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ORIGINAL ARTICLE

Effect of Exercise Type and Adenosine on the Concentration of Lipoprotein Lipase, Triglyceride and Very Low Lipoprotein in High Fat Diets Fed Rats

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KEYWORDS

Adenosine;
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ABSTRACT: The effect of insulin-like adenosine in metabolism regulating, including glucose release and blood lipid metabolism, has been proven before. From one side, physical activity leads to Adenosine Monophosphate Protein Kinase (AMPK) activation and increasing (LPL) levels. Very light lipoprotein has the most combined affinity with the wall of the arteries, which leads to arteries occlusion. The purpose of the present study is to investigate the effect of two types of exercise (Endurance and Interval) and adenosine on the concentration of lipoprotein lipase, triglyceride and light lipoprotein in rats fed with high fat diets. In an experimental study, 70 male wistar rats were randomly divided into eight groups. In the first stage, subjects received high fat diet for 13 weeks. After that, they trained for 5 weeks each week for 12 weeks. At the end of the period, after the anesthetic, the heart and blood were removed to measure LPL, triglyceride (TG) and very low levels of lipoprotein (VLDL). High fat diet resulted in a significant increase in lipoprotein lipase, triglyceride and low valprooprotein levels. Intraperitoneal exercise showed a higher reduction in lipoprotein lipase compared with continuous exercise. Moreover, adenosine reduces lipoprotein lipase, and the interactive effect of adenosine and intolerant exercise was higher. Continuous exercise with adenosine had the greatest effect on reducing triglycerides. Regardless of its type, exercise with adenosine resulted in very low levels of lipoprotein levels. The effect of physical activity on the concentration of lipoprotein lipase, triglyceride and low lipoprotein is dependent on its type. Therefore, it is recommended that intensive periodic exercises with adenosine be used to protect the heart from damage caused by high fat diet.

INTRODUCTION

Obesity as one of physiological changes can be a potential risk factor for metabolic syndrome, type 2 diabetes, cardiovascular disease, cancer, and other diseases singularly [1]. Nowadays, studies have focused on the effects of some medications. In this regard, adenosine can be considered as one of the most effective biological agents in physiological pathways, such as neurotransmitter in the peripheral and central nervous system, and inflammatory process [2].

AMPK (Adenosine Monophosphate Protein Kinase) is one of the proteins involved in heart muscle metabolism, which acts as a cellular energy status sensor; and it is activated by increasing the ratio of AMP: ATP(Adenosine Three Phosphate) caused by metabolic stress associated with ATP production (such as glucose deprivation, lack of oxygen), or ATP consumption (such as muscle contraction) [3]. It has a strong association with the activity of the LPL of the heart, which has been shown to play a direct role in AM

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proliferation in the expansion of FA by the use of LPL [4]. On the other hand, it has been shown that inhibition of lipoprotein lipase (LPL) in the heart causes the maximum absorption of blood fats in the heart [5].

On the other hand, the effects of certain drugs on metabolism are well-defined, which can be seen in the adenosine drug [6]. The effects of adenosine on the regulation of metabolism, including the release of glucose [7] protein synthesis [8], and the metabolism of blood lipids which have been proven [9].

Adenosine has been shown to cause insulin-like effects in the metabolism of adipose tissue [10]. In fact, it reduces the response of lipid cells to various lipolytic hormones [11, 12]. Adenosine receptors have also been shown to cause changes in the cardiovascular system: prolongation of conduction in the atrioventricular node, decrease in the number of cardiac pacemakers (negative chronotropic effects), negative inotropic effects (due to activation of potassium outflow and hyperplasarization) [13, 14]. The reduction in ATP catabolism rates [15, 16], as well as the activation of AMPK, is one of these changes [17]. In addition, adenosine activates the protective mechanisms of ischemic injury. At the cellular level, adenosine directly protects the heart by inhibiting platelet aggregation and adhesion of endothelium inflammatory cells, and by reducing neutrophil production of dismutase [18, 15]. On the other hand, studies show that exercise exercises activate AMPK [19]. And increase the LPL levels [20]. However, the researchers encountered contradictions in the results that may be related to one or more factors, including the use of different exercise intensities, the duration and different amounts of the base of the lipoprotein [20]. Very light lipoproteins carry about 60 to 80 percent of the total plasma cholesterol in normal conditions, and have the highest combined affinity with the wall of the arteries. Cholesterol deposition on the wall of the arteries eventually leads to the proliferation of their smooth muscle, absorbs fibroblasts, and promotes vascular obstruction [20].

MATERIALS AND METHODS

Society of the study

In an experimental trial, 70 male wistar rats with an average age of 5-6 weeks and an initial weight of 128 ± 32 g were purchased from the Amol Pasteur Institute and randomly divided into 8 groups based on 130 gram weights of homogeneity including normal control - Normal diet, high fat meal control, high fat meal control and adenosine, high fat and placebo control, high fat diet and endurance training with adenosine infusion, high fat diet and endurance training with placebo, high fat diet and intense exercise A periodic injection of adenosine, a high-fat diet, and a periodic intensive training with placebo infusion. All rats were kept in appropriate laboratory conditions and the cycle of light and darkness was 12:12 hours with an average temperature of 22 ± 2°C. This study was performed in two stages including obesity and exercise. After transferring the rats to the lab, a week later, a normal diet was used to adapt to the new environment. The subjects were kept in transparent polycarbonate cages of 30, width and height 15 cm manufactured by Razi Rad Company. The participants' food was prepared from Karaj livestock feed company. For each 100 grams of mouse weight, 5 grams of food were fed into cages each week after weighing. In this study, the animals were fed free water in a 500 ml bottle of laboratory animals. It should be noted that this study was designed and implemented in accordance with the ethical guidelines for animal research adopted by the Ministry of Health, Medical Education and Healthcare.

Dietary compositions

The fatty foods were prepared with 40% fat (20% soy oil and 20% fat), 13% protein and 47% carbohydrates, and in the 13 weeks all 69 rats used this diet. After reaching the obesity benchmark, the practice continued with a high-fat diet.

Practice protocol

At first, one week of training was done as a knitting step (with speeds of 6.8 and 10 m / min). In this research, the *criterion was to* reach the peak speed. After 10-20 minutes of warming at 40 to 50 percent of the maximum speed, the speed of the belt was increased by 1.8 to 2 m / min every minute, until the rats lost their vitality [21]. After obtaining the average, the maximum speed for all rats in the training groups was 85% of the maximum speed for the high-fat group with severe periodic exercises and 65% of the maximum rate evaluated for high-fat diet group with endurance training was recorded in the first week [21, 22]. The cooling stage also included 1 minute running at speeds of 15 m/min and 2 minutes at 10 m/min. The main program also included two levels of exercise that began in the endurance training protocol of 20 m/min and 15 minutes in the first week, gradually increasing to 25 m/min and for 31 minutes on week 12. In the periodic exercise protocol, speeding 31m/min, 7 one minute attempts and a 1 minute rest started at 15m/min in the first week, gradually increasing to 55 m/min, 10 minutes per minute and one minute the rest came at a speed of 25 m / min in the twelfth week. It should be noted that the rats acted weekly in five sessions.

The dose of adenosine consumed by the mice

Adenosine and adenosine control groups received adenosine 0.2 mg/kg for 12 weeks (seven days a week) subcutaneously 3 hours before the workout. The saline group received a physiological serum similar to those receiving adenosine groups.

Measurement of lipoprotein lipase, triglyceride and light lipoprotein

Twenty-four hours after the last training session, from each group, 5 rats were randomly selected for heart tissue and anesthetized by intraperitoneal injection of ketamine-xylazine. The heart tissue was rapidly dissected and placed inside a microtire and placed in liquid nitrogen. ELISA method was used to measure lipoprotein lipase and a biochemical method was used to measure the amount of triglyceride and light protein lipoprotein.

Statistical analysis

All data in the text, tables and forms are reported based on average and standard deviations. To determine the effect of high fat diet on lipoprotein lipase, triglyceride and very low protein lipoprotein, normal diet control and high fat diet control were compared by independent t-test. To determine the effect of aerobic training, adenosine and their interaction, two-way analysis of variance was used for independent groups with the design of 3 (continuous exercise, periodicity and lack of exercise) in 2 (receiving adenosine and not receiving adenosine). If a significant difference was observed, Ben Verne's follow-up test was used to determine the location of the difference. A significant level for all calculations was considered to be less than 0.05. All calculations were performed using SPSS software version 21.

RESULTS

The high fat intake significantly increased the concentration of lipoprotein lipase (t = 12.83, P = 0.001) triglyceride (t = 17.91, P = 0.001) and very light lipoprotein (t = 27.26, 12.83, P = 0.001) (Table 1).

Table 1. Changes in lipoprotein lipase, triglyceride and light lipoprotein.

Variable	Number	Average	Standard Deviation
Normal control	3	66.33	6.46
High fat diet control	3	162	12.85

Regardless of the type of exercise, it significantly reduced lipoprotein lipase (F = 189.46, P = 0.001, μ = 0.940). Although both types of exercises reduced lipoprotein lipase levels compared with the control group, severe intolerance training decreased the concentration of lipoprotein lipase (P = 0.011) more than continuous exercise (P = 0.011).

Adenosine also reduced lipoprotein lipase (F = 35.56, P = 0.001, μ = 0.597). Exercise interaction and adenosine also reduced lipoprotein lipase (F=70.26, P=0.001, μ = 0.854). Of course, the most interactive effect was observed when adenosine was accompanied by aerobic training. In other words, the concurrence of these two interventions reinforced each other in reducing lipoprotein lipase.

Table 2. Changes in lipoprotein lipase in the studied groups. Information is reported based on average and standard deviation.

Variable	Group	Average	Standard Deviation
LPL	Adenosin	290	26.07
	Control	108	11.67
	Interval exercise with adenosine	74.8	4.35
	High interval training	174.8	4.35
	Endurance exercise with adenosin	179	18.70
	Endurance exercise	117.2	11.10

Regardless of the type of exercise, it significantly reduced lipoprotein lipase (F = 189.46, P = 0.001, μ = 0.940). Although both types of exercises reduced lipoprotein lipase levels compared with the control group, severe intolerance training decreased the concentration of lipoprotein lipase (P = 0.011) more than continuous exercise (P = 0.011). Adenosine also reduced lipoprotein lipase (F = 35.56, P = 0.001, μ = 0.597). Exercise interaction and adenosine also reduced lipoprotein lipase (F = 70.26, P = 0.001, μ = 0.854). Of course, the most interactive effect was observed when adenosine was accompanied by aerobic training. In other words, the concurrence of these two interventions reinforced each other in reducing lipoprotein lipase (Table 2).

Interval and continuous training significantly decreased triglyceride (F = 103.24, P = 0.001, μ = 0.896). Both exercises reduced triglyceride levels compared to the control group. There was no difference between the effect of exercise practice. Adenosine also reduced the concentration of triglyceride (F = 156.24, P = 0.001, μ = 0.929). Exercise interactions and adenosine also reduced triglyceride levels (F = 70.26, P = 0.001, μ = 0.854). Regarding triglyceride, the highest reduction was seen when continuous exercise was associated with adenosine (Table 3).

Table 3. Triglyceride variations in the studied groups. Information is reported based on average and standard deviation.

Variable	Group	Average	Standard Deviation
TG	Adenosin	135	5.96
	Control	70.8	3.96
	Interval exercise with adenosine	46.6	5.004
	High interval training	57.96	3.63
	Endurance exercise with adenosin	38.6	2.87
	Endurance exercise	59.2	4.44

Both intralum and continuation training resulted in a significant reduction of lipoprotein (F = 103.24, P = 0.001, μ = 0.896). Both types of exercise led to a reduction in light lipoprotein levels in comparison with the control group. There was no difference between the effects of exercise practice. Adenosine also reduced the concentration of very light lipoprotein (F = 181.28, P = 0.001, μ = 0.883). Exercise interactions and adenosine also led to very low levels of lipoprotein (F = 156.24, P = 0.001, μ = 0.929). In the case of very light lipoprotein, the reduction in the continuity of continuous training with adenosine and intubual training was similar (Table 4).

Table 4. Very light lipoprotein changes in the studied groups. Information is reported based on average and standard deviation.

Variable	Group	Average	Standard Deviation
VLDL	Adenosin	61	2.44
	Control	20.2	1.72
	Interval exercise with adenosine	15.46	1.05
	High interval training	20	2.30
	Endurance exercise with adenosin	14.92	1.57
	Endurance exercise	18.66	1.10

DISCUSSION AND CONCLUSIONS

The results of this study showed that adenosine and exercise in fatty foods fed rats may have different effects on the concentration of lipoprotein lipase, triglyceride and lipoprotein, depending on the type and intensity of exercise. So far, limited research has been done on the role of physical and adenosine exercises on the concentration of lipoprotein lipase, triglycerides and very light lipoprotein that this study can provide valuable information about the effects of physical activity and adenosine on these concentrations.

The concentration of lipoprotein lipase, triglyceride and lipoprotein was significantly higher in the group receiving the ripe food than in the group receiving normal food. The levels of lipoprotein lipase decreased in both treatment groups, while the decrease was higher in the high-intensity training group. It has been shown that adenosine has insulin-like effects in the metabolism of adipose tissue [28]. In fact, like insulin, adenosine in mice reduces the response of lipid cells to various lipolytic hormones [29, 30]. Another important insulin-like effect of adenosine is the activation of lipoprotein lipase activity, which suggested that part of this effect could be related to the reduction of lipid peroxidation AMP [31, 32]. In this study, adenosine also reduced the concentration of lipoprotein lipase. Various factors, including physical activity, affect LPL regulation [25]. Studies have shown that physical activity can play a key role in energy interactions by reducing adipose tissue and improving the metabolism of lipids and carbohydrates [26]. Increasing energy costs affects LPL levels and plasma TG metabolism [27]. Interaction of adenosine and exercise type showed a decrease in LPL concentration in both training groups, while the decrease in LPL concentration was observed in the intolerant exercise group and adenosine. In other words, the concurrent effect of these two interventions is greater in reducing the LPL concentration.

Often, simple fats are referred to as neutral fats, and mainly include triglycerides. Triglycerides are the main form of fat storage in the body that makes up more than 95% body fat [22]. In this study, exercise regardless of its type caused a significant decrease in triglycerides. In addition, interactive exercise and adenosine also led to a decrease in triglyceride levels. The important thing about the importance of triglycerides is that the effect of concurrent continuous training and adenosine has the highest reduction. However, there was no significant difference between the effects of two types of exercises alone.

Recent studies have shown that with regular training, low-density lipoprotein can be reduced and subsequently increased high-density lipoprotein [24]. Lower lipoprotein elevations are an independent risk factor for coronary artery disease, and a reduction of 06mg / dl reduces the incidence of coronary artery disease by 50% over the next two years [22]. The positive effects of a very low level of lipoprotein and a high density lipoprotein increase are independent and increasing. The risk of vascular events can be reduced by 60% in treatment regimens, which are aimed at simultaneously reducing the incidence of very light lipoprotein and increasing high-density lipoprotein [23]. In this study, there was a significant decrease in the rate of light lipoprotein following exercise. These effects became more pronounced with adenosine intervention. In addition, as triglyceride, there was no significant difference between the two types of exercise in VLDL values. Both types of exercises are effective in reducing VLDL. On this basis, it is recommended that exercises involving adenosine supplementation be performed in the presence of high-fat foods.

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