessed at 5 % level of significance.

Table 1: Comparing Time Taken And Work Done To Attain Submaximal Heart Rate Between Cases And Controls

	Case	Control	P value
Time taken min	3.14± 1.15	4.46±0.58	<0.001**
Work done KJ	126.8±66.4	196.7±41	<0.001**



Graph 1: Cases Are Divided According To Duration Of Diabetes

Table 2: Time Taken And Work Done To Attain Submaximal Heart Rate In Sub Groups Divided According To Duration Of Diabetes

	<1yr	1-5yr	>5yr	P value
Time taken Min	3.23±1	3.12±1.3	3.13±1.2	0.96
Work done KJ	127.6±63.6	127.3±76.6	124.98±56.2	0.004**

DISCUSSION

This study intended to check the exercise response of type 2 diabetics to submaximal exercise. Time taken and work done to reach the desired sub maximal heart rate was recorded.

Subjects in both the groups were well matched with respect to age (p=0.96) and gender (p=1.000). All the anthropometric parameters are matched between two groups with insignificant p value.

Table 1 shows that time taken to reach 70% maximal heart rate in diabetics is significantly faster with p value <0.01. The work done (p=<0.01) for the target heart rate (70% maximal heart rate) is lesser in diabetics compared to controls.

Both the ability to deliver oxygen to the skeletal muscle and use of oxygen by the muscle may be compromised in type 2diabetes⁽⁷⁾ which could be the reason of reduced work done in diabetics compared to controls.

In our study diabetics have reached the desired heart rate very fast compared to non-diabetics. The accelerated heart rate response may be due to cardiac autonomic neuropathy

seen in diabetics⁽⁸⁾

Table 2 shows that work done (p=0.004) for target heart rate is significantly reducing as the duration of disease is increasing.

Impaired functional capacity of mitochondria in skeletal muscle is observed in type 2 diabetes. Moreover, the impairment of the myocardial and skeletal muscle energy metabolism observed in type 2 diabetic patients is related to changes in circulating metabolic substrates⁽⁹⁾. All these abnormalities may contribute exercise deficit observed in type2diabetes.⁽⁷⁾

Reduction in the work done for target heart rate may be due to insulin resistance seen in many diabetics. The molecular mechanisms implicated in insulin resistance are related to the increased expression and/or activity of key enzymes and signalling proteins regulating skeletal muscle glucose and fat metabolism⁽⁹⁾ One of these proteins is the glucose transporter isoform 4 (GLUT-4), strongly associated with improved insulin action in glucose uptake. Furthermore, the expression and/or activity of proteins involved in insulin signal transduction in skeletal muscle may also play a role⁽⁹⁾

All links in oxygen transport chain are affected and contribute to reduced work done.

Considering all the advantages of exercise in diabetics and by the finding of our study that diabetics have exercise intolerance, it is advisable for life style changes which include proper diet with regular aerobic exercise. This will be of major help to the diabetics by reducing the progression of the disease as such and by reducing other causes of mortality.

CONCLUSION

A case control study was conducted to check the exercise response of type 2 diabetics to submaximal exercise. Time taken and work done to reach the desired sub maximal heart rate was recorded in Type 2 diabetics and compared with age, sex and BMI matched healthy subjects.

Study shows that time taken to reach 70% maximal heart rate in diabetics is significantly faster, the work done for the target heart rate is lesser in diabetics compared to controls. Response to submaximal exercise according to duration of diabetes shows that work done for target heart rate is significantly reducing as the duration of disease is increasing.

From our study we conclude that determining time taken to reach submaximal heart rate in diabetics can be used as a test for exercise intolerance. If exercise intolerance is identified early, required intervention and lifestyle modification can be recommended, which can be of major help to diabetics.

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