Increased Secretion of BNP Levels as an Indicator of Overload in the Heart During Physical Exercise Without Rest Days

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Abstract. This study aims to compare the levels of heart muscle BNP against aerobic and anaerobic physical exercise without rest days, and to find out how the positive and negative effects on heart function. This study is an in vivo laboratory experiment, the animals used were 15 wistar rats which were divided into 3 groups (control group, aerobic exercise treatment group for seven days in a row, anaerobic exercise treatment group for seven days in a row). How to do physical exercise on animals using a treadmill for animals, with a speed of 20 m/min for aerobic exercise for 30 min, and a speed of 35 m/min for anaerobic exercise for 20 min. The measurement of BNP levels using the ELISA Kit conducted at the Biochemistry and Molecular Laboratory, University of Indonesia. Results of the study showed that aerobic and anaerobic physical exercise performed for 7 consecutive days without a rest day, resulted in an increase in BNP levels compared to the control group. There was no significant difference between the levels of heart muscle BNP in the aerobic and anaerobic physical exercise groups, as indicated by the statistical test 4,55 ± 2.77 vs 9.44 ± 55.98 with pvalue = 0.217 ($p > 0.05$). Although BNP levels in the anaerobic group tended to be higher than in the aerobic group, these two types of physical exercise both resulted in a load on the heart muscle, because there is no time to recover energy, oxygen, and nutrients for the heart muscle. Given the importance of recovery time for heart function, it is advisable to exercise at a regular frequency in a week, and with recovery days, in order to avoid overloading the heart muscle.

Keywords: BNP levels · physical exercise · aerobic · anaerobic

1 Introduction

Role physical activity is now widely known, one of which is to improve physical fitness, especially heart and lung endurance, but until now is still a study that continues to

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learn about how the positive and negative effects of exercise on the heart function. Each exercise is a stressor to the body. If the body was given stressor is done regularly, scalable, and programmed well, the body will adapt to form a coping mechanism [1]. Instead of physical exercise are not measurable or performed with maximum intensity, can cause problems health because of the disruption of homeostasis of the body and can even cause myocardial stress and damage to the heart muscle [2].

At the time of physical activity, the energy source can be derived from the metabolism of aerobic or anaerobic metabolism. In the light intensity physical activity and a moderate source of energy mostly comes from aerobic metabolism. Heavy intensity physical activity a source of energy largely derived from the metabolism anaerobic [2, 3]. High-intensity aerobic exercise and anaerobic can form free radicals due to the release of electrons of the respiratory chain.radicals free formed may cause disruption in the molecular or cellular level [3–5].

The body's response during exercise load is an increase in *heart rate* and followed by flow, and a continuously high pressure in the vessels and filling the arteries of the heart that is maximally dilated, this condition will induce the release of inflammatory cytokines and accelerate injury in the blood vessels. and the heart itself [6] then several biomarkers are thought to show an indication process starting with inflammation, stress on the heart, ischemia, and infarction that may occur during the adaptation of the heart [7] Inflammatory cytokines originating from the ventricles of the heart and released during heart overload are *Brain Natriuretic Peptide* (BNP) [8].

BNP is a hormone type-B which will be stimulated when the ventricle of the heart to stretch and pressure or response into changes in volume and pressure overload that can cause supply oxygen is not comparable with the activity of the heart when doing high-intensity aerobic physical activity and anaerobik [4, 5].

Research conducted by Flora (2011), showed that in mice that do anaerobic physical activity for 10 days without a day of rest resulted in changes in rat heart muscle histology. On the 10th day of occurs heart muscle damage which is characterized by ischemia and infarction [9]. According researchers to in this situation is likely to occur also changes in the heart muscle BNP levels, as an indicator of the occurrence of an excessive burden on the ventricular wallstress.

Due the effect of aerobic physical activity of high intensity and anaerobic, not onlyleads to reduced oxygen supply to the heart muscle, but can also cause changes in the levels of BNP, but until now not known how much influence both physical exercises without a rest day on the secretion production of BNP in muscle heart to be developed as an indicator of ventricular wallstress of the heart.

Therefore, further research is needed to compare the level of BNP in the heart muscle with aerobic exercise and anaerobic without a day rest for 7 days in a row.

2 Methods

This animal experiment was carried out in the Faculty of Medicine, Universitas Indonesia's animal house. Fifteen male wistar rats, 6–8 weeks old and weighing 80–100 g, were randomly allocated to one of three groups: control (P1), aerobics exercise 7 days in a row without a day off (P2), and anaerobic activity 7 days in a row without a day

off (P3) (P3). There are no rat dropouts. A treadmill at a speed of 20 m/min was used continuously for 30 min for aerobic exercise, and a treadmill at a speed of 35 m/min was used constantly for anaerobic exercise for 20 min. The treadmill was used for 7 days straight with no break days. The aerobic and anaerobic exercise experimental protocols were adapted from Fahrenia's [10] approach, which is based on Soya et al. [11]. For one week, all rats were acclimated to the treadmill by introducing them to it at a modest pace. For the treatment group, mice were exposed to a treadmill by training rats on a treadmill every day, progressively increasing the speed and time. This is done so that by the time the study was completed, the rats were used to the treadmill instrument. This tool should be introduced in no more than 15 min (5–15 min).

The study was authorized by the Faculty of Medicine's Ethical Committee at Universitas Sriwijaya. The rats were beheaded and their hearts were removed at the end of the experiment. Cardiac muscle tissue was kept at −70 °C until it was processed.

After the treatment ends, the mice are removed from the animal treadmill and quickly weighed again. As soon as it is weighed, the mouse is put into a place containing ether. In anesthetized condition, the mice are removed from the anesthetic site and then surgically removed by opening the chest cavity through the section on the midsternum and taking the heart muscle.

2.1 Cardiac Muscle Homogenat and Measurement of BNP Level

Protein levels of cardiac muscle tissues were measured spectrophotometrically at $\lambda =$ 450 nm.

Weigh the heart muscle due to more than 0.1 g of insertion into the microtubes which contains 1 ml of 0.1 M PBS with a pH of 7.4. Put the microtubes into a container containing dry ice. The specimens are then milled using tissue grinder in cold conditions. Then after grinding, a centrifuge at a speed of 5000rpm is carried out for 10 min to produce a supernatant, then the supernatant is stored at −80 °C. Carried out organ harvesting and manufacturing heart of tissue the heart muscle homogenates for examination BNP levels using ELISA kit (Enzyme Linked Immuno-sorbent Assay) in the laboratory of the Department of Biochemistry and Molecular Biology, Faculty of Medicine, Universitas Indonesia.

2.2 Statistics

SPSS 17.0 software was used to analyze the research data. ANOVA was used to compare mean differences between groups at a significance threshold of p 0.05.

3 Results

Table 1 shows that the data is normally distributed and homogeneous p value $> 0, 05$.

Test normality to determine whether the data is normally distributed or not, and because the sample size is less than 50 then use Shapiro-Wilk test that can be seen in the Table 2.

Table 1. Average Weight research subject /animal

Group	Initial Weight	P
Control	98,75±10,30	**0,179**
Physical Exercise aerobics		
7 consecutive days	100,0±8,165	
Physical Exercise Anaerobic		
7 consecutive days	92,50±25,98	

Homogenity test of variance levene's test p>0,05

Table 2. Normality test subject research

Group	p	(pg/ml)
Control	4,42±2,90	**0.859**
Physical Exercise aerobic		
7 consecutive days	4,55±2,77	**0,409**
Physical Exercise anaerobic		
7 consecutive days	9,44±5,59	**0,569**

Normality test with shapiro wilk $\alpha = 0.05$

Table 3. Levels of BNP Myocardial Aerobic exercise group 7 consecutive days compared with control group

Group	Control	(pg/ml)	p
Control	4,42± 29,06		
Physical Exercise aerobic			
7 consecutive days		4,55±2,77	**0,948**

significant difference compared to the control group if (P <0.05) Independence t-test

Table 2 shows the value of $p > 0.05$ then be concluded that the data were normally distributed.

Based on Table 3, BNP levels indicate that the heart muscle in the group treated with aerobic exercise 7 days in a row without a day of rest no significant difference compared with the control group, with $p = 0.948$ ($p > 0.05$).

Based on Table 4, it can be concluded that BNP levels in the cardiac muscle groups of anaerobic 7 days in a row without a day of rest no significant difference with the control group ($p > 0.05$) (Table 5).

Table 4. Levels of BNP Myocardial Anaerobic exercise 7 consecutive days compared with control group

Group	Control	(pg/ml)	p
Control	4,42±29,06		
Physical Exercise anaerobic 7 consecutive days		9,44±55,98	**0,379**

Significant difference compared to control group if (p<0.05)
Independence t-test

Table 5. Comparison of levels BNP group aerobic exercise and anaerobic 7 consecutive day without a day of rest

Group	(pg/ml)	p
Physical Exercise aerobics 7 consecutive days	4,55±2,77	**0,286**
Physical Exercise anaerobics 7 consecutive days	9,44±5,59	

Independence t-test

4 Discussion

At BNP levels myocardial strain wistar rat rattus novergicus before and after aerobic physical exercise 7 days in a row without a day of rest. In this study it was found that the aerobic exercise group 7 days in a row there BNP levels were no differences significant of the heart muscle than the control group $p = 0.948$ ($p > 0.05$). BNP levels increase heart muscle during group aerobic treatment performed for 7 days in a row without a day of rest compared to the control group even though the increase is no significant.

According to researchers, physical exercise is done everyday without resting phase resulting in heart muscle had experienced a recovery or restoration of oxygen, and nutrients to muscle, the heart therefore the heart muscle responds to aerobic physical activity performed continuously without a day of rest as a burden on the heart muscle, when compared with the control group BNP levels of the heart muscle is no difference significant ($p > 0.05$).

The study ever conducted by Dzuvo et al. (2014), also explained that in mice treated with physical exercise duration gradually pool for 7 consecutive days (0.81 ± 0.14) showed no significant differences in BNP levels cardiac muscle compared with the control group (0.8 ± 0.08), so that the research can be concluded that by doing pool exercises during 7 consecutive days did not significantly influence the secretion of BNP in the cardiac muscle of mice.

Results of measurements of BNP cardiac muscle groups anaerobic 7 days in a row without a day of rest was found that, there was an increase in the levels of BNP heart muscle no significantly than the control group $p = 0{,}379$ ($p > 0.05$). According to

researchers, increased levels of BNP heart muscle is because exercise physical given increasingly responded by heart as an excessive burden.

The Study by Xiao et al. [13] showed that in mice given tough physical training (swimming) with frequencies higher for 21 days have elevated levels of BNP heart muscle that is the higher in accordance with the duration of treatment, as an indicator the occurrence of hypertrophy of the heart muscle cells. Increased of levels BNP were higher explains that, the longer and more strenuous exercise physical anaerobic done then be signified the increasing burden of stress on the LV and diastolic blood pressure.

Another study conducted by Purnomo (2011) also showed that, exhausting physical exercise can lead to ischemia is a condition decrease or loss of oxygen supply. This is due to the increasing needs oxygen to muscles during strenuous physical exercises while the oxygen supply cannot meet the needs in muscles that have an impact on the occurrence of oxygen debt. Results of research by Purnomo supported by Wang et al., (2007) [13] which explains that, in mice induced mild hypoxia, resulting in apoptosis in cardiac muscle cells of mice results in increased secretion of BNP in heart muscle in accordance with the duration of exposure to hypoxia. Something similar research described in Flora (2012) [9] which states that, in mice fed anaerobic physical exercises without a rest day occurs the heart muscle response in addressing the given load. The longer treatment is given, the heart muscle responds to physical exercise such as an increasingly heavy burden. It is characterized by the presence of ischemia to cardiac muscle in the 7th day of physical exercise anaerobic, and infarction in the heart muscle on the 10th day of anaerobic exercise. Research conducted by Ferdinal (2009) [14] states that, in mice induced systemic hypoxia chronicle can increase gene hypoxia inducible factor-1α that play a role in the regulation of gene expression in B-type natriuretic peptide-45.5 ischemia also can occur during strenuous exercise. Ischemia is a condition reduced or loss of supply of oxygen (O2).

This is due to an imbalance of the need for increased oxygen to the muscles during strenuous exercise, while the supply of oxygen (O2) provided are not met. During ischemia followed by reperfusion which is a process reflux oxygen (O2) in ischemic tissues, they can lead to metabolic stress on the body that cause xanthin oxidase free radical. Comparative levels of BNP myocardial wistar rats performing physical fitness aerobics with anaerobic in this research, in the group of aerobic exercise and anaerobic 7 days in a row without day of a rest not there is a significant difference with $p = 0.286$ ($p > 0.05$). According to researchers, these two exercises either aerobic or anaerobic exercise conducted for 7 days in a row are equally excessive burden to the heart muscle. Therefore physical exercise is carried out everyday, and there is no rest for the recovery phase or heart muscle for energy recovery, oxygen and nutrition.

Recovery after exercise physical is essential for muscle and tissue repair and build strength. It is even more critical after a heavy weight training session. Muscle takes approximately 24–48 h to fix and return to its optimal state. Working again too soon will only result in tissue damage and not build muscle back [15].

According Astrand et al. (2003) [16], supplying oxygen to the heart is important, because cell-cardiac muscle cells have limitations in energy through metabolism anaerobic. This situation is reinforced by the fact vascularization system of the heart muscle,

the capillary least one cardiac muscle fibers. Therefore, there is relationship a very close between energy usage with consumption of oxygen to the heart muscle.

5 Conclusion

There is no significant difference in the levels of BNP cardiac muscle in group aerobics treated 7 days in a row without a day of rest ($p = 0.286$) compared with the group of anaerobic 7 days a row without a day of rest. This indicates that is physical exercise aerobic or anaerobic performed continuously without day arrest may improve heart muscle BNP levels were considered to constitute burden an excessive or ventricular wall stress on the walls of the heart that triggers the hormone BNP. The higher BNP levels explained that the longer and harder anaerobic physical exercise was carried out, it became a sign of increasing stress load on the left ventricle and diastolic pressure.

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