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Effect of a stepwise cycling on insulin resistance and CRP in adult males with type II diabetic

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Abstract

Recent studies have shown that type II diabetic is associated with systemic inflammation. This study was aimed to determine the effect of a single stepwise cycling on serum C-reactive protein and insulin resistance in type II diabetic patients. For this purpose, seventeen adult males with type II diabetic were selected to participation in this study by accessible sampling. Blood samples were collected before and immediately after a stepwise cycling test in order to measuring serum CRP, glucose concentration and insulin resistance. Student's t-tests for paired samples were performed to determine significance of changes in variables by exercise test. No significant change was found in serum CRP by cycling test in subjects (1161 ± 214 vs 1184 ± 287 ng/ml, p=0.234). Cycling test resulted in significant decrease in glucose concentration (234±34 vs 212 ± 33 mg/dl, p=0.039), but insulin resistance was not changed (4.67 ± 1.23 vs 4.65 ± 1.12, p=0.148). Based on these data, we conclude that single cycling test for short-time can not improve serum CRP and insulin resistance while is associated with glucose reduction.

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Introduction

It is well known that diabetes occurs when pancreatic islets are not able to secrete enough insulin and/or the sensitivity of glucose-metabolizing tissues to insulin decreases (Wang *et al.,* 2010). Although the main physiological abnormalities are insulin resistance and impaired insulin secretion (Reaven *et al.,* 1988; DeFronzo, 1987), Accumulating evidence indicates that inflammation may play a crucial intermediary role in pathogenesis, thereby linking diabetes with a number of commonly coexisting conditions thought to originate through inflammatory mechanisms (Pradhan et al., 2001). In type 2 diabetes, the failure of β-cell function and β-cell mass reduction are predominantly associated with the increase in circulating cytokines and with persistent hyperglycemia (Stumvoll *et al.,* 2005). Therefore, inflammation has also been postulated to play a role in the pathogenesis of type 2 diabetes.

Among inflammatory markers, marked evidence indicates the use of hs-CRP as an independent predictor of increased CVD risk in diabetic and non diabetic patients (Albert *et al.,* 2002; Ridker, 2003). In this context, A growing body of literature and more recent cross sectional data suggest that C-reactive protein (CRP) as a inflammatory cytokine, a sensitive physiological marker of subclinical systemic inflammation, is associated with hyperglycemia, insulin resistance, and overt type 2DM (Hong *et al.,* 2007; Utzschneider *et al.,* 2006).

Overall, the scientific evidence confirm the role of CRP as an inflammatory cytokine in the pathogenesis of type 2 diabetes and its relation with insulin resistance and diabetes in people with type 2 Hypercalcemia has repeatedly been reported. Hence, developing appropriate strategies for reducing or balancing the systemic levels of this inflammatory marker has been the focus of researchers in health sciences. Meanwhile the role of exercise as a non-pharmacologic treatment has been studied several times. Although some studies have supported the beneficial effects of exercise on balancing this inflammatory marker (de Salles *et al.,* 2010; Eizadi *et al.,* 2011), others have reported no effect on serum levels of physical activity (Lakka *et al.*, 2005). However, most of the studies in the field of sports have been limited the long-term effects of exercise on CRP levels and the role of a short or single session exercise was been less frequently studied. Hence, the present study aims to determine the effect of a relatively moderate-intensity exercise of short duration on serum levels of CRP as well as glucose and insulin resistance in type 2 diabetes.

Material and methods

Subjects

To evaluate the effect of a short-time exercise on serum CRP, glucose and insulin resistance in diabetic patients, seventeen sedentary adult males with type II diabetic (38 ± 4 years mean ± standard deviation of mean (SD), 26 ≤ BMI ≤ 33 kg/m2,) participated in the study. After the nature of the study was explained in detail, informed consent was obtained from all participants.

Inclusion and exclusion criteria

Subjects included individuals with no cardiovascular diseases, gastrointestinal diseases, kidney and liver disorders. In addition, if any of the people had been participating in regular exercise or diet program during the past 6 months, they were excluded study. In addition, exclusion criteria included inability to exercise and supplementations that alter carbohydrate-fat metabolism. The subjects were advised to avoid any physical activity or exercise 48 hours before the exercise test.

Anthropometrical measurements

Weight was measured by an electronic balance and height by a stadiometer. Height of the barefoot subjects was measured to the nearest 0.1 cm. Waist and hip circumferences were measured with the subject standing erect with arms at the sides and feet together, wearing only underwear. BMI was calculated as weight (kilograms) divided by height squared (square meters). Body fat percentage was determined using body composition monitor (OMRON, Finland).

Biochemical measurements

Venous blood samples were obtained before and immediately after a single bout stepwise cycling test in order to measuring serum serum CRP, glucose concentration and insulin resistance. Cycling exercise test was a YMCA standard test on leg ergometery cycle (Tunturi, made in Finland). This protocol was performed in 5 continues stage without rest between stages. Each stage lasted 3 minute (Mullis *et al.,* 1999). Glucose was determined by the oxidase method (Pars Azmoun, Tehran, Iran). Serum CRP was determined by ELISA method (Diagnostics Biochem Canada Inc. High sensitivity C - reactive protein (Hs-CRP)). The Intra- assay coefficient of variation and sensitivity of the method were 5% and 10 ng/mL, respectively. Insulin and glucose levels were used for the homeostasis model assessment of insulin resistance ($HOMA_{IR}$ = (fasting insulin (μIU/ml) × fasting glycemia (mmol/l))/22.5.

Statistical analysis

Data were analyzed by computer using SPSS software version 15.0. Normal distribution of data was analyzed by the Kolmogorov-Smirnov normality test. Student's paired 't' test was applied to compare the pre and post exercise values. An alpha-error below 5% was considered as statistically significant.

Results

In this study, serum CRP and some indicative markers of type 2 diabetic responses to a single both cycling exercise were investigated in adult males with type II diabetes. Anthropometric and metabolic characteristics of the study are shown in Table 1.

The study finding showed that serum CRP levels were not acutely affected by the cycling exercise when compared to baseline values (p = 0.321). No significant change in serum insulin was observed immediately after exercise test compared before exercise (p = 0.198). Glucose concentration was decreased significantly by exercise test in studied subjects (p = 0.023). No significant differences were found in insulin resistance after exercise when compared to baseline values (p = 0.214).

Table 1. Mean and standard deviation of anthropometrical and biochemical variables in baseline and after intervention in studied patients.

Groups / Variables	Pretest	post-test
Age (year)	40 ± 3.6	40 ± 3.6
Height (cm)	174 ± 6	174 ± 6
Weight (kg)	99 ± 8	99 ± 8
BMI (kg/m2)	30.36 ± 2.55	30.36 ± 2.55
Body fat (%)	30.14 ± 3.28	30.14 ± 3.28
Glucose (mg/dl)	216 ± 33	192 ± 29
Insulin (μIU/ml)	8.58 ± 2.23	8.48 ± 2.65
Insulin Resistance	4.71 – 1.44	4.66 – 1.13
CRP (ng/ml)	1170 - 212	1185 - 187

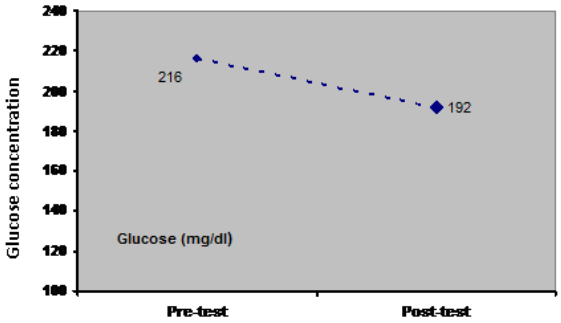

Fig. 1. Data of glucose concentration before and immediately after cycling test in studied patients. Glucose concentration was decreased significantly by exercise test in studied subjects (p = 0.023).

Discussion

Although some previous studies have been reported that long term exercise training decreases serum CRP or another inflammatory cytokines, but our study data showed no significant change in this cytokine after a single both exercise with moderate intensity.

CRP remaining unchanged in response to the exercise test was observed while blood glucose levels significantly reduced. In fact a single session including 15 minutes of biking with relatively moderate intensity led to significant decrease of

blood glucose in diabetic subjects. Furthermore, no significant change was observed in insulin resistance through the exercise test.

American Heart Association and the Centres for Disease Control and Prevention in the USA support the notion that CRP is the best and most clinically useful of the markers of inflammation currently available (Pearson *et al.,* 2003). In this context, a growing body of literature use CRP as the only marker of inflammation, however, choosing a wider spectrum of inflammatory markers can give us a better picture of the specific mechanisms involved (Julia *et al.,* 2010).

The data of inflammatory cytokine responses to exercise training are conflict and controversial. Several training interventions have not produced changes in the basal CRP (Hammett *et al.,* 2006; Fischer *et al.,* 2004; Bautmans *et al.,* 2005; Marcell *et al.,* 2005), while significant reductions in inflammatory markers have been observed following training in some another studies (Kohut *et al.,* 2006; Stewart *et al.,* 2005). Some longitudinal studies show that regular training induces a reduction in the CRP level (Fallon *et al.,* 2001; Mattusch *et al.,* 2011). In another study, exercise training intervention for long term(20 weeks) is not associated with any significant change in serum CRP in in 652 sedentary healthy, young and middle-aged, white and black women and men (Lakka *et al.,* 2005). Our study data showed that cycling exercise for one session failed to change serum CRP in diabetic patient.

Here it is necessary to point out that the lack of a control group (non-diabetic male subjects) was one of the main limitations of this study. Because, although most previous studies have reported that the level of CRP in diabetics is higher than non-diabetics, it is possible that in this study there is no significant difference in CRP levels between diabetic patients and non-diabetic subjects and that baseline levels in these patients is within normal range. Given the chance, no change in CRP diabetic subjects in this study is justified. In this context, some recent studies have observed no significant differences in baseline levels of inflammatory cytokines between diabetics and non-diabetics or obese and non-obese subjects. In support of this hypothesis, the findings of a study showed that exercise would increase CRP levels in those who already have high CRP baseline levels before exercise. These findings point out that the baseline levels of inflammation is an important factor in response to exercise. It is also possible that in this study the exercise has not been not long enough or sufficiently intense to affect levels of CRP or other inflammatory markers. These findings may also apply to insulin resistance in response to exercise.

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