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COMPARATIVE STUDY OF RESPIRATORY RESPONSE FOR SUB MAXIMAL EXERCISE IN TYPE 2 DIABETICS

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ABSTRACT According to WHO, 346 million people worldwide suffer from diabetes.Abnormal hemodynamic responses to exercise have been observed in diabetic subjects. With the above background, study was taken to evaluate respiratory response to submaximal exercise in type 2 diabetics using ergospirometer and compare the results with healthy control. Later to corelate the exercise response with respect to duration of diabetes Type 2 diabetes patients performed exercise on MEC PFT system till heart rate reached submaximal level (70%of max). Respiratory response recorded with following parameters- minute ventilation (VE), respiratory rate (RR) and tidal volume(TV). Abnormal respiratory response was seen in diabetics with significant rise in respiratory rate (p=0.02). Exercise intolerance is increasing with the duration of diabetes which is shown by significant increase in VE (p=<0.01) and TV(p=0.02) corresponding to their duration of diabetes. Findings of our study prove our hypothesis that there is exercise intolerance in type 2 diabetics even without cardio vascular or respiratory disease. It also shows that exercise intolerance is progressive with duration of disease.

KEYWORDS : Respiratory responses, Type 2 diabetes, Ergospirometer, Sub maximal exercise.

INTRODUCTION

According to WHO, 346 million people worldwide suffer from diabetes. [1] The worldwide prevalence of DM has risen dramatically over the past two decades, from an estimated 30 million cases in 1985 to 285 million in 2010. Based on current trends, the International Diabetes Federation projects that 438 million individuals will have diabetes by the year 2030**.** Although the prevalence of both type 1 and type 2 DM is increasing worldwide, the prevalence of type 2 DM is rising much more rapidly, presumably because of increasing obesity, reduced activity levels as countries become more industrialized, and the aging of the population. Worldwide estimates project that in 2030 the greatest number of individuals with diabetes will be aged 45–64 years.[2]

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]

Through this study, we aim to evaluate respiratory response to submaximal exercise in type 2 diabetics.

OBJECTIVES OF THE STUDY

1. To record the respiratory response to submaximal exercise in Type2 diabetes, using ergospirometer
2. To compare respiratory response with healthy controls
3. To compare the exercise response with respect to duration of diabetes

METHODOLOGY

Institutional ethical committee clearance was obtained before starting the study. Cases were taken from diagnosed type 2 diabetics at medicine department of Victoria hospital, with consideration of inclusion and exclusion criteria.

Subject's complete history was taken to exclude any other medical illness. Written informed consent was taken. If subject fulfills the selection criteria of age 35-60 years with uncomplicated diabetes, then their general physical examination was carried out. Subjects medical history was checked to rule out exclusion criteria of hypertension, severe obesity (BMI>35), retinopathy, peripheral neuropathy, any peripheral vascular disease, urine microalbinuria was checked to rule out nephropathy. Subjects were explained the complete procedure and they were familiarized with the instrument. Subjects Blood pressure was recorded,12 lead ECG was connected which is read throughout the procedure to get heart rate. Face mask is connected from which breath to breath inspired air is analyzed. Oxymeter is connected to finger to check the saturation throughout the procedure. Before starting the exercise resting Respiratory parameter (Tidal volume, VE and Respiratory rate) is noted. Now subject was asked to do submaximal exercise on MEC PFT system. Subjects performed steady state aerobic exercise to reach 70% of their maximal heart rate(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. Their respiratory response as reflected in the parameters (tidal volume, respiratory rate and VE)were obtained. Age, sex and BMI matched controls who were healthy individuals were selected and same exercise protocol was followed and the recordings were taken. Later results were compared between cases and controls.

Treadmill model – PC ECG12 DE 55 was used for the study. Treadmill was connected to MEC- PFT (Medical Electronic Constructions –Pulmonary Function Test) system data interface version 2012 software; It had a connection to air flow meter which analysed inspired and expired air. It also had attachment for oxymeter to check oxygen saturation of blood.

RESULTS

This study intended to record respiratory responses to submaximal exercise in type 2 diabetic subjects aged 35-50 years and compare the values with age and BMI matched normal controls and to check the hypothesis that diabetics have reduced exercise tolerance compared to non-diabetic subjects even in absence of clinical cardiovascular disease. In each subject respiratory parameter like respiratory rate, tidal volume and VE were recorded before and after sub maximal exercise. The results were tabulated in master chart and statistically analysed.

Statistical Methods: Descriptive and inferential statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean SD (Min-Max) and results on categorical measurements are presented in Number (%). Significance is assessed at 5 % level of significance.

+ Suggestive significance (P value: 0.05<P<0.10)
* Moderately significant (P value:0.01<P 0.05)
** Strongly significant (P value: P0.01)

Table 1: Comparing resting respiratory parameters between cases and controls

	Case	Control	P value
VE lt/min	6.2±1.81	6.8±1.9	0.21
RR /min	19.6±4.9	19.2±3.1	0.61
TV Lt	0.42±0.17	0.44±0.12	0.63

Table 2: Comparing Respiratory parameters attained after submaximal exercise between cases and control

	Case	Control	P value
VE lt/min	21.5± 11.5	23.1±5.8	0.45
RR /min	29.2±5.7	27.1±5.5	0.02*
TV Lt	0.8±0.4	1.16±2	0.28

Table 3: Respiratory response to submaximal exercise in sub groups divided according to duration of diabetes

Respiratory system				
	<1yr	1-5yr	>5yr	P value
VE lt/min	37.92±5.3	19.89±5.4	8.5±1.7	<0.01**
RR /min	28.3±2.9	27.45±5.4	33.6±6.8	0.02*
TV Lt	1.4±0.2	0.73±0.2	0.42±0.2	<0.01**

This study intended to record respiratory responses to submaximal exercise in type 2 diabetic subjects aged 35-50 years and compare the values with age and BMI matched normal controls and to check the hypothesis that diabetics have reduced exercise tolerance compared to non-diabetic subjects even in absence of clinical cardiovascular disease. Results were expressed in tables as mean ± standard deviation. Age and gender distribution of all the subjects in two groups were well matched with respect to age (p=0.96) and gender (p=1.000). Anthropometric parameters are matched between two groups with insignificant p value.

Table 1 shows no difference in respiratory resting parameters between the two groups.
Table 2 show respiratory responses after submaximal exercise. It is evident that there is significant rise in respiratory rate (p=0.02) in diabetics.

In our study VE is slightly decreased in diabetics though not statistically significant. Significant increase in respiratory rate must be to compensate decrease in VE due to the diabetic influence on integrity of the pulmonary connective tissue and microvasculature. In diabetics there is alteration in the pulmonary connective tissue and also modification of alveolar surfactant. There is thickening of the alveolar and capillary endothelial basement membranes, pulmonary micro angiopathy which brings about reduction in diffusing capacity.[5]

Table 3 shows respiratory response of diabetics with respect to their duration of diabetes. Which shows significant increase in RR(p=0.02). Reduction in VE(p=<0.01) and TV (p=0.02) corresponding to their duration of diabetes.

Respiratory parameters like VE and tidal volume is deteriorating with progression of the disease which may be due to increase in damage to the pulmonary connective tissue and pulmonary microvasculature and also modification of alveolar surfactants.[5] To compensate this change there is increase in respiratory rate according to duration of disease.

Physical inactivity has been identified as a major determinant of type 2 diabetes, and increased activity has been shown to improve insulin sensitivity and glycaemic control among nondiabetic individuals, as well as those with impaired glucose tolerance or overt type 2 diabetes.[6]

Exercise reduces blood glucose through an increase in insulin-dependent and insulin-independent glucose transport to working muscle.[7] Studies show that modest increments of physical fitness in diabetic subjects reduces the risk of overall mortality by two-fold[8]

For these reasons, regular aerobic physical activity must be considered an essential component of the cure of type 2 diabetes mellitus.[7]

Walking is a low impact, easy to perform, and therefore acceptable physical activity for people with type 2 diabetes. Studies have showed that walking improves quality of life[9]. Exercise increases insulin sensitivity (both short and long term), lowers blood sugar levels, reduces body fat and improves cardiovascular function. Because of this, exercise offers enormous benefit to patients with diabetes.[10]

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 undertaken to check the, respiratory response to sub maximal exercise in Type 2 diabetics aged 35-50 yrs. They were compared with age, sex and BMI matched healthy subjects. Respiratory parameters like VE, tidal volume and respiratory rate were recorded. All parameters were recorded during resting and at the end of reaching sub maximal heart rate in all subjects. The results obtained were tabulated, statistically analysed and discussed. It is found that,

1) Response to submaximal exercise shows that there is significant rise in respiratory rate (p=0.02) in diabetics. It also shows that time taken to reach 70% maximal heart rate in diabetics is significantly faster with p value <0.01.
2) Response to submaximal exercise according to duration of diabetes shows significant increase in RR(p=0.02) and reduction, VE (p=<0.01), TV(p=0.02) with respect to their duration of diabetes.

Findings of our study prove our hypothesis that there is exercise intolerance in type 2 diabetics even without cardio vascular and respiratory 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.

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