Interactive effects of sulfonylurea drugs, aerobic and strength training on Glycemic control in type II diabetes

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Abstract

This study is of semi-experimental type. In this study, 30 male patients with type 2 diabetes were selected as samples randomly. The subjects were divided into three groups. The first group took glibenclamide daily. Second group consumed glibenclamide daily and participated in strength training. The third group consumed glibenclamide daily and participated in aerobic exercise. To measure variables before and after training used bloods samples. Data was subjected to one-way analysis of variance. It showed that no significant differences on HbA1c, LDL, and TG among groups (P>0.05) but there are significant difference between groups in HDL (P<0.05).

Keywords: HbA1C, LDL, HDL, Triglyceride, Aerobic training, Strength training, Glibanclamide;

1. Introduction

The diabetes is most common endocrine diseases by which more than 6 percent of the world's population is affected (Townsend, 2000). Since many years ago, exercise alone or with a diet and medication has been known, as the basic infrastructure in treatment of diabetes (Marcus et al., 2008). Doctors recommend those suffering Type II diabetes, by regular physical activity, and enjoying the benefits of exercise on metabolism cardiovascular risk factors, prevent the development of their disease (Thomas et al., 2006). Having features such as: low cost and lack of nature of the drug has caused an increase in patients' tendency to use exercise as a supplement to control blood sugar. Two main goals of treating diabetes are reducing sugar and increased body fat (Armstrong, 1991). Hyperglycemia mode in long periods leads to the appearance of several complications, especially in tissues such as: heart, eyes, kidneys, nerves and blood vessels (Andreoli et al, 2010). Obesity, especially having fat around the abdomen is the result of tissue strength to insulin. Increased insulin Hyperglycemia, state of ketoacidosis and, high blood pressure are other complications of diabetes (Fonseca, 2006). These symptoms tend to combine together and create a condition known as metabolic syndrome. In diabetes, the blood sugar level is usually controlled by a combination of diet, exercise, and tablets lowering blood sugar such as Metformin and Glibenclamide or insulin injection. One of Medications that use to treat Type II diabetics are Glibenclamide tablets (Glyburide) (Lebovitz et al, 2009).

Glibenclamide tablets, increase insulin secretion from pancreatic beta cells or increase body's response to insulin (Sardar et al, 2006). On the other hand, physical activity and exercise also consumes the body's overall sugar by muscle cells and reduces blood glucose concentrations. Recent research has shown that exercised skeletal muscle has

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more ability to absorb glucose and this ability is independent of insulin. Therefore exercise is taken as a supplement method for treating diabetes and insulin strength. A training program also increases glycogen making in skeletal muscle and reduces blood glucose levels (Wilmore et al., 2008). Although the beneficial effects of exercise in treating type II diabetes is still controversial, but some researchers believe that exercise alone or with drug therapy is effective in controlling blood sugar while some researchers in their research findings are opposed.

Hence, a few sample of research are mentioned here. Sardar et al (2005) in their study examined the interactive aerobic exercises and the effect of tablet glibenclamide on glycemic control of type II diabetic patients. His research findings showed that there are no significant differences in the amount of hemoglobin HbA1c between the group of aerobic exercise who took glibenclamide tablets and the group that took only glibenclamide tablets. He noted that aerobic exercise and using glibenclamide tablets improve the sensitivity of cells to insulin ratio. Massey - Benedetti et al (1996) have studied the effect of exercise on metabolic control of type II diabetic patients. Their research subjects were under medical treatment with Glymipride or glibenclamide. Evaluation of changes in blood glucose, plasma insulin and C peptide in the four- study- groups showed that in the interactive group exercise with medication, blood glucose levels had significantly reduced compared to drug groups. Gudat et al (1998) conducted a study about the effects of exercise and glibenclamide in lowering blood glucose in patients with type II diabetes and they found that taking this drug with exercise decreases glucose concentration, but each alone causes a slight reduction in blood glucose. Shahla Khan and Rap (1995) in a research titled the effect of training, diet and medication on hemoglobin A1C levels in patients with type II concluded that the exercise has no effect on blood glucose control. Larsen et al (1999) studied interactive effects of glucose lowering drugs of the sulfonylurea and exercise in patients with diabetes Type II. Their findings suggest that concurrent use of sulfonylurea and exercise caused a fast decline blood sugar. Sigal et al (2007) studied the effect of aerobic exercise, strength training and doing both simultaneously, to control blood sugar diabetes type II.

They came to the conclusion that although the sensitivity of insulin in all three experimental groups compared with control group improved significantly, but no changes in lipid levels, hemoglobin A1C exists. Also among the three training groups, the group that combined aerobic and strength exercises have done a better performance in improving the insulin sensitivity. Misra et al (2008) examined the effects of a strength training program on insulin sensitivity, blood glucose, blood lipids and body composition in patients with diabetes type II. The results of their study show that insulin sensitivity after strength training has significantly increased. Also, after doing these exercises hemoglobin A1C levels has decreased significantly. Also total cholesterol and triglyceride levels found significant difference after strength training. Ramachandran et al (2007) in a research titled insulin strength and categorization of cordial metabolism hazardous factors in adolescents of southern India state that up to 67.7% of the children population HDL amounts has reduced, but triglyceride, blood pressure, and the amount of glucose has increased.

They assert that there is a connection between insulin strength and blood fat hazardous factors and this insulin strength has a positive and meaningful correlation with the amounts of BIM, body fat, and absolute cholesterol. Marcus et al (2008) in a research with the title comparing simultaneous aerobic training and exterior strength training with aerobic exercise in type 2 diabetic patients showed that although the decrease in A1c hemoglobin amounts, yet there isn’t any significant difference between these two groups. However, the level of energetic muscles is increased in a group with aerobic and extraversion strength training. The accomplished studies regarding the simultaneous effect of aerobic training and drug therapy on the blood glucose level and HbA1C values of diabetic patient indicate that aerobic training make beneficial compatibilities in skeletal muscles and in result the blood glucose level and HbA1C values decrease, whereas cardio-respiratory preparedness(vo2max) will increase. But only a few studies dealt with examining the effects of strength training with drug therapy in diabetic patients.

Thought the studies regarding glucose control improvement with aerobic training has shown in the background, only a few volume of literatures point out that the strength training could be considered as a useful parameter in controlling type 2 diabetes. One of the advantages that could be obtained from strength training is improvement of muscle strength or the ability of force production, strength and muscle potency. Due to more reliance of the body on sugar consumption during short time activities such as strength and speedy training, so it seems training with weight in comparison to aerobic exercises result in more decrease in the blood sugar of diabetic individuals. On the other hand, aerobic training with more reliance on non-sugar resources as fat tend to have less advantage in sugar controlling and has more influences on cardiovascular risk factors. On this basis, the purpose of this research is to find an answer to this question: what is the difference between the effects of aerobic training and strength training
along with drug therapy on blood sugar controlling in type 2 diabetes patients? And also which of these aerobic and strength training will control the blood glucose in diabetic individuals better?

2. Method

2.1. Participants

This study is of semi-experimental type and the sampling was randomly. In this study 259 male patients with type 2 diabetes that referred medical centres of Abadan city in three months were participated voluntarily. They are using from glibenclamide tablet, 30 patients selected as samples randomly. Selection criteria are having a range of sugar during the last three months between 150 to 250 mg per dL, no history of coronary heart disease and lack of regular physical activity. After providing the necessary information regarding the nature and how to do research and express the potential hazards, we received consent from the subjects. The subjects in the present research are divided in to three groups. The first group (control group) took only 5 mg glibenclamide daily for 12 weeks. Second group daily consumed of 5 mg glibenclamide daily and participated in strength training for 12 weeks. The Third Group Daily consumed of 5 mg glibenclamide daily with participated in aerobic exercise for 12 weeks.

2.1.1. Measures

To measure blood glucose levels, HbA1c, triglycerides and lipoproteins HDL and LDL before and after training used bloods samples. All blood samples were drawn from an antecubital vein. For each sample, 14 ml of blood were drawn and collected in a vacutainer containing EDTA (anticoagulant and chelating agent). Blood samples were separated by centrifugation at 4°C for 15 min at 2,000 g in a Beckman TJ-6 centrifuge. Plasma was transferred to a storage vial and stored at 70°C until it was analyzed. All blood samples measurement for triglycerides (TG), Low-density lipoproteins (LDL), and high-density lipoproteins (HDL) by standard colorimetric reflectance spectrophotometry, for measurement of HbA1c used from Biosystems medical kit made in Spain.

2.1.1.1. Procedure

Pre test Data was collected from blood sampling than used 12 weeks aerobic and strength training. And at the end giving post test via blood samples again. All data were evaluated for normality of distribution and homogeneity of variance before hypothesis testing. All statistical analysis was accomplished using SPSS (v 16). Main effects of training modality (aerobic and weight) and time (pre-exercise (baseline) and post-exercise), were assessed using One-Way Analysis of Variance. Statistical significance was conferred at P = 0.05. When main effects were detected, the Tukey test was used for post hoc comparisons.

3. Programs training

3.1. Strength training

Ten untrained male volunteers used weight training three times a week consecutively for 12 weeks. All subjects were instructed on the proper technique for weight training by a trained instructor and were familiarized with all this movements before initial testing. The weight training program consisted of (Elbow flexion, chest press, abdominal flexion in the first session each week, shoulder flexion (with dumbbell), butterfly, and Leg press in the second session each week, Squat, knee flexion (Hamstring), and Gastrocnemius in the third session each week). During this study, subjects were encouraged to increase intensity (amount of weight). Subjects performed a brief warm-up consisting of static stretching and low intensity exercise before and after each training session.

3.1.1. Aerobic training

Ten untrained male volunteers used running exercise three times a week consecutively for 12 weeks. The aerobic training program consisted of approximately 30 min (5 min activity and 2 min rest) x 3 d/wk, intensity of training at 50% –60% of each subject’s predicted maximal heart rate. During the first week, subjects were acclimated to the this training and, by the second week, almost all subjects were working at approximately 70% – 80% maximal heart
rate and exercising for 30 min (5 min activity and 2 min rest) x 3 d/wk. Subjects performed a brief warm-up consisting of static stretching and low intensity exercise before and after each training session.

4. Results

Our research founding showed in table 1. Following 12 weeks aerobic and strength training with using daily 5 mg glibenclamid there were no significant differences between experimental groups and control group in rates of HbA1c, LDL, and TG (P> 0.05). However HbA1c values in strength and aerobic training groups dropped respectively 4.5% and 2.8% percent, and LDL levels in strength and aerobic groups dropped respectively 6.7% and 5.6% percent. Also Triglyceride in both group decreased, but in strength group it decreased 2.4% versus 7.7% in aerobic group. Research founding’s about HDL showed that there were significant differences between experimental groups and control (P<0.05). But Comparing with Tukey test showed that no significant differences exist between aerobic and strength groups (P<0.05). However, HDL levels in strength and aerobic groups increased respectively 16% and 21% percent.

Table 1: Mean & Standard Deviation of Variables in Experimental and Control Groups.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Pre test</th>
<th>Post test</th>
</tr>
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<tbody>
<tr>
<td>HbA1c</td>
<td></td>
<td></td>
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<tr>
<td>Strength group</td>
<td>7.65 ± 1.1</td>
<td>7.31 ± 1.02</td>
</tr>
<tr>
<td>Aerobic group</td>
<td>7.85 ± 1.16</td>
<td>7.41 ± 1.33</td>
</tr>
<tr>
<td>Control group</td>
<td>7.21 ± 1.03</td>
<td>7.1 ± 1.39</td>
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<tr>
<td>LDL(mg/dl)</td>
<td></td>
<td></td>
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<tr>
<td>Strength group</td>
<td>123.5 ± 55.8</td>
<td>115.18 ± 57.6</td>
</tr>
<tr>
<td>Aerobic group</td>
<td>124.9 ± 56.2</td>
<td>117.5 ± 56.41</td>
</tr>
<tr>
<td>Control group</td>
<td>122.6 ± 52.8</td>
<td>120.9 ± 52.3</td>
</tr>
<tr>
<td>HDL(mg/dl)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strength group</td>
<td>42.7 ± 15.2</td>
<td>49.5 ± 16.7</td>
</tr>
<tr>
<td>Aerobic group</td>
<td>42.1 ± 15.7</td>
<td>51.16 ± 17.2</td>
</tr>
<tr>
<td>Control group</td>
<td>40.88 ± 14.8</td>
<td>43.25 ± 15.25</td>
</tr>
<tr>
<td>Triglyceride</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strength group</td>
<td>161.5 ± 137.9</td>
<td>158.7 ± 136.3</td>
</tr>
<tr>
<td>Aerobic group</td>
<td>157.2 ± 139.2</td>
<td>145 ± 128.2</td>
</tr>
<tr>
<td>Control group</td>
<td>158.23 ± 124.1</td>
<td>154.1 ± 138.9</td>
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</tbody>
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5. Discussion& Conclusion

Findings of this study about the effect of aerobic and Strength strength exercises with use of glibenclamide tablets on HbA1c index (Hba1c) indicate that there was no significant difference between the exercise group and control group which only taking glibenclamide tablets. The researches being done by Sardar and et al (2005), Larsen J. J. and et al (1999), Massi-Beneddi, (1996) also confirmed these research results. The muscle contraction increases membrane permeability to glucose due to increased number of glucose carriers in the plasma membrane (Glut4) so will improved insulin action on glucose metabolism with increasing the glucose carriers (Guyton et al, 2006; Peirce, 1999). The muscle contraction has insulin-like effect and with exercise, muscle cells intend to rebuild glycogen stores (Wilmore et al, 2008). Therefore after exercise, blood glucose levels are low in a few hours (Dunstan et al, 2002; Agurs-Collins et al, 1997).

It should be pointed out that further reduction in HbA1c levels between aerobic exercise and strength groups compared with the control group. The regressive effect of glucose will increased when aerobic exercise and strength training (weight training) combine with glibenclamide tablets because the glibenclamide lead to increase insulin release from pancreatic beta cells and also can decreases the liver glucose production. On the other hand, exercise increases permeability of muscle cell membrane to glucose and increases peripheral glucose. Concentrations of anti-regulatory hormones (glucagons, growth, and nor epinephrine ...) in blood decreased After glibenclamide tablets and insulin increased plasma, but by exercise and reduction of insulin concentration will increased the rate of counter
anti-regulatory hormones in the blood, which may this increase due to the effect of glibenclamide tablets. About less reduction of HbA1c levels in weight group can be said the carbohydrates (body's main fuel) during the power activities and intensities exercise from the main substrate (glycogen and glucose) is converted to lactic acid. At the end of exercise, during the recovery mode and return to rest state, some of lactic acid in muscles is again converted to glucose due to Cori cycle and used by muscle as fuel (Robergs, 2000).

These processes lead to a reduction in diabetes blood sugar harvest in diabetic persons. Research findings about the effects of aerobic exercise and strength training on triglyceride levels between groups, revealed that there was no significant difference between aerobic exercise and strength training compared with the control group. But the investigation shows that triglyceride has been reduced more in the aerobic training group. The researches being done by Sigal, Ronald, j (2007), Ramchandran, Ambady, and et al (2007), Marcus, Robin and et al (2008) also confirmed these research results. Triglyceride is main source of energy in physical activity and kind of endurance. Lipoprotein lipase (LPL) is a triglyceride degrading enzyme, which causes release of free fatty acids (FFA) from triglycerides to provide energy during aerobic activities. So there is a high correlation between the lipoprotein lipase enzyme activity and blood triglyceride harvest (Kelley, 2007; Peirce, 1999).

Therefore it could be concluded that blood triglycerides is reduced in healthy individuals during aerobic activity and LPL enzyme amount increased. It is notable that insulin inhibits the action of the hormone-sensitive lipase. This is same enzyme that hydrolyzed triglycerides stored in fat cells (Guyton et al, 2006). In people with diabetes, the most important effect insulin lack is that the lipase enzyme active in fat cells highly and causes to hydrolysis of stored triglycerides and release large amounts of fatty acids and glycerol into the circulation. When free fatty acids increased, active muscular fibers tend to use more of this type of available substrate (Robergs, 2000).Our research findings indicate that significant differences among the experimental groups on HDL index and the HDL amount have increased in aerobic exercise group more. The researches being done Misra, Anoop and et al (2008) also confirmed these research results. Physical activity and exercise, especially aerobic activity lead to increase in plasma HDL levels significantly that this increase affected from activation of LPL and ASyl Lystyn cholesterol transferase enzymes and decreased of hepatic lipase activity. Research findings about the LDL levels show that there is no significant difference between the aerobic exercise and strength groups, although the LDL levels has been reduced in groups of aerobic and strength, 5.92 and 4.32 percent respectively. The researches being done by Sigal, Ronald, j (2007), Ramchandran, Ambady, and et al (2007), Marcus, Robin and et al (2008) also confirmed these research results. Absence of significant changes in LDL index could be caused from limitations in the precision control on a diet. On the other hand in most diabetic patients the body relies on free fatty acids to produce energy. As noted in previous discussions in the absence of insulin, the hormone-sensitive lipase in fat cells are highly active and a lot of fatty acids enter blood.

The great amount of plasma fatty acids increases hepatic inversion of some fatty acids into the liver phospholipids of some fatty acids and cholesterol, the two main products of fat metabolism. These two substances along with additional triglycerides which are made simultaneously in the liver enter the blood in the form of lipoprotein. Sometimes plasma lipoproteins in the absence of insulin are increased to three times the total concentration of plasma lipids of normal value 0.06 percent to give a few percent.

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References


