Effect of Far Infrared Radiation with bag Infrared on recovery after submaximal physical activity

by Gadis Meinar Sari

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Sport Coaching

EFFECT OF FAR INFRARED RADIATION WITH BAG INFRARED ON RECOVERY AFTER SUBMAXIMAL PHYSICAL ACTIVITY

Arifah Kaharina[1], Gadis Meinar Sari[2], Damayanti Tinduh[3]

[1,2,3]Sports Health Science Medical Faculty Airlangga University
[1]arifahkaharina@gmail.com, [2]damayanti.tinduh@fk.unair.ac.id, [3]sarigadis@yahoo.co.id

Abstract

Recovery is an attempt to make the body recover after physical exercise. There are several types of recovery: active recovery and passive recovery, but recovery with Far Infrared Radiation (FIR) with infrared bag method is not well known. This study aims to prove the effect of FIR radiation with infrared bag method in the decrease of blood lactic acid level as indirect marker of fatigue after physical activity in submaximal intensity. The method used was pretest-posttest control group design, with a sample of 14 people divided randomly into two groups, G1 radiation recovery group FIR 45°C for 15 minutes, G2 control group by lying down for 15 minutes. Both groups were subjected to a maximum of 85% of maximal heart rate with ergocycle, then recovery. The result of independent t-test with significance level of $p<0,05$, delta 2 G1 (pretest-posttest) and delta 2 G2 (pretest-posttest) was $p=0,008$, meaning there was significant difference of decrease of blood lactic acid level in group of FIR with the control group. Thus from the results of this study it can be concluded that the decrease in blood lactate acid levels was greater in the FIR radiation recovery group than the recovery group with lying recovery.

Keyword: recovery, lactic acid, infrared, far infrared radiation, bag infrared, submaximal physical activity

INTRODUCTION

Severe physical exercise exposes the athlete to the physical and mental stress that is important for improved performance, but furthermore it can induce overtraining and even severe injury. This can happen if recovery is inadequate in an exercise program (Noponen et al., 2015). Recovery is the return of conditions to a baseline state before a match or activity (Bompa & Haff 2009). This phase is a necessary condition by the body to return to its original state, an imperfect recovery will degrade the performance of an athlete.

In submaximal activity, 70% of energy role comes from the anaerobic glycolysis system and 30% from the aerobic system (Bompa & Haff, 2009). This means that in submaximal physical activity with predominant energy from the anaerobic energy system will increase the concentration of lactic acid in muscle and blood that becomes indirect markers of fatigue. To reduce the fatigue that occurs, the lactic acid level should be lowered to the normal threshold again.

Recovery can be either active or passive (complete rest). One of the passive recovery is thermal therapy or hot therapy. Hot therapy is an agent whose only purpose to deliver heat (Hayes & Hall, 2016). One type of the thermal therapy is infrared (infrared). Infrared radiation is an wave energy that complements or fills the electromagnetic spectrum and has been used effectively for thousands of years to treat or alleviate certain diseases and discomforts (Vatansever & Hamblin, 2012). The infrared classification according to its wavelength is divided into the near infrared, mid infrared, and far infrared.

One of the infrared device is an infrared bag or infrared bag, which belongs to the far infrared (FIR) category with a wavelength of between 5,6-1000 μm (Noponen et al., 2015). FIR wavelengths can penetrate up to 1,5 inches (nearly 4 cm) below the skin (Vatansever & Hamblin, 2012). The function of infrared sauna and infrared bag is based on the heating effect of infrared radiation. The heat from infrared has the potential to improve recovery speed from exercise by improving blood circulation and decreasing the stress of the body (Noponen et al.,

2015). The mechanism effect of FIR radiation is unknown (Lin et al., 2008), but the same wavelengths between the FIR and the human body can be one factor that allows for FIR to penetrate deeper into the body (Noponen et al., 2015). Because the mechanism of FIR radiation on muscle fatigue recovery is unclear, it is necessary to investigate the effect of FIR radiation on changes in blood lactic acid levels after submaximal physical activity. The purpose of this study was to prove the effect of FIR radiation with infrared bag method on the decrease of blood lactic acid level after submaximal physical activity.

METHOD

This research uses a quantitative approach with the type of design of the pretest-posttest control group design (Zainuddin, 2000). The protocols in this study have been approved by the ethics commission of the Faculty of Dentistry Airlangga University (number: 049/HRECC.FODM/V/2017). The population in this study are the second semester students of Sport Science, Faculty of Sport, University of Surabaya, male, 18-23 years old, normal resting HR (60-80 bpm), normal BMI (18,5-22,9 kg/m²). The sample size was 14 people, divided into two groups with simple random sampling. Consists of the FIR passive radiation recovery group (n=7) and the passive recovery group by lying down (n=7).

Procedure

Before physical activity, measurements of blood lactic acid (baseline) were measured. Before the subjects does physical activity, they do some stretching first, then warm up by paddling the ergocycle for 5 minutes with increasing load and speed to limit the subject's capability (85% HRM). After reaching the subject's submaximal ability, it was maintained for 5 minutes. After that the speed was lowered gradually for cooling down for 5 minutes. Preliminary observations of submaximal exercises by measuring blood lactate acid levels immediately after physical activity as the pretest data. Subjects recovered and retrieved posttest data. Measurement of blood lactic acid level with accutrend lactate analyzer. The infrared bag tool uses FIR (Far Infrared) heating element which was made from carbon fiber yarn, provided with 45°C for 15 minutes (Jaco/South Korea/45-80°C/500 watt). Giving radiation to the lying down subject, the entire body is in the infrared bag except the head.

Data Analysis Technique

Data analysis of research results using: (1) Descriptive statistical test; (2) Test of distribution normality, (3) Homogeneity test, and (4) Different test.

RESULT AND DISCUSSION

Based on the measurements on the subject of research, the following results are obtained:

Table 1. Mean data of age, weight, height, IMT and HR rest

Variable	Group 1 (n=7)	Group 2 (n=7)
Age (year)	19,71 ± 1,70	20 ± 1,16
Body weight (kg)	60,13 ± 4,16	59,31 ± 5,28
Height (cm)	167 ± 4,76	167,86 ± 6,07
BMI (kg/m^2)	21,54 ± 0,68	21,03 ± 1,21
HR rest (bpm)	68,14 ± 7,80	63,00 ± 2,89

Note:
G1 = FIR radiation group with infrared bag
G2 = control group

Normality test results in all variables and in all groups showed p>0,05 so that all data of the research results are normally distributed. From the research that has been done showed that the lactic acid level of subjects's blood ranged from 1,4-2,9 mMol/l. The mean values of blood lactic acid levels immediately after physical activity in the FIR group was 10,94 mMol/l and in the control group was 11,80 mMol/l. This results proves that there is an increase in lactic acid levels as a result of anaerobic metabolism after the subjects do a physical activity in the submaximal intensity in both groups when compared with baseline. The mean values of lactic acid blood levels were immediately after recovery in the 5,71 mMol/l FIR radiation group and the control group of 9,27 mMol/l. It showed that there was a decrease in blood lactic acid levels after the subjects do recovery when compared with the pretest conditions in both groups. The results of the measurements showed significant differences in the posttest states of both groups with higher levels of the lactic acid in control group than the FIR radiation group.

Table 2. Mean value of blood lactic acid level

BLAL (mMol/l)	Group 1 (n=7)	Group 2 (n=7)	p
Baseline	2,37 ± 0,40	2,11 ± 0,53	0,329
Pretest	10,94 ± 1,03	11,80 ± 1,46	0,229
Posttest	5,71 ± 0,97	9,27 ± 2,87	0,009

Note:
Baseline = before submaximal physical activity
Pretest = immediately after submaximal physical activity
Posttest = immediately after 15 minutes recovery
BLAL = blood lactic acid level

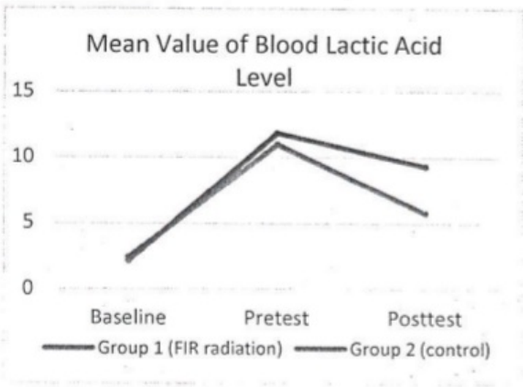

Figure 1. Chart of baseline, pretest and posttest mean of the blood lactic acid level

Table 3. Independent t-test on blood lactic acid levels of G1 and G2

	BLAL Variable	p
Delta 1	G1 *Baseline* – G1 *Pretest* / G2 *Baseline* – G2 *Pretest*	0,070
Delta 2	G1 *Pretest* – G1 *Posttest* / G2 *Pretest* – G2 *Posttest*	0,008
Delta 3	G1 *Baseline* – G1 *Posttest* / G2 *Baseline* – G2 *Posttest*	0,003

Based on the results of the independent t-test, delta 1 (baseline-pretest) blood lactic acid levels between the two groups showed p=0,07 (p>0.05). So there was no significant difference in elevated blood lactic acid levels before immediate after physical activity in the FIR radiation group and control group. This condition illustrates that the maximum ability possessed by the subject in each group has a balanced value (homogeneous). The presence of differences in blood lactic acid levels after recovery is a result of different treatments given to

the study subjects. The result of independent t-test, delta 2 (pretest-posttest) test of blood lactic acid level between the two groups showed p=0,008 (p<0,05). Then there was a significant difference in the decrease in blood lactic acid levels immediately after physical activity immediately after recovery in the FIR radiation group and control group. The result of independent t-test, delta 3 (baseline-posttest) test of blood lactic acid level between the two groups showed p=0,003 (p<0,05). Then there was a significant difference in elevated blood lactic acid levels before physical activity immediately after recovery in the FIR radiation group and control group.

The results of this study prove that the heat from radiation FIR gave an effect on the decrease of blood lactic acid levels. The heat from the infrared has the potential to improve recovery from exercise by improving blood circulation and decreasing the stress of the body (Noponen et al., 2015). The heat from the infrared bag causes vasodilation of the blood vessels of the skin. With vasodilation of blood vessels, it will increase blood flow about twice as much as it can promote heat loss from the body and cause increased oxygen supply, antibodies, leucocytes, nutrients and enzymes, along with increased metabolite elimination (Bell & Prentice, 1994). This acceleration of circulation helps speed up the recovery, due to the acceleration of supply of all the necessary tissue and the acceleration of disposal of metabolites/lactic acid. Resulting in increased expenditure of lactate metabolism from muscle to blood circulation, and acceleration of lactate metabolism by neutralizing organs (Giriwijoyo & Sidik, 2012).

According to Arovah (2016), the heat produced by FIR can increase the blood flow of the skin by widening the blood vessels that can increase the supply of oxygen and nutrients in the tissues. Increased oxygen supply is useful to restore the state of oxygen debt and supply of nutrients as a source of energy, so that the oxygen demand was met and the role of the aerobic metabolism system becomes dominant. With the presence of oxygen, lactate can be transported into the mitochondria to oxidize. Lactate can be picked up from the cell by MCT, possibly along with extracellular transport from H^+. These blood lactates can then be taken and used as fuel by adjacent skeletal muscles, as well as the heart, brain, liver, and kidneys so that the levels of lactic acid blood can be decreased (Hall et al., 2016).

Sufficient oxygen supply during recovery, will play a role for metabolic processes in muscles together with pyruvic acid through Kreb's cycle process (Foss & Keteyian, 1998). The pyruvate oxidation increases with the catalyst of the pyruvate carboxylase enzyme, so that pyruvate enters to the Krebs cycle. With aerobic metabolism is not produced lactic acid, so that lactic acid levels will decrease. Increased blood circulation is also needed to transport lactate to the liver. Lactate is converted into glucose in the process of gluconeogenesis that takes place in the Cori cycle in liver cells. Thus a larger ATP is formed and lactate levels decreased to accelerate the recovery of physical fatigue.

CONCLUSION AND SUGGESTION

Based on the research result of the FIR radiation effect with infrared bag method to decrease blood lactate acid level after submaximal physical activity, obtained conclusion of FIR radiation with bag infrared method decrease blood lactate acid level for recovery after submaximal physical activity. The researchers suggest that in the use of an infrared bag for recovery, special procedures such as rehydration prior to radiation is important. Also, wearing accessories or clothing made of metal, wounded and inflamed subject are prohibited from doing recovery with infrared radiation.

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