The Acute Response of Blood Coagulation, Fibrinolysis, and Recovery Time after an Exhaustive Anaerobic Activity in Male Athlete and Non-Athlete Students

Mohsen Foroughi^{1,a,*}, EllaheFakhr Tabatabai², Shahriar Saeidian³

¹Borojerd Educational Organization, Borojerd, Iran

²School of Sport Science and Physical Education, Azad University of Borojerd, Borojerd, Iran

³Department of Biology, Faculty of Science, Payame Noor University, Tehran, Iran

^amoh.foroughi@gmail.com

Keywords: blood coagulation, fibrinolysis, anaerobic activity, fibrinogen, platelet, PT, PTT

Abstract. The purpose of this search is the response of male athlete and non-athlete coagulation factor, fibrinolysis and time of recovery after one session of exhaustive anaerobic activity. A quasi-experimental study was performed on 24 persons of male students (athletes, non-athletes), from 18 to 24 years old. The exercise protocol was a RAST test, in which every tester covered 6 rounds the distance of 35 meters with Highest power and there were 10 seconds for resting. Three stages of blood sampling were performed) before, immediately and one hour after the test). Data were analyzed by using the Kolmogorov Smirnov test, Levin test, the statistical analysis method of compound variance and Kruskal-Wallis ($p < 0.05$). The result of this study shows that a session of anaerobic activity has significant effects on factors such as hematocrit (platelet and non-coagulation) D-Dimer (of athlete group, and so, these effects observed for hematocrit, time of non-athlete PTT, platelets, and D-Dimer and also the time of recovery between two groups. But no significant difference observed for athlete group PTT, platelets, and D-Dimer group of non-athletes, PT and fibrinogen in both groups (athlete and non-athlete). This search offers that a session of anaerobic activity on blood coagulation, fibrinolysis and recovery time was effective. So the responses of athlete and non-athlete people can be different from in some factors.

Introduction

Today, physical activity and exercise scientifically and their impact on different body systems are considered and in this regard, most information is obtained. Research and studies in this field have shown that exercise has a positive effect on efficiency and maintain the body's health. However, if the physical activity on a regular basis and appropriate and in accordance with scientific standards will not only useful but also endanger health. According to the professionalization of the sport and trying to make a better record, athletes need to exercise a high level. Since these activities, one must withstand the pressure too much, many comments have been made about the intensity of activities. A group of researchers to oppose the intense training and other categories have confirmed it. One of the major systems of the body that are affected by physical exercise is blood coagulation so lifelessness of systems depends on blood coagulation. Blood clotting is an amazing machine that produces clots in the arteries and causes hemostasis. However improper and uncontrolled its activity accommodating with active coagulation of blood clot cause death. In normal conditions, this system regulates by regulators. To keeping these condition and equilibrium, coagulation factors, regulatory proteins and cells are very impressive. Sudden physical exertion is associated with an increased risk of acute myocardial infarction and sudden cardiac death. In addition, activation of the coagulation cascade and/or reduced fibrinolytic capacity after physical exercise has been reported in patients with cardiovascular disease (6). Thus began a new chapter in sports research and researchers are trying to discover the relationship between vigorous activity that began with the mechanisms of the human body (8). Under normal circumstances, the scale of these devices by various factors regulating valves are kept balanced and to keep the balance, regulating coagulation factors and proteins and cells with

a certain delicacy and intelligence are working too much [6]. Intensive training with an increased risk of heart attack and sudden cardiac death associated with regular exercise and style while the offer is problematic because physical activity varies according to the intensity and duration of the exercise performed by people with different levels of physical fitness [14]. Previous studies on the effect of exercise on blood coagulation factors have provided mixed results. Submaximal exercise does not affect the PT and PTT but increased hematocrit and platelet [3]. Niaki and Mohammadi [4] by studying anaerobic exercise on Hematologic changes cakeboxersman observed, changes in hematocrit and platelet counts were not significant. Hansen et al. concluded in their study that will increase the level of activity coagulation eight factors and fibrinolysis [17]. In another study, colon and colleagues (1997), said fibrinogen and plasminogen catabolism increased after intense physical activity, but the PT did not change significantly [13]. Cahroman et al. in their studies concluded that levels of PT and D-Dimer increase after acute sport [21]. Nailin [27] by study activity of platelets, coagulation, and fibrinolysis in during exercise in healthy men observed exercise increases the concentration of platelets and leukocytes independently of thrombin to exercise increases the coagulation and fibrinolysis but the balance between them seems to be preserved [27]. Kovin [22] announced fibrinolytic activity in post menopausal women can be improved by 3 weeks submaximal training schedule. Madarame et al. [24] concluded after practice, none of the variables prothrombin complex thrombin-antithrombin type 3 and D. Dimer no change significant. According to different research results and other similar studies, in relation,n to impact aerobic exercises blood coagulation and fibrinolysis factorson athletes and non-athletes in this study attempted to examine effect of these exercises on the blood coagulation system and fibrinolysis athletes and non-athletes and recovery time.

Method and Materials

Current study In the form of the semi was performed on non-athlete student sand footballers man that was 24-18 years old of Islamic Azad The University of Boroujerd. At first, a call was announced at Azad The University of Boroujerd. According to the questionnaire that was given to them to announce their cooperation for this study, 83 people announced readiness to test. Of this number, in the end, 12 people from non-athlete students 18-24 years old, who had all the necessary conditions to participate in this project, as the non-athletes man was given to the researcher. Also of University boys soccer team targeted 12 people others were selected as athlete group purposeful. All subjects athlete, according to the questions in the questionnaire were at least 3 years of experience in sports soccer. Also, they have not the history of blood diseases, heart and, no smokers and also does not consumed certain drugs when doing research. A few days before the test, primary coordination was with responsibility for clinical laboratories of the Boroujerd city and with collaborators meeting to assess the fitness and familiarity with the manner in which was held. Two days before the exam, the final arrangements have been made with co-investigator and director of the lab and of the subjects were asked to measure the indicators listed At 8 am and fasting in the GMAT tend to them was 48 hours before sampling does not have any physical activity. The subjects rested for 30 minutes before starting the test. During the rest, the first stage of sampling (pre-test) was carried out of them, thus one of athlete group and one of the non-athlete group simultaneously, before exercise, blood samples were taken from the brachial artery. Then the researcher divided the subjects into groups of three for rotating the physical test (RAST test) was taken from them. Immediately after completion of the test, from any three persons blood samples were taken by laboratory scientist stationed Championship. In the test (RAST test) subject runs full speed distance of 35 meters for 6 times and between any 35 meters does the rest for 10 seconds. Information received from any subjects were recorded in the form of data collection in the second blood sample was taken immediately after exercise (post-test). An hour later, of the subjects were collected in the two groups of blood samples for third times (recovered). Of covaglomer Coatron device made in Germany to measure of fibrinogen, PT and PTT factors, Cell counter - Coulter T-890-Coul Ter made in America to measure hematocrit and platelets and the nephelometry device, model AD-200 is made in the Netherlands for

measuring D- Dimer. In this study, of statistical analysis by using the Kolmogorov-Smirnov tests for homogeneity of variance Levin and analysis of variance within groups (pre-test and post-test) and between group (two groups), Kruskal-Wallis test and post hoc Tukey at ($p < 0.05$) were used.

Results

Changes of PT time in athletes and non-athletes subjects in three stages of pre-test, post-test and recovery time was not significant (Table 1). Changes of PTT time in the athlete group of pre-test stage, post-test and recovery time was not statistically significant. But in non-athlete group observed a significant difference in the time PTT. By using Tukey test showed differences in pretest to post-test and it was found that anaerobic exercise reduces the time PTT (Table 2). In the blood hematocrit athletes and non-athletes in three stages different was significant. By using Tukey test showed that the difference in the two groups, depending on the post-test phase is woven with lower hematocrit anaerobic exercises that the participants mobile (Table 3). With an analysis of variance (ANOVA) showed that the amount of fibrinogen in the blood of athletes and non-athletes in three stages (pre-test, post-test and recycling) was not significantly different (Table 4). Also, with analysis of variance (ANOVA) was found in the number of blood platelets athlete subjects, there is a significant difference. Using the Tukey test showed that the difference between the pre-test and post-test and post-test stage to increase platelet counts were observed and recovery phase is associated with reduced platelet count. But in the non-athlete participants did not show a significant difference in the number of platelets (Table 5). Using the Kruskal-Wallis test showed that the D-Dimer test athletes significant difference in three stages. The difference between the pre-test to post-test, pre-test stage this factor was associated with increased recycling and recovery of the post-test phase was to reduce this factor. But untrained subjects, no significant difference in this factor in any of the three phases (Table 6).

Table 1: Statistical indicators of PT time in both athletes and non-athletes group

The significance level	recovery	Post-test	Pre-test	subjects	Protrombin time (second)
	Average and standard deviation	Average and standard deviation	Average and standard deviation		
0/24	13/1±1/4	14/42±2/3	14/25±2/28	Athlete	
0/87	13/52±1/5	13/22±1/3	13/29±1/5	Non-athlete	

Table 2: Partial thromboplastin time PTT statistical indicators in both athletes and non-athletes group

The significance level	Recovery	Post-test	Pre-test	subjects	Partial thromboplastin time (second)
	Average and standard deviation	Average and standard deviation	Average and standard deviation		
0/13	42/82±11/3	40/16±9/3	49/39±12/7	Athlete	
*0/02	40/62±5/4	39/33±5/9	47/73±10/6	Non-athlete	

Table 3: Statistical indicators hematocrit HCT in two groups of athletes and non-athletes

The significance level	recovery	Post-test	Pre-test	Subjects	Hematocrit HCT%
	Average and standard deviation	Average and standard deviation	Average and standard deviation		
*0/02	42/99±2/9	46/1±2/04	44/11±2/7	athlete	
*0/013	43/05±2/6	46/52±2/7	44/32±2/9	Non-athlete	

Table 4: Statistical indicators of fibrinogen in two groups of athletes and non-athletes

The significance level	Recovery	Post-test	Pre-test	Subjects	Fibrinogen (mil/lit)
	Average and standard deviation	Average and standard deviation	Average and standard deviation		
0/7	253/5±42/9	263/9±33/3	265/91±39/4	Athlete	
0/9	253/7±46/04	260/9±47/2	261/4±53/1	Non-athlete	

Table 5: PLT platelet statistical indicators in both athletes and non-athletes

The significance level	recovery	Post-test	Pre-test	subjects	(Milm ² *1000)
	Average and standard deviation	Average and standard deviation	Average and standard deviation		
*0/003	279/5±46/9	314/8±47/5	267/5±32/7	athlete	
0/08	299/8±58/9	341/9±45/9	299/1±47/02	Non-athlete	

Table 6: Statistical indicators in both athletes and non-athletes D.Dimer

Level Significant	Average rating			subjects	Fibrinolysis D.Dimer(m. ilt/grm)
	recovery	Post-test	Pre-test		
*0/001	17/5	26/76	11/21	athlete	
0/79	20/13	17/58	17/79	Non-athlete	

Discussion

The results of research showed the increased activity of blood coagulation factors and fibrinolysis, but in most cases this increase was temporary and in some cases were not significant. According to Gonzales [16] and Smith [28], this changes in healthy athletes as physiological reactions, without any clinical symptoms considered. Also argue that changes in blood coagulation and fibrinolysis system in athletes is less [16, 28]. Bärtsch et al. [30] suggest that in healthy volunteers, activation of blood coagulation and fibrinolysis cascades of coagulation is a balance between the two systems, but if the person is a preparation for the aggregation of blood factors, provides the prevalence of this imbalance. Atherosclerosis, smoking, drugs, oral contraceptives, older age, obesity are the causes of imbalance. Having the opportunity to study the effects of exercise on blood coagulation process using the complex process of blood coagulation to graphically show (Tromboclastografy) is a solution to this difference [29].

Answer of two groups to activity showed that there are not significant difference between the PT of them, particularly in the period (before, immediately after and one hour after the test) that this results is similar to the results of Cullen et al. [13] that saw no change in PT with activity In healthy non-athletes male. The PT extrinsic pathway coagulation index and short of it depends on the concentration of prothrombin. Radmehr [3] and Qanbarniaki [4] have shown that the activity using various training programs had no significant effect on the PT but Habibian and Votes increase or decrease according to the report [1, 11] it is likely that changes of PT depend on the type and intensity of physical activity. Mousavi et al. showed that the PT reduced immediately after aerobic and resistance exercise significantly [7].

PTT of athlete boys decrease 18.6 %after the test immediately and increased 6/6% in recovery time compared to the post-test for which he was near to resting but any of the difference was not significant. But PTT of non-athletic boys immediately after test 17.6 % had a significant reduction. PTT is one of the clotting factors that it is slower from PT and mechanisms begins its by damage to the blood vessel wall is damaged and contact with the collagen and indicators Anqadmypathis internal [23]. Halter et al. [18] proved a significant decrease PTT after intense activity in healthy people. Fibrinogen levels between the two groups and at no stage did not significantly change the results spacer (2008) that saw no change in fibrinogen was similar after physical activity [28] fibrinogen substance of the coagulation cascade and the main determinant of viscous flow blood, high fibrinogen levels are associated with increased risk of cardiovascular disease [20] changes in fibrinogen plasma volume is dependent differences [10]. Some researchers increased or decreased fibrinogen using various training programs have reclaimed as possible these changes were due to the intensity of training, the preparation and the type of activity. Kolen were fixed fibrinogen rise after intense physical activity, healthy non-athlete men [13].

Hematocrit as expressed as a percentage red blood cells to total blood volume [2] hematocrit deficiency anemia symptoms and conditions such as reducing plasma volume (indehydration) or when the red blood cells increases (Likebeingat a height), its value increases. In this study, hematocrit in both athletes and non-athletes group from pre-test to post-test in the order of 4.5% and 4.9%, but the increase was not statistically significant. But the recovery phase by 6.77% and 7.5% significant reduction showed that the results of research of Mc Naughton et al. [25] observed that the effect of exercise on the hematocrit is consistent. Some researchers have reported an increase in physical activity have hematocrit after doing activity Radmehr [3] showed increase the amount of hematocrit after maximal exercise and submaximal non-active girls [3] that may be this changes depends on the type of test and duration activity.

The number of platelets in the non-athlete group immediately after exercise 14.3% cycle time in 12.3 percent, which was close to resting platelets, but these changes were not statistically significant but athletic groups at post-test 17.7% significant increase there was a significant difference between the two groups. Arazi et al. [9] have shown that exercise can cause increased loads platelets. Elevated levels of platelets can release fresh platelets from the vascular bed in the spleen and bone marro was well as the release of epinephrine, which shrinks the spleen, whereabout a third of platelets to be stored, and because during physical activity increases the secretion of epinephrine, this mechanism could explain why a large increase in cycle sport with platelet count [9]. Bourey [12] observed an increase in platelets after strenuous activity. The results of the research Ikarogi et al. [19] also similar.

D-Dimer athletic groups immediately after the exercise of 11.21 to26.76 that this difference was statistically significant increase in non-athletes from 17.79 to 20.13 D-Dimerin the recovery phase will see the difference statistically not significant. Balancing short-term training activities to increase the hemostatic system and coagulation system leads to acute exercise with fibrinolysis system offset [18]. Gough et al. [15] increased the activity of fibrinolysis after intense exercise in healthy men showed as well as the results of research [26] and [11].

Conclusion

The results of this study showed that doing anaerobic exercise on blood coagulation and fibrinolysis factors contributed so that athletes and non-athletes response to anaerobic activity in some of these factors will be different. This difference may be due to surface preparation of people. Activation of blood coagulation and fibrinolysis cascades of coagulation is a balance between the two systems. Fibrinolytic index increased D-Dimer can be effective in preventing thrombosis. These results suggest that more research on people of different age and long-term effects of exercise on these factors take place.

Acknowledgement

Very thanks to the participants and officials Brvjrd Khunmis Takable University.

References

- [1] M. Habibiyani et al., Compared the effects of a aerobic session and resistance exercise on the activity of coagulation factors in healthy women, *Journal of Materials Science and Engineering*. 12(4) (2009) 33 -37
- [2] V. Dorland, *Dorland Medical Dictionary*, Golban Publications with Arian teb and Ghazi jahani, 2004.
- [3] A. Radmehr. Comparison of maximal and submaximal exercise on blood clotting time female student -athlete Islamic Azad University of Tabriz, MS Thesis in Physical Education. Islamic Azad University of Tehran, 2004.
- [4] G. Niaki, S.H. Mohammadi, The effect of four weeks of aerobic exercise on plasma Lypoprotein boxers man cake hematologic changes, *Letter of Applied Exercise Physiology*. 88 (2009) 75-87.
- [5] A. Ghanbari Niaki, S.M. Tayebi, Dolroz H. Effects of eccentric resistance exercise on blood coagulation factors in students idle boy, *Journal Blood*. 8(3) (2011) 195-206.
- [6] H. Golafshan, *Foundations of anticoagulant and laboratory procedures*, Koushamehr Publications, 1999.
- [7] S. Mousavi, M. Habibiyani, Comparison of two methods of acute aerobic and resistance of plasma fibrinogen concentration in young women *Journal of Gorgan University of Medical Sciences*. 4 (2009).
- [8] B. Mirzaei Ghaziani, Significant changes in blood cortisol peak morning and evening cleansing makers elected by the people of Gilan in practice . Master Thesis in Physical Education. University of Guilan, 1997.
- [9] H. Arazi, E. Asghari, P. Lotfi, Effects of an exercise session and preparing special kung fu skills on hematologic variables, *Exercise Physiology And Physical Education*. (2009) 235-240.
- [10] S. Ahmadizad, MS. EL-Sayed, The acute effects of resistance exercise on the main determinants of blood rheology. *J. Sports Sci*. 23 (2005) 243-249.
- [11] M. Arai et al., Influences of strenuous exercise (triathlon) on blood coagulation and fibrinolytic system. *Thrombosis research*. 57(3) (1990) 465-471.
- [12] RE. Bourey, SA. Santoro. Interaction of exercise m coagulation, platelets, and fibrinolysis. *Med. Sci. Sports Exerc*. 20(5) (2003) 439–446.
- [13] D. Collen et al., Turnover of fibrinogen, plasminogen, and prothrombin during exercise in man, 1997.

-
- [14] Eriksoon–Berg et al, .Retained fibrinolytic response and on coagulation activation after acute physical exercise in middle – aged women with previous myocardial in farction. *Thrombosis Research*. 105 (2002) 481–486.
- [15] Gough et al., The effect of exercise and heart rate of fibrindytic activity. *Blood Coagul. Fibrinolysis*. (2004) 179–182.
- [16] F. Gonzales, Blood platelet function in healthy individuals of different ages . Effect of exercise and exercise conditioning. *J. Sports Medphys. Fitness*. 36 (2006) 112–116.
- [17] J.B. Hansen. Basal plasma concentration of tissue Plasminogen activator (t – PA) and The adaption to strenuous exercise in familial hyper cholesteralaeamia (FH), *Blood Coagul. Fibrinolysis*. 5 (2001) 781–787.
- [18] H.C. Gunga et al., Markers of coagulation, fibrinolysis and angiogenesis after strenuous short-term exercise (Wingate-test) in male subjects of varying fitness levels. *International journal of sports medicine*, 23(07) (2002) 495-499.
- [19] H. Ikarugi et al., High intensity exercise enhances platelet reactivity to shear stress and coagulation during and after exercise. *Pathophysiology of haemostasis and thrombosis*. 33(3) (2003) 127-133.
- [20] S. Kamath, Lip GY. Fibrinogen: biochemistry, epidemiology and determinants. *QJM*. Oct; 96(10) (2003) 711-729.
- [21] S. Kahraman. The effect of exercise on fibrinolytic and coagulation systems in healthy volunteers. *J. Thromb. Haemost. Supplement*. 2 (2007) P-S-362.
- [22] HD. Kevin, B. Osterud, The effect of physical conditioning suggests adaptation in procoagulant and fibrinolytic potential. *Thromb. Res*. 87 (2009) 559–569.
- [23] J. Lekakis, H. Triantafyllidi, V. Galea. The immediate effect of aerobic exercise on haemostatic parameters in patients with recently diagnosed mild to moderate essential hypertension. *J. Thromb. Thrombolysis*. 25(2) (2008) 179-84.
- [24] H. Madarama et al., Effects of low-intensity resistance exercise with blood flow restriction on coagulation system in healthy subjects. *Clinical physiology and functional imaging*. 30(3) (2010) 210-213.
- [25] L.R. Mc Naughton. Plasma Volume response associated with a sprint triathlon in novice triathlets, *Int. J. Sport Med*. 10 (2006) 161-164.
- [26] Molz.A-B. The effect of different exercise intensities on the fibrinolytic system. *Eur. J. APPL. Physiology*. 67 (4) (2007) 298–304.
- [27] Li Nailin, Platelet Activity, Coagulation, and Fibrinolysis During Exercise in Healthy Males.*Arteriosclerosis, Thrombosis, and Vascular Biology*. 27 (2007)407-413.
- [28] J.E. Smith. Effects of strenuous exercise on homeostasis. *J. Sport Med*. 37 (2002) 433–435.
- [29] W. Speiser, Increase blood fibrinolytic activity after physical exercise: comparative study in individuals with different sporting activities and in patients after myocardial in fraction taking part in rehabilitation sports program. *Thromb. Res*. 51 (2008) 543–555.
- [30] P. Bärtsch, A. Hachberli, P.W. Straub, Blood coagulation after long distance running: ant thrombin III prevents fibrin formation. *Thromb. Haemost*. 63(3) (2000) 430–434.