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Investigation of Blood Hormone and Respiratory Parameters in Active and Passive Tolerance Period after Anaerobic Test in Football Players

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Abstract

The aim of the study was to determine the changes in blood hormone and respiratory parameters in recovery phases. 28 voluntary men participated in the study, with an average age of 19.75±1.61 years and playing active football during the league season. Wingate Anaerobic Power Test and Respiratory Function Test (RFT) were applied to the subjects who were randomly divided into two groups, active and passive group. Blood samples were collected from and RFT was applied to all subjects before and after the test. Cortisol hormone, Partial Oxygen Pressure (PO2), Partial Carbon Dioxide Pressure (PCO2), lactic acid (LA) values were obtanied with datas taken from blood samples. The forced vital capacity (FVC), forced expiratory volume (FEV1), and rate of 1. Second of forced expiratory volume to the forced vital capacity (FEV1 / FVC) were measured by the PFT test. SPSS 24.0 program was used for statistical evaluation of the data. As a result; both 5-minute active and passive recovery methods did not reduce the cortisol ratio, but continued to increase in minute increments. In terms of PO_2, passive recovery was found to be a more effective method than active recovery. 5 minutes of active and passive recovery did not reduce LA level and did not affect each other significantly. FVC and FEV_1 values were found to be higher in the active recovery group than in the passive recovery group at the onset of AT recovery. Active recovery was found to have positive effects on vital capacity FVC and FEV_1.

Keywords: wingate anaerobic power test, respiratory function test, active and passive recovery, cortisol hormone, lactic acid

1. Introduction

Nowadays aerobic capacity for healthy life and anaerobic capacity for performance sports becomes a necessity. Often there is a need for anaerobic performance in counterattack and suppressed defenses of team competitions like football, in the last minute sprints of athletics, and more sports (Çakmakçı, 2013). The energy changes, the fundamental condition of muscle contraction to bring about anaerobic performance, and the compounds that emerge as ready energy as a result of reduction of energy change are very important for muscles and for exercise (Sevim, 2010). Nowadays, the intensity of exercise and how much energy will be consumed can be predicted to a great extent and the performance appraisal is based on how long energy resources and connected systems can be renewed. The first energy source of the exercise is Adenosine Triphosphate (ATP). After that, the other three energy systems take over the task, respectively, according to the intensity and duration of the activity (Günay, Cicioğlu & Kara, 2006). One of these systems is the lactic acid system or anaerobic glycolysis. "The anaerobic glycolysis term is used for types of exercise self-produced necessary energy for cell without oxygen (O_2)" (Karakuşoğlu, 2008). Glucose and glycogen in the anaerobic glycolysis environment dissociate to LA without the need for O_2. So that averaging 4 millimol/liter (mmol/lt) of ATP synthesis is provided and two of them are used as movement energy (Noyan, 1996). It is observed LA conversion as there is no O2 in the environment while glycogen divided by decomposition. When intertitial fluid and LA reaching the blood starts to accumulate and reaches high density (Bompa, 2011), it lowers the acid base balance (pH) of the body and makes muscle contraction difficult, resulting in fatigue and even termination of exercise (Çakmakçı et al., 2010). Cortisol hormone is also effective in exercise. The organism perceives exercise as a stress factor and increases some hormone levels such as glucagon in blood, cortisol and growth hormone (Pınar, 2015). Depending on the severity of exercise, cortisol blocks protein synthesis and increases protein catabolism in order to provide an energy source at the stage when energy is beginning to become insufficient. It also makes the concentration of amino acids with fatty acids of lipids in liver

tissues and provides energy to the muscles by enabling the gluconeogenesis to occur (Hazar et al., 2011). Respiration parameters also work intensively during exercise and recovery. The levels of respiratory parameters can be measured by tests with linear (test that the metabolism increases from stable to the end of the current level) increasing resistance versus constant resistance with aerobic and anaerobic activity (Temo çin et al., 2004). The air taken in breathing is inspiration, the air expelled is expiration. The amount of air blown out at maximum level of expiration in the continuation of maximum inspiration is a demanding vital capacity and an important parameter (Atabek, 2015). The most important functions of respiration are; gas exchange; the removal of O_2 and the introduction of carbon dioxide (CO_2), the body heat level and water, the loss of heat. O_2 requirement changes is dependent on the intensity and duration of muscle contraction in the unit. The O_2 diffusion capacity significantly affects the O_2 capacity in the exercise while demonstrating the rate of O_2 passing from the alveoli to the blood (Çakmakçı, Fişekçioğlu, Çınar, Akkuş & Kılıç, 2005). The amount of O_2 and CO_2 gases entering and exiting the tissues in the molten state is determined by the partial pressure of the gas and the degree of dissolution (Ackerman, 2006). Normally, while the hemoglobin (Hb) O_2 saturation is 98% in PO_2 of 100 millimeters (mmHg) (Gelir et al., 2013). The O_2 saturation of the venous blood is about 70-75% (Koçoğlu, 2006). In a high-intensity exercise, O_2 consumption and CO_2 emissions may increase 20 times. Cells start to use more O_2 for metabolism, in which case the amount of interstitial fluid PO_2 decreases, PCO_2 increase (Kaya, 1994), LA level in the blood increases by consisting metabolic acidosis, and decreases pH. When the intensity of the exercise drops or the recovery starts, as the blood flow increases, after a while the O_2 reaching the tissues increases and the PO_2 increases (Çakmakçı et al., 2010). At the level of bicarbonate (HCO_3) transported in the plasma, an increase is observed in the time of 5 to 30 minutes in the zone where fatigue occurs, but LA responds to the real level within 1-2 hours of time. PH balance is stabilized when the bicarbonate reaches the values required for the buffering task (Kaya,1994). Immediately after the activity, the energy expenditure of the metabolism continues in a linear manner, the activities in the organism continues for a while and does not immediately fall to the resting level, and the use of O_2 continues during the rest period. It is aimed to recover muscles to resting level before exercise by recovering after exercise. The sportsman can recover quickly after exercise based on the reimbursement of the O_2 borrow in the exercise, the renewal of energy source repositories, the removal of LA from blood and muscle, and the renewal of the O_2 myoglobin stores (Günay , Cicioğlu & Kara, 2006). Athletes who can be recovered quickly and in a shorter time may perform at a higher level against their competitors (Demiriz, Erdemir & Kayhan, 2015).

The aim of this study was to investigate the changes of cortisol hormone, blood gases, LA and respiratory capacity parameters and their affects upon each other after the anaerobic test on phsical education students' active playing football during 5 minutes of active and passive recovery phases.

2. Methods

The study that is approved by Inonu University Clinical Research Ethics with protocol of 2016/170, was made in Sivas Cumhuriyet University Physiotherapy and Cardiopulmonary Rehabilitation Unit. The study was conducted on 28 voluntary male football players who were actively playing football, 19.75±1.61 years of age, physical education and sport student. The subjects were informed by an informed consent form and required permission was obtained from the relevant university. Blood samples were collected from all subjects before the test (BT), after the test (AT), at the third minute of the recovery period (3MRP) and at the fifth minute of the recovery period (5MRP). The Respiratory Function Test was applied to all subjects before, after, and at the fifth minute of recovery.Weight measurements of subjects Felix Magro on 100 gr. precision scale, and height measurements were measured on 1 mm precision F. BOSCH Medizintechnik brand metal height gauge fixed to the wall. Resting heart rate of subjects was measured by telemetric heart rate monitor (Polar 610i, Finland) and 40% was calculated.

2.1 Wingate Anaerobik Power Test (WanT)

WanT test a modified Monark 824 E model (made in Sweden) with a modified bifold for WanT was made on the foot bicycle ergometer. For the test, a load of 75 g/kg was calculated for each kg of body weight of all subjects. Pre-WanT subjects were rested for 5 minutes on the cycling ergometer by warming them with small sprints, then resting for 2 minutes without resistance or sitting on an ergometer just to stabilize fatigue, muscle heat and blood flow during warming. They wanted to reach the highest pedal cycle in the shortest time period without resistance in the acceleration phase. The test was started at a range of 2 to 5 seconds when the weight of the ergometer was estimated to be 75 g / kg body weight. The subjects pedaled in the supramaximal pedal cycle in resistance time of 30 seconds. Subjects were orally supported during the test.

2.2 Respiratory Function Test (SFT)

Care Fusion Run-7402 brand Ergo spirometer was used to measure respiratory functions. Spirometer measurements were taken as the best values as the result of triple breathing of the subjects after compression of their nose with clamps and maximum breathing. Volume (L) was used as the unit of measure.

2.3 Active and Passive Recovery

Active recovery group after WanT was actively recovered at 40 ± 10% heart rate interval followed by Covidien's Nellcor SpO2 monitor system connection from the Proitness 3000-3AC treadmill. The passive recovery group recovered passively only by sitting.

2.4 Blood and Hormone Measurement

The study was conducted early in the day and the subjects were hungry for better measuring of hormone levels and better outcome. Venous blood samples were collected from all subjects four times in total including CT, AT, RP3M and RP5M. The blood taken for cortisol hormone level was centrifuged at 3500 rev and plasma and sera were separated. Hitachi Cobas 6000 device for cortisol hormone, ABL 800 devices for blood gases and LA level were used. Increased blood was taken to the hospital cold tube store at – 80 C ºin ependorf tubes. It was used in units of micrograms/deciliter (mcg/dl) for cortisol hormone, millimeter (mmHg) for PO2 and PCO2, and milimol/liter (mmol/l) for lactic acid.

3. Results

The data were given in median (min-max). The normal distribution relevance of the data was examined by the Shapiro Wilk test. Mann-Whitney U test was used to examine differences between groups. Significance level was determined as $p < 0.05$ and theanalyzes were done in IBM SPSS statistic 24.0 program.

Table 1. Descriptive statistics of age, height, weight, BMI variables

Variables	Groups Active (*n*=14) Avarage ± SD	Median (Min-Maks)	Passive (*n*=14) Avarage ± SS	Median (Min- Maks)
Age	19.43 ±1.16	19.00 (17.00-21.00)	20.07 ±2.06	20.50 (17.00-24.00)
Height	176.71 ±5.59	175.50 (169. 00-190. 00)	180.64 ±7.71	180.00 (166. 00-194. 00)
Weight	72.96 ±7.76	73.50 (56.70-83.30)	73.52 ±9.13	74.10 (55.60-90.80)
BMI	23.35 ±2.41	23.35 (19.90-28.20)	22.51 ±2.21	22.30 (19.20-28.70)

SS: Standard deviation

The mean age of the participating active group was 19.43 ± 1.16, the passive group was 20.07 ± 2.06, the mean height of the participating active group was 176.71 ± 5.59, the passive group was 180.64 ± 7.71, the mean weight of the participating active group was 72.96 ± 7.76, the passive group was 73.52 ± 9.13, the mean Body Mass Index of the participating active group was 23.35 ± 2.41, and the passive group was 22.51 ± 2.21.

Table 2. Comparison of CT, AT, RP3M and RP5M cortisol hormone levels of active and passive recovery groups.

Variables	Active (n=14)	Passive (n=14)	p
BT_kor (Median ±SD)	10.91 ±4.22	12.44 ±4.26	0.35
AT_kor (Median ±SD)	11.43 ±5.12	11.62 ±4.16	0.916
RP3M_kor (Median ±SD)	11.02 ±5.17	10.83 ±4.01	0.913
RP5M_kor (Median ±SD)	11.30 ±5.06	11.04 ±4.10	0.882

In Table 2, There was no statistically significant difference between active and passive groups in terms of cortisol measurements at different times ($p < 0.05$).

Table 3. Comparison of active and passive recovery BT, AT, RP3M and RP5m pO_2 levels

Variables	Active (n=14)	Passive (n=14)	p
BT_pO_2 (Median (Min-maks))	36.55 (28.8-67.1)	40.7 (29.2-58.6)	0.52
AT_pO_2 (Median (Min-maks))	33.9 (26.2-83.3)	37.9 (27.2-90.3)	0.613
RP3M_pO_2 (Median (Min-maks))	44.85 (28.7-95.2)	62 (34.7-124)	**0.031**
RP5M_pO_2 (Avarage ±SD)	52.29 ±15.36	73.38 ±23.47	**0.009**

In the Table 3, there was a statistically significant difference between the active and passive groups in terms of pO_2 measurements performed in the third and fifth minutes, while there was no statistically significant difference between active and passive groups in terms of pO_2 measurements at other times ($p<0.05$).

Table 4. Comparison of BT, AT, RP3M and RP5M pCO_2 levels of active and passive recovery groups

Variables	Active (n=14)	Passive (n=14)	p
BT_PCO_2 (Median ±SD)	45.89 ±5.36	45.66 ±5.96	0.916
AT_PCO_2 (Median ±SD)	53.76 ±10.54	51.69 ±8.57	0.573
RP3M_PCO_2 (Median ±SD)	45.37 ±8.01	40.56 ±7.53	0.114
RP5M_PCO_2 (Avarage (Min-maks))	40.7 (32.8-53.9)	35.35 (31.3-51.4)	**0.041**

In the Table 4, there was a statistically significant difference between the active and passive groups in terms of PCO2

measurement at the 5th minute, while there was no statistically significant difference between active and passive groups in terms of PCO2 measurements at other times ($p<0.05$).

Table 5. Comparisons of TÖ, TS, TP3D and TP5D LA levels of active and passive recovery groups

Variables	Active (n=14)	Passive (n=14)	p
BT_lac (Avarage±SD)	1.31±0.34	1.84±0.42	**0.001**
AT_lac (Avarage ±SD)	8.17±1.87	8.85±2.86	0.462
RP3M_lac (Avarage±SD)	10.11±3.14	10.55±3.25	0.719
RP5M_lac (Avarage ±SD)	9.11±2.87	10.50±3.61	0.268

In the table 5,there was a statistically significant difference between the active and passive groups in terms of lactic acid measurement before the test, while there was no statistically significant difference between active and passive groups in terms of lactic acid measurements at other times ($p<0.05$).

Table 6. Comparison of BT, AT, and RP5m FEV1 levels of active and passive recovery groups

Variables	Active (n=14)	Passive (n=14)	p
BT_FEV1 (Avarage±SD)	106.64±26.62	95.71±17.73	0.212
AT_FEV1 (Avarage ±SD)	118.21±18.64	98.57±18.94	**0.01**
RP5M_FEV1 (Avarage ±SD)	114.93±20.98	102.57±16.57	0.095

In Table 6, there was a statistically significant difference between the active and passive groups in terms of FEV1 after the test, while there was no statistically significant difference between the active and passive groups in terms of FEV1 measurements at other times ($p<0.05$).

Table 7. Comparison of BT, AT, and RP5M FVC levels of active and passive recovery groups

Variables	Active (n=14)	Passive (n=14)	p
BT FVC (Avarage±SD)	116.36±14.34	102.07±11.61	**0.008**
AT FVC (Ortanca (Min-maks))	105 (94-141)	100 (81-127)	**0.043**
RP5M FVC (Ortanca (Min-maks))	108 (96-145)	102.50 (82-123)	0.0888

In Table 7, there was no statistically significant difference between the active and passive groups in terms of FVC measurement at 5 minutes, while there was a statistically significant difference between active and passive groups in terms of FVC measurements at other times ($p <0.05$).

Table 8. Comprasion of Active and passive recovery BT, AT, and RP5M FEV1 / FVC levels

Variables	Active (n=14)	Passive (n=14)	p
BT FEV1/FVC (Median (Min-maks))	81.34 (59.26-90.51)	80.32 (53.16-90.54)	0.854
AT FEV1/FVC (Avarage±SD)	88.423±6.81	80.99±12.41	0.063
RP5M FEV1/FVC (Avarage±SD)	83.53±7.70	82.63±10.27	0.796

In Table 7, here is no statistically significant difference between the active and passive groups in terms of FEV1 / FVC measurements performed at different times ($p <0.05$).

4. Discussion

There was no significant difference between the two groups in the levels of cortisol hormone levels of TCE, TS, TP3D and TP5D in the study of active and passive recovery after WanT test ($p<0.005$). The level of cortisol hormone before anaerobic test was higher in both groups due to strase. RP3M and RP5M did not show a significant decrease in both active and passive groups. As a matter of fact, Albayrak et al. (2013) reported that there was no significant change in cortisol hormone levels before and after submaximal training in their study of 10 footballers with a mean age of 17. Wahl et al. (2013) reported that active and passive recovery methods affect LA and PH, but to date, there have been few studies examining the effects of acute hormonal response on parameters in active and passive recovery and the study did not find a significant difference in active and passive recovery cortisol rate in the study. When there is a certain target, they have associated exacerbated metabolic stress with acute hormonal responses that are in a healing mode Özmerdivenli & Karacabey (2000) have applied aerobic and anaerobic exercises by separating the students of 60 (30 male, 30 female) Physical education department into 3 separate groups and they reported that cortisol levels decreased after 4 hours from exercise, affected by many factors related to the stress and varied depending on exercise type. Ersöz et al. (1996) applied passive recovery 9 athletic athletes with a mean age of 23after submaximal exercise for 45 minutes at 60 - 70% VO2max workload. They have arrived that 45 minutes of activity at the 60-70% intensity of the plasma cortisol reaction did not change at the time of activity (45 minutes), reached peak at 30 minutes of post-activity recovery, maintained peak value even at 60 minutes, and decreased to resting level after 120 minutes. Hoffman & Pedersen (1994) reported that plasma cortisol ratios started to increase at set time-span intensive activities and that maximal

concentrations would reach 20 minutes after exercise and that the cortisol ratio in both aerobic and anaerobic activities would be high 90 minutes. In our study, there was no significant change between AT cortisol level and RP3M and RP5M cortisol levelsWhen the literature review, ıt has been reported that there is a linear increase in cortisol hormone level after aerobic exercise over a certain percentage. In our study, the lack of a decrease in TP5D cortisol level during the subsequent active and passive recovery processes of anaerobic exercise indicates that there is no short-term effect of active and passive recovery and shows that the increase in cortisol concentration may continue in the following minutes of recovery. In our study, venous blood values were examined and PO_2 value recovery after WanT was higher than RP3M and RP5M passive recovery group ($p<0.005$). We found that the PO_2 effect is better in the active recovery group than in the passive recovery group. As a matter of fact, PCO_2 value was found lower in TP5D passive recovery. No significant difference was found at other times ($p<0.005$). We think that the reason for this is that after the test the active recovery group continues to exhaust and the passive recovery group is the rest. It is known that a high-intensity activity forms hypoxia in arterial blood. In the result of passive recovery reduces the heart rate to the relaxation rate at rest, arterial blood will receive more O2. For this reason, PO2 was found to be higher in passive recovery. Koyama et al. (2000) in the study of 21 volunteers with coronary disease applied active and passive recovery after cyclical ergometry with a symptom-free incremental maximal exercise test. According to active recovery, passive recovery has beneficial effects on the respiratory system. Wahl et al. (2013) have applied WanT to 12 triatlet cyclists as our work. When they compared the PO2 values in active and passive recovery, they found that PO2 was significantly higher in the passive recovery direction as the result we obtained. Fashi et al. (2014) applied a high intensity endurance test (RHIET), which lasted for 2 minutes 30 seconds and last 30 seconds with maximum power, to 10 physical education department students. As a result of active stretching and passive recovery after exercise, they compared arterial blood samples rather than venous blood, which is the limit of our study. Passive recovery strongly suggests that the O2 arterial pressure is greater than the active and tension healing and this strongly supports the outcome of our work. They also assumed that the energy required for short-term active recovery would result in less oxygen because of to release LA concentrations, to resynthesize phosphocreatine and to refill myoglobin and haemoglobin. Thomas et al. (2014) have given drinks with carbohydrate, bicarbonate and placebo to 12 athletes during rest, and then applied three different of active and passive recovery after three different sprint tests. As a result, they compared the blood samples of passive recovery with other recovery methods and found no significant difference in terms of PO_2. Dupontg & Berthoin, 2004) have compared the effects of post-training recovery types on the 12 male subjects. As a result, they reported that PO_2 was significant for passive recovery when compared to active recovery, when tired during repeated high intensity exercise. In our study and supporting studies in the literature, passive recovery after an anaerobic exercise was found to be a more effective method in terms of PO_2. There was no significant difference between BT, AT, RP3M, RP5M blood LA in levels of active recovery and passive recovery groups after WanT ($p<0.05$). It has increased considerably during and after exercise compared to the level of rest. This increase in RP3M did not even reach the level of rest at RP5M. Although many studies have been reported that active recovery is more effective, many studies have reported no significant difference. Although there was a difference between active recovery and passive recovery in this study, no significant difference was found. While (Bosak , Bishop , Smith , Green , Richardson & Iosia, 2006) in their study for 12 athletic athletes did not find a meaningful difference in between the two methods of recovery in terms of LA, They found that there was a difference between the recovery times in some sportsmen. Therefore, they stated that the recovery should be applied according to the person. (Harbili et al. (2007) in a study for 22 male athletes have applied active recovery to half of them, passive recovery to the other half after WanT. Although 10 minutes of active recovery was at blood LA level and 10 minutes of passive recovery was lower than blood LA level, no significant difference was found. Again Gürses et al. (2016) in their study for 5 male and 5 female athletes from National Swimming Team in 3 different days have applied 3 different recovery methods after anaerobic test and they did not find statistically significant difference between groups in terms of LA. Sarı et al. (2016) have applied practiced active relaxation by walking and relaxation with massage methods to 15 male athletes after swimming training they had done on different days. There was no statistically significant difference in terms of LA. Hazır & Gül (2015) have applied to the 11 active athletes for every other day and 3 times after the WanT 20 minutes sitting passive recovery, core exercise combined with passive recovery and active recovery in the cycling ergometry. They did not find any statistically significant difference in the LA exluding rate. Bonen and Belcastro have used a range of recovery strengths ranging from 30% to 80% VO2max in one study and found that as the intensity increased, the amount of lost LA decreased. Active recovery; Heart, liver and kidneys can be work easier in the muscles accumulated lactic acid (Alemdaroğlu & Koz, 2011). However, studies that argue that the method of active recovery is effective in recovering is a matter of debate about the duration of active recovery; In these studies, it has been reported that active listening, which takes 3-5 minutes positively affects performance, but this result is independent from LA. While the impact of active recovery on reducing LA acid levels has been confirmed in many studies, there are also contradictions concernd with performance outcomes (Arslan et al., 2006). In our study, the same result could not be obtained with the literature because of the measurement with venous

blood. However, the presence of a number of studies supporting the outcome of our study suggests that active and passive recovery methods are not clearly demonstrated to be more effective. When observations in the respiratory phase are evaluated, two or more parameters of lung volume capacities should be evaluated together (Çakmakçı et al., 2005). In our study, the respiratory parameters that we found to be meaningful were forced vital capacity (FVC) while the other was the maximal respiratory gas volume (FEV_1) (Atan et al., 2013). In literature, studies in this area are usually limited to pre-exercise and immediate after measures. There is no so many studies to investigate the reactions of FVC and FEV1 in post-exercise recovery phases, so the examination of FVC and FEV1 values in our study recovery phase is originally based on primary studies in this area. FVC/FEV_1 measurements ın the respiration function test performed before WanT, WanT and RP5M showed no statistically significant difference in terms of active and passive recovery, while FVC was found to be lower in the passive recovery group than in the active recovery group. RP5M values returned to values at rest level. We think that active recovery affects vital capacity positively. FEV_1 value was found to be lower in passive recovery group than active recovery group. Active recovery group has positive effects on FEV_1. Both FVC and FEV1 measurements achieved positive results in terms of active recovery. Passive recovery stops suddenly muscular mobility after a high intensity exercise and leads to impaired rhythmic breathing during intense exercise. It is thought that this condition has a negative effect on the respiratory volume and therefore results in lower respiratory return than active recovery.

There was no reduction in cortisol hormone levels in the 5-min active and passive recovery after WanT, an anaerobic exercise test. It is seen that there is no effect of active and passive recovery in a short time and it supports the result that the increases next minutes of recovery after the exercise in the literature, and thus it is thought that cortisol can play an active role in the renewal of energy resources by maintaining the role of gluconeogenesis in recovery. The PO_2 effect was found to be better in the passive recovery group than in the active recovery group. In the literature, it has been found that passive recovery is a more effective method in terms of PO_2. After anaerobic exercise, ATP-PC deposits can be renewed by 5 minutes recovery. However, it was found that the 5-minute recovery period was not sufficient for LA to return to the resting level. It has been found that neither the active nor the passive recovery has a different effect from each other during the 5-minute recovery period. Many studies similar to the results we have found in the literature, as well as their different conclusions, show that it is not clear which is a more effective method. We think that the cause of this is due to the different application of the factors such as the structure of the test applied, the type of blood intake, the severity applied in recovery, and the duration of recovery. Before the WanT test, when started AT recovery FVC and FEV1 values in respiratory function test, which we applied AT and RP5M, were found to be lower in passive recovery group than in active recovery group. It has been understood that active recovery group has positive effects on FEV_1. It is thought that active recovery affects vital capacity positively. It has been seen that RP5M breathing values return to their resting values, and the exercise-induced O_2 deficit will be closed in less than 5 minutes. In the future, studies to investigate pulmonary function values in the recovery phases after anaerobic test and to investigate whether or not they are effective in regenerating energy sources in cortisol recovery with gluconeogenesis will contribute to the results of our study and will clarify the unknowns in this area.

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