

# HYPERBARIC OXYGEN AND ACTIVE RECOVERY TO INCREASED BLOOD LACTATE CLEARANCE

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## ABSTRACT

This study aims to assess how much influence recovery with hyperbaric oxygen pressure 1.3 ATA, 1.7 ATA, and active recovery on increased lactate clearance and assess differences in the influence of recovery with hyperbaric oxygen at pressure 1.3 ATA, 1.7 ATA, and active recovery on increases blood lactate clearance.

This type of research is experimental research, using the design of "The Pretest-Posttest Control Group Design". Subjects in this study were badminton players who are students of the State University of Surabaya in the Unit Student Activity of Badminton, with a total of 30 people. The sample is divided into three groups, each 10 people. The group is (1) the recovery with HBO at 1.3 ATA, (2) the recovery with HBO at 1.7 ATA, and (3) active recovery.

Based on the above analysis it can be concluded that recovery with hyperbaric oxygen at pressure 1.3 ATA to increase blood lactate clearance is higher (by 63.08% or 8.99 mmol/l) when compared with the recovery with hyperbaric oxygen at pressure 1.7 ATA (amounting to 51.22% or 7.95 mmol/l), and active recovery (45.53% or 6.37 mmol/l). There are differences in the effect of hyperbaric oxygen recovery at 1.3 ATA pressure, hyperbaric oxygen recovery at 1.7 ATA pressure, and active recovery to increased lactate clearance. Increased lactate clearance was highest in group 1 (recovery with hyperbaric oxygen at pressure 1.3 ATA) can increase blood lactate clearance by 63.08% or 8.99 mmol / l followed by group 2 (recovery with hyperbaric oxygen at pressure 1.7 ATA) of 51.22% or 7.95 mmol / l, and group 3 (active recovery) of 45.53% or 6.33 mmol / l. 30 minutes is not enough time to recovery when resting lactate levels.

**Keywords:** HBO 1,3 ATA, HBO 1,7 ATA, active recovery, blood lactate

## INTRODUCTION

Citius - Altius - Fortius, faster, higher and stronger is the motto of the estuary every sports coaching accomplishments. The motto is not just a phrase or a slogan that is always magnified, but contains a challenging message for every person who engaged in the world of sports achievement.

Athletes in achieving success is not only supported by appropriate skills and techniques but also must be supported by a good physiological profile, which in this case is a combination of strength (strength), flexibility (flexibility), agility (agility), velocity (speed), aerobic capacity and anaerobic capacity (Noakes 2000). Aerobic capacity is simply described as the body's capacity to perform physical activity without making a person out of breath (running out of breath), while the anaerobic capacity is the capacity or the old one to be able to do high intensity work where someone seemed to run out of breath (Tessitore et al. 2005) . Anaerobic Work is determined by the level of energy and capacity of substrates forming clearance (clearance) lactate. High levels of substrates and rapid

lactate clearance can increase both the capacity and stability of anaerobic work (Monedero et al. 2000).

Physical activity using a primary anaerobic energy system will be able to stimulate the production of lactic acid, so it will increase both lactate levels of lactate in the muscles and in the blood. Increased lactate will cause a decrease in pH and a decrease in pH will cause the enzyme to be slow so that the formation of ATP will be slow anyway, this condition will cause fatigue that eventually will hinder achievement. Therefore it is necessary optimization of recovery by accelerating the metabolism of lactate neutralize organ.

Mechanism of recovery from muscle and blood lactate is strongly influenced by the activities undertaken after maximal activity. This will affect the mechanism of the release of lactate from the blood to the muscles, increasing blood flow, lactate uptake by the liver, heart, and skeletal muscle. Speed spending will affect the metabolism of lactic next, so that lactate can immediately re-establish energy metabolism through Krebs cycle. FalkS (1995), lactic important recovery is to increase blood flow, increased cardiac output, increased lactate transport, thereby rapidly forming energy back.

Several attempts were made to increase the anaerobic capacity for, among others, with intermittent exercise, nutrition intervention and optimization of future recovery. However, optimizing the recovery period between the time the game was much studied in depth. This is unfortunate, given the quality of the recovery period is critical achievement especially in sport championships with high levels of competition and have a championship system that demands repeated high-intensity work.

In the last century, competitive sport has become more professional, technological advances and increased movement in the science of exercise physiology has contributed to improve the efficiency of the training program. At each session (often exercise twice a day) is a quantitative and qualitative forms of optimization to approach the maximal exercise load or supra-maximal or maximal load (Barnett, 2006). Therefore it is important for athletes to competitive use time recovery (rest) and peting consider that loading-recovery cycle is the key point of the exercise. In addition to purely rest with passive recovery, some strategies and methods have been proposed for athletes to improve muscle function recovery after training or competition (Vanderthommen, Marc, et al., 2010).

Optimizing the recovery period in line with theoretical studies which state that athletes physiological conditioning is not only done in the exercise but also during exercise recovery, during the game, and the period of recovery between matches (Lattier et al. 2004). Optimizing recovery techniques important to remember that good quality recovery can reduce fatigue, both objectively (fatigue index) and subjective (rating of perceived exertion), increases the body's physiological adaptation to exercise and reduce the risk of injury (Dupont et al. 2004). In the end, the challenge of less optimal recovery period when the match had to be answered by scientists in the field of sports to find a formulation of the optimal recovery strategy. In this study some recovery techniques to be tested is an active recovery and the recovery of high-pressure air in the room or hyperbaric oxygen (HBO).

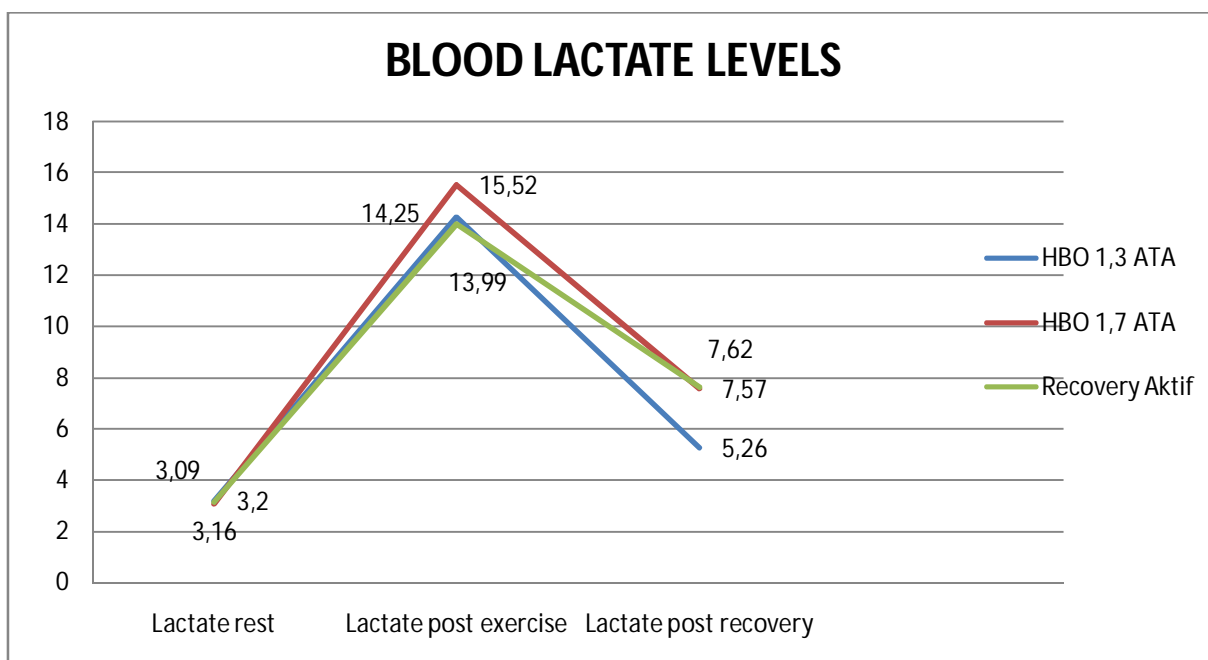
This research was important to strategically because sports competition is getting tougher now, so it should do well on optimizing physical training period, the period of the competition, and the recovery period, as long as the effort is largely focused on the physiological capacity building training phase. In response, this study aims to complement this by focusing their efforts on optimizing the recovery phase of the athletes, which in turn affects the performance enhancement of athletes performance. Samples athletes used in this study are badminton athletes who are members of the Unit of Student Activity Badminton. The basis of the use of the sample resulted in the characteristic athlete badminton game badminton sport energynya predominantly used in accordance with the anaerobic treatment of the RAST test (Running-based Anaerobic Sprint Test).

## **METHODS**

The type of research is experimental research. Results taken from the treatment of instantaneous (acute response). The study used a "randomized pretest-posttest control group design". In this study, the population is a student at the Faculty of Sport Science State University of Surabaya. While the sample in this study is the students in the Unit Student Activity of Badminton in Surabaya State University with an age range 19 to 23 years. The sample used in this study were 10 people for each treatment group. Data collection instrument used in this study are: Lactotest and Stick Calorimeter is used to determine blood lactate levels. To determine the effect of recovery on blood lactate levels using Anova analysis.

## **RESULTS**

The three research groups decreased blood lactate levels after recovery for 30 minutes with the hyperbaric oxygen recovery 1.3 ATA, hyperbaric oxygen recovery 1.7 ATA, and active recovery with very mild to mild intensity. ANOVA statistical test obtained with  $F = 4.203$  and  $P = 0.026$  because  $P < 0.05$ , significant difference in blood lactic acid levels of the three groups of the study. The difference can be seen in the results of LSD test: no significant difference between group 1 and group 2 is characterized by  $P = 0.263 > 0.05$ , no significant difference between group 1 and group 3 is characterized by  $P = 0.008 < 0.05$ , and no significant differences between group 2 and group 3 are marked with  $P = 0.94 > 0.05$ . In group 1 had an average decrease of 8.99 mmol/l. In group 2 had an average decrease of 7.95 mmol/l, and in group 3 had an average decrease of 6.37 mmol/l.



**Figure.** Blood lactate levels

## DISCUSSION

The results showed that the recovery hyperbaric oxygen pressure of 1.3 ATA with an average increase in lactate clearance of 8.99 mmol/l higher than the recovery with hyperbaric oxygen at 1.7 ATA 7.95 mmol/l, and the average the average increase in lactate clearance of 6.37 mmol/l in the group of active recovery. Research conducted Ishii, Yoshimasa, et al. (2005) that recovery with an atmospheric pressure of 1.3 ATA setup for a more significant recovery dispose of lactate compared with hyperbaric oxygen at a pressure of 1 ATA and 2.0 ATA. A similar study conducted Kim, Sungdo, et.al. (2011) that the recovery of low-pressure hyperbaric oxygen (1.3 ATA) was able to significantly reduce the average visual analog scale (VAS) score to see the condition of fatigue from 5.0 to 2.1 ( $P < 0.001$ ). Research conducted Sueblinvong T, Egtasaeng N, Sanguangrangsirikul S. (2004) showed that a significant decrease in blood lactate concentration at minute 15, 20, 25 after recovery with hyperbaric oxygen compared to the recovery of different groups.

Oxygen in the chamber was about 95% -100%. Someone who is in hyperbaric conditions, oxygen content in the plasma will increase from 0.3 to 6.6 ml/100 ml of blood with no change in oxygen transport by hemoglobin. Hyperbaric oxygen at 3.0 ATA pressure to increase the supply of oxygen to the tissues from 20.0 to 26.7 mL O<sub>2</sub>/100 ml blood (Scott Delaney, MD; DL Montgomery, 2001). Hyperbaric Oxygenation provide 100% oxygen uptake (760 mmHg; 14.7 pounds per square inch-psi, or 1ATA). At 2.4 ATA pressure (45m below sea level) and breathe 100% oxygen, there was an increase O<sub>2</sub> partial pressure (Pa O<sub>2</sub>) from 100 mmHg to  $\pm$  2000 mm Hg (Irvine D. Prather and Judy R. Wilson, 2004). This condition is believed that the role of hyperbaric oxygen to increase the oxygen supply to the musculoskeletal system in the area of active and mobile experience fatigue after

activity, increases the synthesis of adenosine triphosphate (ATP), and promote the metabolism of substances fatigue, making athletes recover faster after a workout or game.

Changes in the levels of lactic acid in the blood and muscle mass during recovery from a fatiguing exercise by oxidized through aerobic system is about 50% after 15 min, 75% after 30 minutes and about 95% after 60 minutes (Fox, EL, Bowers RW & Fross, ML 1993). Changes in lactic acid faster when recovery is done actively, by mild or moderate activity. For individuals who are not trained, if done with optimal intensity activity between 30% to 45% of VO<sub>2</sub> Max, and for well-trained athletes between 50 and 65% of VO<sub>2</sub> Max (Patellongi, I., 2000).

Furthermore Patellongi, I., (2000), states that lactic acid accumulates in the blood and muscles after a tiring work will be removed in several ways, among others: converted into liver glycogen, into glucose, a protein, oxidized through the system aerobic form ATP, CO<sub>2</sub>, and H<sub>2</sub>O. This shows that most of the lactic acid is oxidized through aerobic system (over 60%). Doing oxidation network include: skeletal muscle, cardiac muscle, liver, and kidneys.

The body of an athlete experiencing tremendous stress every day. To address the risk of injury and physical exhaustion resulting from the cycle of daily exercise many athletes are turning to alternative treatments to ensure peak performance and to protect their most valuable investment. Athlete's performance is highly dependent on the physical condition of an athlete. Recovery with hyperbaric oxygen treatment recovery is one of the most interesting and effective to use for athletes today. Hyperbaric Oxygen works by triggering the body condition of athletes up to the cellular level, with the most important thing of all elements of life, namely oxygen (Staples, J. & Clement, D. 1996). Use of hyperbaric oxygen chamber for recovery will allow athletes to recover faster and improve his health in general so that athletes have a greater physical performance (Brown, D, 2012). Research conducted on football players in Scotland, the recovery time needed for injured joints, muscles, ligaments, and tendons is reduced to 70% after the player uses hyperbaric oxygen therapy.

Hyperbaric Oxygen with light pressure (mild HBO) is a form of therapy that is safe to increase the uptake of oxygen to the body by increasing the air pressure. Hyperbaric oxygen chamber with light pressure allows a person in the HBO chamber pressure greater than atmospheric pressure is 1 ATA normal environment. HBO mild pressure ranged from 1.3 to 1.5 ATA (a situation similar to swim to a depth of 11 to 15 meters), while the high-pressure HBO > 1.5 ATA. On HBO with low pressure air combined with 89-93% pure oxygen is passed through an oxygen mask and simple, this condition allows the dissolved oxygen in the body fluids running into areas of the body that are difficult to reach larger than Hyperbaric oxygen conditions with more pressure large. Oxygen dissolved in the fluid-saturated, lymph fluid (joint) synovial and cerebrospinal fluid that surround the brain and spinal cord. Hyperbaric oxygen by light pressure is a form of oxygen therapy is beneficial to increase oxygen levels in the blood plasma. Oxygen in plasma increased with a higher number so that oxygen is delivered directly to the body's tissues, organs, and the brain (Fellows, 2011).

Empirically known that given 100% oxygen at a pressure greater than 3 ATA will induce oxygen that are toxic, while the administration of pure oxygen at a pressure greater than 1.75 ATA proven to cause incidents of toxic oxygen delivery pressure higher than 1, 5 ATA. Thus, in our study using compressed air at a very low pressure of 1.3 ATA aims to eliminate the need to provide additional oxygen and minimize oxygen toxicity and side effects of hyperbaric oxygen alarming (Kim, Sungdo, et. All. 2011).

The use of hyperbaric oxygen for tennis players capable of removing ammonia from the blood, leading to faster recovery from fatigue, and prepares players for the next game. In this study, conditions for granting the use of hyperbaric oxygen exerts less pressure than the condition to medical therapy. Also, the atmospheric pressure does not need to exceed 1.5 ATA and oxygen exposure time in the hyperbaric oxygen chamber no more than 30 minutes (Ishii, Yoshimasa, et al., 2005).

Recovery with hyperbaric oxygen is one method of recovery of the most interesting and most effective when used for athletes today. Hyperbaric Oxygen works by spurring the body condition of athletes up to the cellular level, with the most important thing of all elements of life, namely oxygen (Staples, J. & Clement, D. 1996). Hyperbaric oxygen increases the ability of red blood cells and plasma of blood to carry oxygen to the tissues in the body level, hyperbaric oxygen also helps the healing process and restore the body in a very good and fast. After some practice time, with hyperbaric oxygen the muscles can be repaired and the brain will function better with the conditions sufficient oxygen. Some athletes also use the hyperbaric chamber as an alternative to the process of recovery from injury and recovery after training or competition (Kahului, 2011).

During recovery with hyperbaric oxygen, athletes are in a very comfortable room, with a greater oxygen pressure when compared to conditions outside the hyperbaric oxygen chamber. With pressure conditions greater oxygen will allow increased oxygen to the layers that are in tissues and organs. With the rise of bariatric pressure in the chamber allows red blood cells and plasma of blood to carry oxygen deep into the tissue and muscle fibers, so that this condition will allow increased functionality and performance naturally. The use of hyperbaric oxygen for recovery is based on the theory that mitochondria is often referred to as the cellular "power" for changing dysfunctional mitochondria protein, carbohydrates, and fats that we eat into energy needed by the body's cells. There are some things that are needed by the mitochondria that mitochondria to work properly. The most important is oxygen. When oxygen levels are low, the mitochondria will produce lactic acid, a chemical compound which is identical with fatigue and muscle pain (Staples, J. & Clement, D. 1996).

Oxygen is an important part of our lives and are used to all the body's vital functions. For example, the brain, which is only two percent of the total weight of us use more than twenty percent of the body's oxygen. Only ten percent of our energy comes from the food we eat, while ninety percent of the rest comes from oxygen. The bacteria, toxins, viruses and parasites can not survive in an oxygen rich environment. If the intake of oxygen by the body is insufficient, the body will experience

imbalance. In today's conditions, the most important factor leading to reduced oxygen intake is pollution and stress.

Oxygen is essential for athletes because oxygen facilitates the production of glycogen, which is one of the main sources of muscular energy. In a process called glycolysis, glucose (sugar) molecule is split into two molecules of pyruvic acid. A pyruvic acid molecule enters the muscle cell, where it combines with oxygen to produce adenosine triphosphate (ATP), the source of muscle energy. When not enough oxygen to produce ATP, the pyruvic acid converted to lactic acid. This lactic acid naturally diffuses into the bloodstream, where lactic acid washed. However, during intense exercise, lactic acid can not be changed quickly and accumulate in muscle cells, a condition that causes fatigue.

## CONCLUSION

There are differences in the effect of recovery with hyperbaric oxygen at pressure 1.3 ATA, recovery with hyperbaric oxygen at pressure 1.7 ATA, and active recovery to increased lactate clearance. Increased lactate clearance was highest in group 1 (recovery with hyperbaric oxygen at pressure 1.3 ATA) can increase blood lactate clearance by 63.08% or 8.99 mmol / l followed by group 2 (recovery with hyperbaric oxygen at pressure 1.7 ATA) of 51.22% or 7.95 mmol / l, and group 3 (active recovery) of 45.53% or 6.33 mmol / l. 30 minutes is not enough time to recovery when resting lactate levels.

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