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ORGINAL ARTICLE

The Effect of Resistance Training on Glycemic Indexes of Streptozotocin Induced Diabetic Rats

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Abstract

Introduction: Aim of present research was to review the effect of resistance training on glycemic indexes of Streptozotocin induced diabetic rats. Methods: For this purpose 36 male rats with weight 308/82±29/57 selected. One week after induction of diabetes diabetic rats were randomly divided into two groups including resistance training and control and healthy rats divided in to two groups including resistance training and control. Resistance training was 5 days per week for 6 weeks. For statistical analysis of data used one way ANOVA and tukey post hoc test ($p \leq 0/05$). Findings: Findings showed that fasting glucose, insulin, HbA_{1c} and insulin resistance in diabetic resistance training were lower than diabetic control ($p=0/001$) also fasting glucose, insulin, HbA_{1c} and insulin resistance in healthy rats were lower than diabetic rats ($p=0/001$). Conclusion: Base on findings of present research six weeks resistance training has significant effect on glycemic indexes of diabetic rats.

Key words: resistance training, fasting glucose, HbA_{1C}, insulin resistance

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Introduction

Diabetes is one of common disease and its prevalence is strongly raising (Casey et al., 2009). In year of 2000 rate of diabetic people estimated approximately 147 million persons and it prospected it raise to 334 million persons in year of 2025 (Casey et al., 2009). For treatment or control of this disease there are various suggested therapeutic methods such as natural medication or change the life style (Gloria et al., 2003). Regular Physical activity is important portion of weight loss programs that like regimen control, use of medication or in time injection of insulin can induce more absorption of glucose by active muscle. In field of effect of species training methods (aerobic, resistance, compound and flexibility) on diabetic markers and effective factors on it, various study conducted (Casey et al., 2009, Carmen et al., 2002, David et al., 2002, David et al., 2006, DiLoreto et al., 2003). For example Taunton et al reported physical activity indices reduction in triglyceride and improves insulin sensitivity (Taunton et al., 1997). Izumi et al showed isometric resistance training induces 30 % raise in concentration of GLUT 4 and improves insulin resistance (Izumi et al., 1999). Reynolds et al reported resistance improves insulin sensitivity (Reynolds et al., 2007). David et al reported high intensity resistance

training improves glycemic indexes (David et al., 2002). Also Andrew et al in research which reviewed the effect of circuit trainings in combination with aerobic training and resistance training on control glycemic indexes, Cardiorespiratory fitness, muscular strength and body composition, reported that HbA_{IC} and fasting glucose reduced following noted trainings (Andrew et al., 2002). Regard to importance of exercise in diabetic patients and also regard to this issue that last researches conducted in human subjects that induced contrast results which it is due to notability of control the effective factors in noted markers, in present study review the effect of resistance training on glycemic indexes of streptozotocin induced diabetic rats.

Methods

Subjects

In present study used 33 male rats with weight of 308/82±29/57 g that propagated in animal lab of stem cells center of Shiraz university. Adaptation period was eight days. All rats used food and water freely. In eighth day– after one night fasting- 20 rats comatosed by 60 mg/kg by streptozotocin (predicted from sigma company). Four days after injection of streptozotocin, fasting blood glucose tested by glucometer. Rats with fasting glucose more than 300 mg/dl entered to protocols. Onset of training program started one week after diabetes induces. Diabetic rats divided in to two resistance and control groups and healthy rats divided in to two resistance and control groups. Training program lasted six weeks, five sessions per week. After this while, blood samples collected for test the research variables.

Training protocols

After finishing of one week adaptation, for familiarization of rats with resistance training and climbing from lather, each of them placed in lower step and without any weight and put their rear organs on steps, climbing educated. For move the rats on lather in situation of top on steps conditioned rats by touch their tails. Familiarization program was four sessions in one week and per session were included three to five repetitions without weight attaching. Resistance training protocol was included six weeks climbing from lather. Height of lather was one meter that distance between two steps was two cm and incline was upstanding. Before the start of training program, all rats climbed three times without weight and rest between repetitions for warming. Selected weight in onset of training was 30 % of weight of rats and increased to 100 % of their weight. For induct the training protocol weights attached to tail of rats by locoplast paste. Rats conducted two repetitions by each weight, and then new weight attached to their tail. Training loads were included 50, 75, 90 and 100 % of maximum weight that rats could climb in last session. In last session of per week, at the end of session, maximum weight that rats climbed, recorded. 24 hours after last training session at the end of six week, all rats sacrificed for measurement of variables.

Biochemical tests

Fasting glucose tested by biochemical kit and enzymatic method (Mauro et al., 2006). Also insulin measured by immunoassay methods. For measurement of insulin resistance used HOMA-IR formula. HPLC method used for measurement of HbA_{IC} by Nycorard system.

Blood sampling

For review the effect of independent variable on dependent variables according to prepared program, all rats sacrificed. In present research endeavored to all rats sacrificed in least time and by least pain and trouble. Comatose done by cetamin and zylozyn and blood samples collected directly from left ventricle.

Statistical analysis

Regards to random distribution of subjects in research groups and confidence of normality of data by (kolmogorov smirnov test), used one way ANOVA and tukey post hoc test. Significant level for all calculations ($\alpha \leq 0.05$) used.

Findings

Results of one way ANOVA test showed that there is significant difference between fasting blood glucose of research groups ($F_{3,32}$= 891.59, p= 0.001). Results of tukey test showed that fasting blood glucose in diabetic resistance training in lower than diabetic control (p=0.001) also in healthy resistance training and control groups is lower than diabetic resistance training and control groups (p=0.001). Results of one way ANOVA test showed that there is significant difference between insulin of research groups ($F_{3,32}$= 421.22, p= 0.001) so that Results of tukey test showed that fasting insulin healthy groups is significantly lower than diabetic groups (p=0.001). Results of one way ANOVA test showed that there is significant difference between HbA_{IC} of research groups ($F_{3,32}$= 556.41, p= 0.001). Results of tukey test showed that HbA_{IC} diabetic resistance training group is significantly lower than diabetic control group (p=0.001) also in healthy resistance training and control groups is significantly lower than diabetic resistance and control groups (p=0.001). Results of one way ANOVA test showed that there is significant difference between insulin resistance of research groups ($F_{3,32}$= 29.77, p= 0.001). Results of tukey test showed that insulin resistance in diabetic resistance training group is significantly lower than diabetic control group (p=0.001) also in healthy resistance training and control groups is significantly lower than diabetic resistance and control groups (p=0.001).

Discussion

Diabetes is most prevalence metabolic disease in human and affects approximately all body structures. In this disease due to relative or absolute absence of insulin, lipids, proteins and carbohydrates metabolism impairs. Its characteristics can point to metabolic abnormality in eye, kidney, nerves, blood vessels and heart. Type 1 diabetic patients during and after exercise are susceptible to reduction of fasting glucose. Exercise can induce intense fluctuation of plasma glucose level that is useful for this disease. Nevertheless, non acute type 1 diabetic patients are not forced to limit their exercise and regular check of fasting glucose. Most type 1 diabetic athletes successfully contribute in training and sport matches. Blood glucose control in a diabetic person who exercising is important so that can set insulin dose and food program by it. Nevertheless exercise can raise the available glucose and reduces insulin needs (Hubinger et al., 1985). Casey and Nicholas (2009) in their review article stated that progressive resistance training in compare with non exercise induces statistically less absolute reduction in HbA_{1c}. In compare with aerobic exercise, there is no significant difference in HbA_{1c}. Progressive resistance training in compare to non exercise induce considerable improve in muscular strength; also significant changes do not happen in body composition. Progressive resistance training raise strength and induce less reduction in HbA_{1c} that may be clinically is important for diabetic patients. Resistance training is a proper choice for management of fasting glucose in diabetic people (Casey et al., 2009). Results of present study showed that resistance exercise induced significant reduction in fasting glucose, insulin resistance and HbA_{IC}. Exercise is less considered as initial factors in treatment of type 1 diabetic disease for improve the glycemic control. Several studies could not show independent effect of exercise in improvement of glycemic control by measuring of HbA_{IC} in type 1 diabetic patients, nevertheless most researches in this field reported improvement of

glycemic indexes (Wasserman et al., 1994, Zinman et al., 1984, Wallberg et al., 1986). Various studies have shown that resistance exercise in effective in improvement of glycemic indexes that is in parallel with results of present study. For example David et al have reported that following resistance training HbA1c in diabetic patients reduce significantly (David et al., 2006); Fenicchia et al in review the effect of acute resistance training on glucose and insulin responses to glucose loading in diabetic female shown that acute resistance training was effective on improvement of glucose improvement, also significant changes in insulin concentration did not happened (Fenicchia et al., 2004); Andrew et al in review the effect of eight weeks circuit training in combined with aerobic and resistance training showed that HbA1c and fasting glucose reduced (Andrew et al., 2002); Carmen et al with review the effect of high intensity progressive resistance training on glycemic indexes of diabetic patients showed that resistance training induces reduction of HbA1c, raise in muscular glycogen storages and reduction of diabetic drug doses in 72 % of experimental than control group (Carmen., 2002). Result of study of David et al showed that high intensity resistance training after two, three and six months induced significant reduction in HbA1c of diabetic elderly. Nevertheless did not change fasting glucose, insulin, lipids, lipoprotein and rest blood pressure (David et al., 2002). Indeed insulin resistance induced disorders are reversible by food regimen and physical activity. Exercise can raise responsibility of body to insulin by increase the glucose transporter in to muscular cells (GLUT-4) and insulin receptors substrates (IRS) and increase the muscular mass (more than 75% insulin stimulation induced glucose uptake is related to muscular tissue). Fatty acids produced from fat tissue impairs GLUT-4 transport to noted cells by accumulation in muscular cells; fatty acids produced from fat tissue impair GLUT-4 transport to noted cells by accumulation in muscular cells; sport prohibit from accumulation of them in muscular cells by raise the fatty acids oxidation. So changes in life style along with concentration on weight loss and increase the physical activity is main mechanisms of contrast with diabetic people who have impaired glucose tolerance test (Grimm et al., 1999, Ross et al., 2002, Foseca et al., 2004). High blood pressure is one of diabetes consequence. Regard to various mechanisms which affect blood pressure, different theories offered about initial blood hypertension that included genetic, sensitivity to salt, increase in activity of sympathetic nerve system, effect of rennin and angiotension and increase in insulin resistance. Hyperinsulinemia and insulin resistance reported in thin hypertensive people who are not diabetic (Williams., 1998). However in Bilgin et al study that reviewed the relationship of glucose with HbA1c in initial hypertension, it shown that these two variables in hypertensive patients are lower than control people (Bilgin et al., 1993), but in other studies which conducted on anti blood pressure drugs, observed these drugs reduce HbA_{1c} in diabetic patients (Inoue et al., 1996, Shionoiri et al., 1994, Torlone et al., 1993). Also some researchers have reviewed the relationship between blood glucose, insulin and blood pressure. For example Chu et al shown that there is direct relationship between HbA1c and systolic blood pressure in 40- 90 aged people (Chu et al., 1993). Also Ferrannini et al controlled 13 patients who had initial hypertension and were not under treatment of anti hypertensive drugs. Base on resumed results, insulin resistance in these patients is directly related with intensity of blood pressure. Also it seems that hyperinsulinemia and increase in insulin resistance make renal absorption of sodium, increase the sympathetic tone and hypertrophy of smooth muscle of vascular endothelium. In the other hand insulin makes change in ionic transport by cell

wall and by this method increase the cytosolic calcium concentration of insulin sensitive vascular and renal tissues (Williams., 1998). Researches show that in insulin resistance induced hypertensive diabetic patients, blood glucose concentration is higher than control group (Bihell et al., 1993) and blood pressure reduce by anti glucose medication such as metformin (Hauner et al., 1994)

Conclusion

Newly resistance training is introduced as effective and therapeutic tool in treatment of chronic disease such as diabetes. According to present reports, these trainings like aerobic trainings are effective in raising of insulin sensitivity, daily energy consumption, self sufficiency and quality of life (Evas et al., 2006, Brooks et al., 2006, Constans et al., 2007), also resistance trainings have potential of raising of muscular strength, fat free mass, density of mineral bone and reduction in joint symptoms that can improve functional status of patient so that patient get her/his testimonial soon and raise his/her self confidence (Sigal et al., 2004). So bas on results of present study six weeks resistance training is effective on glycemic indexes.

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