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Research Article

The Effect of 12 Weeks of Compound Set Training on Cardiotaphin-1 and Platelets and their Relationship of Young Bodybuilder Male

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Abstract

Cardiotrophin-1 causes cardiac hypertrophy and improves cardiac structures, and platelets are involved in heart atherosclerosis. Resistance training is part of bodybuilding athletes train. So, the aim of the study was the effect of 12 weeks of compound set training on cardiotaphin-1 and platelets and their relationship in active young males. In this semi-experimental study, subjects were 30 active male bodybuilders in Ardabil who randomly divided into two groups of exercise (n = 15) and control (n = 15) after matching height, weight, BMI, Vo2max, and 1RM. Subjects performed 12 weeks of compound training including ten stations (leg press, chest press, barbell curl, front lat pull down, front leg, parallel, back lat pull down, cable pulley row, barbell shoulder press, and back leg), 15 second at each station with 60-40% 1-RM, and a 45-second interval rest. Training were completed three sessions per week, and 60 min in each session by subjects. Before and after 12 weeks, 5 ml of blood was taken from the brachial vein. Serum cardiotrophin-1 was measured using an ELISA kit made by ZellBio (Germany) and a US-made Hyperion ELISA device. Serum platelets were measured using a platelet kit of Mahsa Yaran Iran Company. Independent and dependent t-test for examining the difference between the mean of intergroup and intragroup data. Pearson correlation coefficient used to investigate the relationship between variables.

Serum cardiotrophin-1 and platelets significantly increased after 12 weeks of compound set training compared to before 12 weeks of compound set training and compared to the control group ($P < 0.05$). There was no significant relationship between cardiotrophin-1 and blood platelets before and after 12 weeks of compound set training in two groups ($P > 0.05$).

Serum cardiotrophin-1 level and platelets increased after 12 weeks of the compound training. So, it is recommended that coaches and athletes pay attention to the results of this study to maintain health and preventing syncope and thrombosis in athletes and perform compound set training Be careful.

Keywords: Compound Set Training; Cardiotrophin-1; Platelets; Bodybuilding Men

Introduction

Performing resistance exercises is a part of a training program that applies various types of external resistance to increase or prevent the decrease of muscle volume, maintaining muscle strength, power, and endurance in people [9,21]. Resistance training (RT) improves muscular strength and endurance, functional capacity and independence, and quality of life while reducing disability in persons with and without cardiovascular disease (CVD) [40]. RT is one of the most powerful tools for improving physical fitness [39] and results in hemodynamic alteration of skeletal and cardiac muscles [7]. Compound set (agonist-agonist muscle groups) training is a type of resistance training that causes strength gains in short periods [4].

Resistance training has a positive effect on health and physical fitness [31], but it may cause sudden cardiac death (SCD) during exercise due to homeostasis disorders [5,14]. Young athletes are healthier than other people, but they may experience SCD in sport [5]. An increase in the risk of sports-related SCD and myocardial infarction (MI) during strenuous exercise in young athletes has reported [5,39]. The SCD of young athlete is a real rare event and is a tragedy [5,14]. The author showed that 2–10% of a young athlete who die suddenly have no evidence of structural heart disease [14,20,21]. At least 30% of the SCD occurs in athletes under 30 years during athletic exercises [14,20,35]. Myocardial fibrosis due to high intensity and volume exercise, leading to malignant arrhythmias may be SCD in sport [8,25]. The risk of SCD approximately doubles during sport, until about 1 hour after its cessation [11,14,20].

Cardiotrophine-1 (CT-1) is a 2.5 KDa protein (203 amino acids in length) [21], and a gp130 ligand and a new member of interleukin- (IL-) 6 family of cytokines [2,17]. It is mainly synthesized within the heart by both cardio-myocytes and noncardiac cells. Once CT-1 is produced by heart, it is secreted through the coronary sinus into the peripheral systemic circulation [5,10,27,37]. CT-1 has different functions, such as providing myocardial protection, preparing the heart for pathological conditions, and producing hemodynamic effects and endocrine [38]. It is an active inducer of cardiac hypertrophy and atherosclerosis [2] and stimulates cardiac fibroblasts, protects myocytes from cell death [31]. CT-1 raised in ischaemic disease after an acute coronary syndrome [7]. It increased after an acute protocol exercise on a treadmill at patients with hypertrophic cardiomyopathy (HCM) [22]. CT-1 may be a predictor of sudden death in exercise [22], for the initial screening and diagnosis of acute myocardial infarction (AMI) in young athletes [14,20,31]. So, CT-1 is a promising biomarker for estimating the presence, severity, and prognosis of atherosclerotic cardiovascular diseases [38]. There is a relationship between CT-1 and the formation of atherosclerosis [38]. Intense physical exercise in humans, to be directly associated with plasma CT-1 concentration. Some exercises in healthy subjects transiently increase plasma CT-1 concentration [16,23]. Also, CT-1 is a diagnostic indicator of mortality in cardiac hypertrophic conditions. Strength training in athletes leads to left ventricular hypertrophy [2]. Left ventricular hypertrophy has shown to increase plasma CT-1 in humans [9]. Mortality and the risk of sudden death in exercise are associated with severe ventricular hypertrophy. CT-1 has associated with cardiac arrhythmias, arterial fibrillation, sympathetic heart failure, and sudden death in exercise [27].

Coronary thrombosis is the most critical homeostasis disturbances causing SCD that occurred during athletic exercises [5]. Prothrombotic factors might play an essential role in SCD [31]. Platelets are coagulation factors that play a crucial role in cardiovascular disease [30,40]. The risk of abnormal blood clot formation due to the increased role of platelets in coronary arteries increases [14,20,29]. Acute exercise can lead to transient activation of the coagulation system, promoting in SCD [11,14,20,28]. Both acute and regular exercise affect platelet function. Studies showed roles for plaque rupture, hemostasis, and thrombosis during sports-related SCD exercise [5]. Thrombosis and plaque rupture, which considered an essential mechanism of SCD in athletes, can occur with coronary stenoses [32]. Beyond the role of platelets in thrombosis, platelet function is essential at inflammatory reactions and immune responses [30,40]. Resistance training temporarily raises plasma platelet levels in healthy individuals [22,35], and platelets also affect IL-6 and CT-1 release [22]. CT-1 increases the number of platelets and red blood cells [38]. High-intensity training such as RE causes rapid, transient changes in the number of platelets (thrombocytes) in the circulation [12]. When this increase is massive, it may have thrombogenic side effects in young and older people [12]. Whereas, Hulmi., *et al.* (2010) showed that 21 weeks of RT did not change the acute RE-induced platelet response. Recently, compound set training has been performed by many young athletes to improve strength and hypertrophy muscles [12]. So, this

study designed to investigate the effect of 12 weeks of compound set training on cardiotaphin-1 and platelets and their relationship of young bodybuilder men.

Methods

Subjects

This research is a clinical trial study. Subjects were 30 active men aged 20-30 years in Ardabil who participated in the study voluntarily, completed the consent and questionnaire including medical and sports information, and randomly divided into two control (n = 15) and experimental (n = 15) groups. Inclusion and exclusion criteria include 4 years of resistance training, no consuming caffeine, alcohol, cigarettes, tobacco, and anti-oxidant supplements (such as excessive consumption of vitamins C, and E, iron and magnesium, copper and Zinc) and no history of any cardiovascular disease and diseases affecting hematological factors such as muscle damage, and the use of anti-inflammatory drugs (such as aspirin, ibuprofen, antibiotics, naproxen, and betamethasone). All subjects were present in the Ardabil gym at 8 A.M., one day before starting the training to determine demographic characteristics including height, weight, BMI, Vo2max, and 1RM.

Procedures and training program

Subjects asked to stand without shoes, with minimal clothing, and back, head, shoulder, hip, and heels touch the Seca scale (Germany). Then, in this position, the height and weight of the subjects were measured in terms of centimeters, and kilograms. Seven-step Bruce ´s maximal test used to estimate Vo2max. Exhaustion time recorded, and VO2max values estimated by the pollack formula at mL/kg/min. The Brzycki formula used to estimate a 1RM of upper and lower limps´ muscles in chest press and squat movements.

Brzycki formula: ((repetition × 0/02780) -1/02780)/weight (kg) = one maximum repetition (1RM) (24)

Then a maximum repetition of the upper and lower limbs of muscles was calculated and matched.

In the compound set training group, subjects performed 60 minutes exercise consisted of 10 stations (leg press, chest press, barbell curl, front lat pull down, front leg, parallel, back lat pull down, cable pulley row, barbell shoulder press, and back leg) after 10 minutes warming up. Exercise at each station was 15 seconds, and the rest time between stations was 45 seconds. Exercise intensity was 40 to 60% of one maximum repetition. Cooling performed by the subjects for 5 minutes at the end of the exercise [21].

Measuring research variables

5 ml of blood took from the brachial vein before and after 12 weeks. Blood samples centrifuged for 10 to 15 minutes at 3000 pm. Serum stored at -20 ° C. Serum cardiotrophin-1 was measured using an ELISA kit made by ZellBio (Germany) and a US-made Hyperion ELISA device. Serum platelets were measured using a platelet kit of Mahsa Yaran Iran Company.

Statistical analyses

Data expressed as mean and standard deviation. Shapiro-Wilk test used to evaluate the normality of the data, t-test used to evaluate the difference between cardiotrophin-1 and platelets Intra and inter groups before and after 12 weeks of compound set training, and Pearson correlation coefficient used to examine the relationship between cardiotrophin-1 and platelets. SPSS software version 25 used for data analysis. The significance level was considered $P < 0.05$. The ethical principles of the implementation process were observed under the Helsinki Declaration. The present study approved and registered in the ethics committee of Ardabil University of Medical Sciences (IR.ARUMS.REC.1398.187) and the Iranian Clinical Trial Center (IRCT) with the code IRCT20181114041655N3.

Results

Shapiro-Wilk test showed that data is standard (Table 1). The demographic characteristics of the subjects show in Table 2.

Table 2 Shows no significant difference between the demographic characteristics of the subjects before 12 weeks compound set training.

Table 3 shows no significant difference between cardiotrophin-1 and platelets in two exercise and control groups at the beginning of the study. 12 weeks of compound set training significantly increased cardiotrophin-1 ($P = 0.0001$) and platelets ($P = 0.0001$). Also, cardiotrophin-1 ($P = 0.0001$) and platelets ($P = 0.001$) significantly increased in exercise group compared to control group. Whereas, there is no significant difference between cardiotrophin-1 and platelets in the control group before and after 12 weeks ($P > 0/05$).

Group	Age	Weight	Height	BMI	Vo2max	Upper 1RM	Lower 1RM	CT-1 Pre	CT-1 Post	PLA Pre	PlA Post
Control	P = 0.261	P = 0.157	P = 0.231	P = 0.017	P = 0.004	P = 0.183	P = 0.032	P = 0.020	P = 0.000	P = 0.714	P = 0.855
	Z = 0.929	Z = 0.914	Z = 0.925	Z = 0.850	Z = 0.806	Z = 0.919	Z = 0.868	Z = 0.854	Z = 0.616	Z = 0.961	Z = 0.970
Exercise	P = 0.505	P = 0.109	P = 0.604	P = 0.101	P = 0.002	P = 0.004	P = 0.606	P = 0.088	P = 0.067	P = 0.930	P = 0.586
	Z = 0.949	Z = 0.904	Z = 0.955	Z = 0.902	Z = 0.783	Z = 0.799	Z = 0.955	Z = 0.898	Z = 0.890	Z = 0.976	Z = 0.954

Table 1: Shapirovilk test results to investigate the normality of data distribution.

CT-1 = Carditrophin-1; PLA = Platelets

Variable	Control (n = 15)	Exercise (n = 15)	P
Age (year)	25.13±1.36	24.67±1.72	0.416
Weight (Kg)	67.20±3.12	67.60±2.29	0.692
Height (Cm)	174.73±2.76	175.33±2.74	0.555
BMI (Kg/m^2)	22.01±0.91	21.99±0.74	0.958
1RM upper limbs (Kg)	32.80±0.77	32.67±0.72	0.630
1RM Lower limbs (Kg)	73.53±1.73	73.13±0.83	0.426
Vo2max (mL/kg/min)	105.07±0.96	104.53±1.36	0.224

Table 2: Demographic characteristics of the subjects in exercise and control groups.

Mean ± Standard deviation, no significant difference between demographic characteristics of subjects at the beginning of the study. P > 0/05.

Variables	Groups	Mean ± SD Pre-test	Mean ± SD Post-test	Depe. t-test Pre-Post	df	Sig.	Indep. t-tet Exercise-Control	df	Sig
CT-1 (Pg/mL)	Exercise	13.69 ± 0.96	16.16±2.07	-5.421	14	0.0001*	-2.64	28	0.0001*
	Control	13.63 ± 1.43	13.52 ± 1.28	-0.265	14	0.795			
PLA (10^3/µL)	Exercise	284.47 ± 3.44	299.87 ± 6.09	-27.40	14	0.0001*	-14.93	28	0.0001*
	Control	284.67 ± 7.65	284.93 ± 7.43	-8.239	14	0.546			

Table 3: Results of Pearson correlation coefficient and t-test between cardiotrophin-1 and platelets at exercise and control groups before and after 12 weeks of compound set training.

* Significant difference at the level of $p < 0.05$.

CT-1 = Carditrophin-1; PLA = Platelets.

There was no significant relationship between cardiotrophin-1 and platelets before and after 12 weeks of compound set training of young bodybuilder male.

Discussion

The results of the present study showed that cardiotrophin-1 significantly increased after 12 weeks of compound set training. CT-1 concentration increased with exercise in healthy subjects. Exercise and exercise-induced hypoxia cause releasing noradrenaline

and increase CT-1 concentrations [16,23]. Hypoxia-induced factor one (HIF-1) increases CT-1 expression that leads to the maintenance of cardiomyocytes in response to ischemia. Myocardial ischemia is probably due to stretching of the myocardial ventricular wall, results in local pressure of myocardial contraction in exercise. This mechanical stretch activates the AKT/stat pathway and IL-6 and CT-1 mRNA expression. [22,26]. Myocardial ischemia is a dynamic process that occurs during exercise and probably increases CT-1 [34] after 12 weeks of compound set training in this study. Twelve weeks of compound set training in the present study is likely to lead to temporary hypoxia. CT-1 expression may increased by endocrine factors such as norepinephrine, aldosterone, fibroblast growth factor-2 (FGF-2), and autocrine factors [23]. CT-1 activates the Jak-Stat, MAP kinase signal transduction pathways, and AMPK in cardiomyocytes [2]. The mechanisms of Stat activation is a signaling cascade leading to NFκB (nuclear factor-kappa B) activation [2]. CT-1-induced NFκB activation and associated cardiomyocyte protection using selective inhibitors of p38 MAPK, ERKs, or Akt in rat cardiomyocytes. Intracellular kinase activation requires for CT-1-mediated benefits in cultured cardiomyocytes [22,23]. Exercise-induced mechanical traction activates JAK/STAT pathways and possibly stimulates IL-6 RNA and CT-1 expression [22,23]. Notably, the JAK/STAT pathway has shown to defend cardiomyocytes against ischemia/reperfusion injury by reducing ROS production [37]. It is promoting the effects of CT-1 [14]. This issue needs further investigation. Another probable reason for the increase of cardiotrophin-1 after training due to the increase of IL-6. IL-6 and its secreted CT-1 are apart of the immune system [29]. IL-6 is one of the most essential predominant pro-inflammatory cytokines in atherosclerosis [27]. IL-6 plays a vital role in the development and progression of inflammatory atherosclerosis. It is known as a risk factor in coronary heart disease [23].

The increase of cardiotrophin-1 after 12 weeks of compound set training in this study is consistent with the findings of Kilim., *et al.* (2015) [13], Limonjeli., *et al.* (2009) [16], and Gonzalez., *et al.* (2005) [9] and Daryanoosh., *et al.* (2016) [6]. Whereas, our findings are inconsistent with Amouli., *et al.* (2015) [1]. These differences are the gender of subjects, their training history, type, intensity, and duration of the training, and the health or illness of the subjects.

Another finding of the present study showed that blood platelets increased significantly after 12 weeks of compound set training. Inflammatory and coagulation processes are not two separate processes. Platelets are activated when several cytokines are released, mediating inflammation [15,21]. Beyond the critical role of platelets in thrombosis, they specialized in assisting and modulating inflammatory reactions and immune responses [17]. Exercise cause increases in platelet counts. This increase; is due to physical activity and the release of fresh platelets from the spleen, bone marrow, and other body reserves. Studies show that epinephrine secretion causes a strong muscular contraction of the spleen (where one-third of the platelets are stored). Epinephrine levels rise during physical activity, especially high-intensity training. This mechanism can explain platelet proliferation after exercise in this study [3,35]. Other mechanisms include levels of troponin, ATP, blood, lactic acid PH, blood catecholamines, which increase platelets count after exercise. The increase of platelets in this study is probably due to the release of these substances from the arteries of the spleen, lungs, and the red bone marrow. Another possible reason for this increase; is increased in body temperature, sweating rate, or plasma catecholamine concentrations [3,16].

Increasing serum cardiotrophin-1 levels and platelets after 12 weeks of compound set training in this study is consistent with the findings of Montserrat., *et al.* (2017) [22], Daryanoosh., *et al.* (2016) [6], Amooali., *et al.* (2015) [1], and Taybi., *et al.* (2011) [35]. Whereas, our findings are inconsistent with the findings of Hulmi., *et al.* (2010) [12] that showed that blood platelets did not change after resistance training.

Our results showed that cardiotrophin-1 levels and platelets increased after 12 weeks of compound set training. SCD is sudden ventricular arrhythmia due to myocardial perfusion-demand mismatch and resultant ischemia [28]. There was no significant relationship between cardiotrophin-1 and platelets before and after 12 weeks of compound set training of young bodybuilder male.

Practical Applications(Conclusion)

Based on the findings of this study, is suggested that young bodybuilders and athletes screened before starting compound set training for coagulation and inflammatory factors for preventing blood coagulation and inflammation. Also, coaches and athletes perform compound set training with proper intensity for maintaining health and preventing thrombosis athletes. Some limitations of the present study was controlling mental state, sleep, and rest at night before blood sampling.

Considering the relationship between inflammatory factors and interleukins with cardiotropin-1 and platelets, is suggested that a study ompleted by measuring these indicators. Also, is suggested that similar research done on girls, women, and adolescents.

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