European Journal of Therapeutics
DOI: 10.5152/EurJTher.2018.463
Original Research

Investigating the Most Commonly Applied Lactate Recovery Method According to the Positions in Football

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ABSTRACT
Objective: This study aimed to investigate the most suitable recovery method that can be applied for eliminating blood lactate accumulated in the blood of football players after training or a match. Furthermore, the effectiveness of the soccer player's role in these recovery methods was determined.
Methods: Herein, 36 professional or professional candidate football players, which included 12 defenses, 12 midfielders, and 12 attackers, were included. Athletes were asked to warm up before the field workout started and then they were subjected to a maximal field test on an 800-m course. The blood samples taken from the athletes after the field test were evaluated for blood lactate. Then, each athlete was rested with either active, passive, or massage recovery methods, and the blood analyses were repeated and recorded. Each athlete was evaluated and recorded for 48 h after the same field test by other recovery method.
Results: According to the obtained statistics, it was found that the most appropriate method for lactate recovery after maximal exercise was active recovery ($p<0.05$). Massage recovery was found to be more effective than passive recovery but significantly less effective than active recovery ($p<0.05$). We determined that the football player positions do not affect the effectiveness of the recovery methods used ($p>0.05$).
Conclusion: The most effective recovery method was determined as active recovery, and the effect was proven even in a 15-min application.
Keywords: Football, lactate recovery, massage, lactic acid

INTRODUCTION

Today, sports is defined in a more extensive manner as "the activities that improve a person's state of health and that maintain the improved health status". Being engaged in sports has become necessary in order to be healthy and maintain this state of health (1). Football is probably the most popular sports branch and the most widespread one with the most crowded audience group and more than 200 million certified players throughout the world. Like in all sports branches, being successful in football is also based on increasing performance and maintaining this performance level for a long time. Today's football, although it seems like a sports activity, has become an industry due to the developing economic conditions and gains. Football players, technical directors and clubs have been making great efforts to reach required performance levels, minimize fatigue after matches and training, avoid injuries and achieve maximum performance within the shortest time possible in order to obtain the highest efficiency from this industry.

In sports branches that require maintaining long-term performance, fatigue is one of the reasons for not being able to achieve the required level of performance. Fatigue was previously considered to be important only in individual sports. However, conducted studies revealed the importance of fatigue also for team sports. This is because the required force is not individual but joint (2).

According to the literature review, studies on lactate recovery include recovery analysis after any sort of maximal effort exerted by randomly selected athletes rather than focusing on any specific sports branch. Although there are some studies specifically focusing on football, there were not any studies investigating the effectiveness of a recovery method from the positional aspect (3, 4). Recovery applications in these studies have varying durations but they generally include time periods of 20 minutes or longer (5). In football, although lactate recovery after a match or training is important, lactate recovery during the 15-minute half-time in matches is also highly important (3, 4, 6).

Akgül et al. (3) conducted a study to investigate the effectiveness of hydrotherapy in lactate recovery in football players. In this study, football players were subjected to a shuttle run test and then blood lactate levels were tested after the players were rested actively in the sports hall, actively in the pool and passively in the pool. This study has shown that active lactate recovery both in the hall and in the pool were significantly superior in comparison to passive recovery.

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Received: 09.01.2018 • **Accepted:** 19.02.2018

In a study conducted on football players by Baldari et al. (7), it was reported that aerobic active resting under the threshold was more effective in lactate recovery in comparison to active resting over the threshold after exercise, and it was emphasized that 3-5 minutes would not be sufficient and this time period should be longer, whereas in literature it is stated that this time period should be between 10 and 30 minutes (8).

A study conducted by Monedero et al. (9) on 18 cyclists has shown that the most effective method for eliminating lactic acid accumulating in the blood after 5 km bicycle riding was active exercise together with massage and that active recovery was more effective than massage and passive recovery.

Our main objective in this study is to investigate the effectiveness of active recovery, passive recovery and massage recovery methods in blood lactic acid recovery, which is highly important for the next exercise or match for football players, to compare this effectiveness according to the football player's position in the games, to determine whether the football player's position provides him an advantage in terms of lactate recovery, to identify which recovery method is more effective in which position, and to create recovery programs specific to the player's position according to obtained results and prepare him for the next effort in the best way possible. Our secondary objective is to determine the effectiveness of 15-minute recovery methods that can be practiced during half-time in order to reduce lactate accumulation in the player's blood and to investigate ways to enable the football player to start the second half of the match in his fittest form.

METHODS

The approval no. 2017/383 of the Clinical Trials Ethics Committee of Gaziantep University was obtained and 26 players between the ages of 16-20 including the professional players of the Gaziantepspor team in the A league and professional candidates in the A2 league. The players were divided into three groups; defense (n=12), midfield (n=12) and attack players (n=12). Informed consent forms were obtained from each player.

Method of the Study

A program consisting of an 800 meter run, at the maximum exercise intensity with the field exercise protocol, was applied on athletes that participated voluntarily in our study. The athletes ran the first 400 meters of the 800-meter course at a heart rate equivalent to 80% of the maximum heart rate (220- age) and the remaining 400 meters as fast as they could together with audible instructions (10). During the entire run, their heart rate was monitored using polar (Polar RS 400, POLAR, Oulu, Finland) watches in order to monitor complications and changes in heart rate. After the exercise, athletes were rested at the pitch-side for 3 minutes and then the lactate levels were measured from capillary blood samples obtained from the fingertip (Lactate Scout Analyzer, EKF Diagnostic, Lepzig, Germany). Then, any of the massage, active recovery or passive recovery methods was applied on each tested player followed by blood lactate level measurement once more. The same player was rested using another method after the same field protocol 48 hours later and blood analyses were repeated. This application was repeated for every player participating in the study.

The Lactate Recovery Methods Applied

Athletes that were subjected to the maximal running course with the field protocol were rested for 3 minutes at the pitch-side, followed by;

Active recovery; they were subjected to a 15-minute run with a heart rate equivalent to 40% of maximal oxygen uptake ($VO_{2\ max}$) and blood analyses were repeated and recorded after the run (11).

Passive recovery; Lower extremities were elevated to a level above the heart level and athletes were rested passively for 15 minutes on a massage bed and blood analyses were repeated and recorded after the rest.

Massage recovery; They were subjected to a classic massage application including the lower extremities for 15 minutes on a massage bed. Massage application was performed by the same person for 7.5 minutes on both lower extremities of the athlete including both the anterior and posterior muscle groups. Blood analyses were repeated and recorded after massage application.

Statistical Analysis

Normal distribution of the data obtained in this study was tested using the Shapiro Wilk test. Variation between methods was tested using repeated measures analysis of variance. Mean±standard deviation values were given for the numerical variables as the descriptive statistics. Statistical Package for the Social Sciences for Windows version 24.0 (IBM SPSS Corp.; Armonk, NY, USA) software package was used for statistical analyses, and $p<0.05$ was considered statistically significant. Sample size was determined by power analysis.

RESULTS

Age, body height and weight of the football players included in the study have similar mean values and exhibit no significant differences ($p>0.05$) (Table 1).

Blood lactate levels of football players who ran at maximal exercise intensity were measured and then passive, active and massage recovery methods were applied in order to evaluate blood lactate levels in millimole/liters (mmol/L) as mean plus minus standard deviation (±SD) (Table 2). Considering the daily lactate changes since measurements were performed in each player with 48-hour intervals, the maximal exercise

Table 1. Mean demographic characteristics of football players

	Age (years)±SD	Height (meters)±SD	Weight (kg)±SD
Position			
Defense	17.25±1.13	177.58±5.17	68.91±5.69
Midfield	17.16±0.93	172.25±3.33	65.58±4.81
Attack	17.58±1.31	177.25±6.18	70.66±6.90

SD: standard deviation

Table 2. The average blood lactate levels before (at the end of maximal exercise) and after recovery

	Passive Recovery (mmol/L)			Active Recovery (mmol/L)			Massage Recovery (mmol/L)		
Position	**Before**	**After**	**% Change**	**Before**	**After**	**% Change**	**Before**	**After**	**% Change**
Defense (n=12)	14.31	10.32	26.85	11.32	3.83	64.25	11.36	5.77	45.99
Midfield (n=12)	12.53	7.81	37.21	10.92	4.23	57.14	9.95	5.20	48.58
Attack (n=12)	12.05	8.29	31.34	11.65	5.66	50.29	10.79	6.55	37.98
Mean±SD (n=36)	31.80±16.89			57.23±17.20			44.18±15.19		

Before: Mean blood lactate measured from football players after applying maximal exercise protocol. After: Mean blood lactate measured from football players after applying recovery method. Change %: Decrease in blood lactate level in percentage from values measured before and after.

Figure 1. Recovery methods versus change % in blood lactate
*Significant difference in comparison to passive recovery (p<0.05)
**Significant difference in comparison to passive recovery and massage (p<0.05)

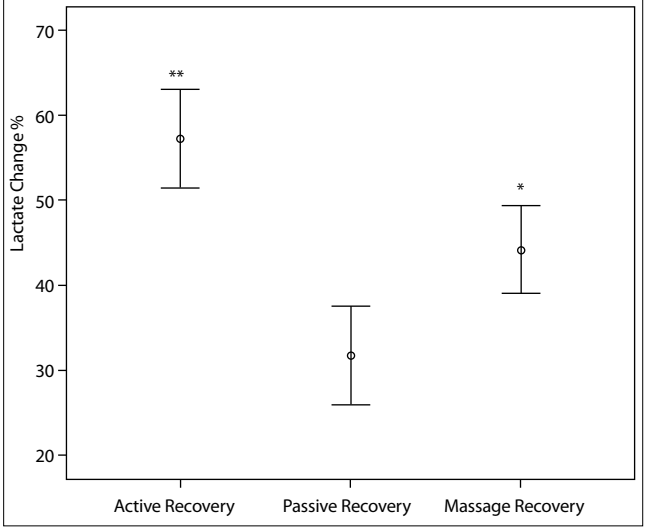
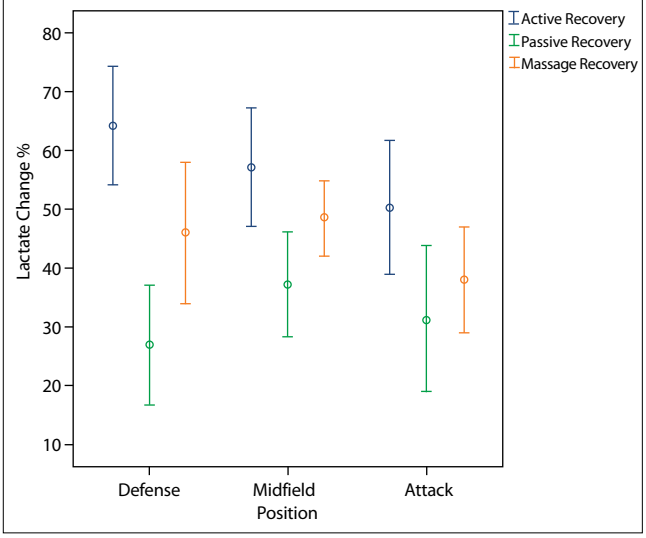


Figure 2. Comparison of the recovery methods by positions
*Significant difference in comparison to passive recovery (p<0.05)
**Significant difference in comparison to passive recovery and massage (p<0.05)



protocol was repeated before applying each recovery method and the decrease in blood lactate level in percentage (change %) was recorded after the application of the recovery method (Table 2).

Comparing the change percentage of blood lactate and the recovery method applied, it was found that active recovery decreases blood lactate at a higher rate as compared to passive recovery and massage (p<0.05) (Figure 1). Moreover, it was understood that massage was significantly more effective than passive recovery but less effective than active recovery (p<0.05) (Figure 1).

There was no significant difference in evaluating recovery methods by football player positions (p>0.05) (Figure 2).

DISCUSSION

As a result of this study, some of the most commonly used lactate recovery methods in football, i.e. active recovery, passive recovery and massage recovery, were compared and it was shown that the most effective recovery method in football players is active recovery. In addition, lactate variance between attack, defense and midfield players, who have different types of exercise activities during the game, was analyzed and which recovery method provided advantages for which positions was investigated. The main findings were that active recovery was the most effective method for all positions and massage was more effective than passive recovery.

Baldari et al. (7) found in their study that the active recovery performed under the anaerobic threshold was more effective in lactate elimination in comparison to the recovery performed above threshold. The study also provided evidence on how long active recovery should last and it was emphasized that recovery periods lasting 3-5 minutes would not be enough and recovery should last for a longer period of time. According to the literature review, active recovery methods should be applied for 10-30 minutes and at an intensity lower than the threshold value (8). In our study, active recovery period was determined as 15 minutes and the intensity of the recovery run was kept under the threshold value. The results of our study also support the importance of active recovery in eliminating lactic acid from the blood.

Another most commonly investigated method among lactic acid recovery methods is massage. One of the reasons for using massage in recovery studies is the opinions supporting that massage accelerates lactic acid elimination in athletes. Ph decreases with the formation of lactate leading to a slow down in glycolysis and therefore the release of energy-providing substances decreases, which limits muscle contraction. Lactic acid accumulating in muscles and in the blood leads to fatigue. In a study conducted on professional swimmers regarding the elimination of this fatigue-causing substance from the blood and muscles, it was reported that massage was more effective than passive recovery in blood lactate elimination but active recovery was significantly more effective than massage (12). In another study conducted on cyclists, it was reported that active recovery was significantly more effective in comparison to massage and passive recovery, however there was no difference between massage and passive recovery (13). In a study conducted by Robertson et al. (4) on athletes engaged in different sports branches, subjects exercised on a bicycle ergometer with 6 repeats of 30 seconds each and then they were passively rested in supine position for 20 minutes or subjected to massage for 20 minutes. It was reported that there was no significant difference between these applications in terms of lactate recovery. However, our study revealed that massage recovery was statistically more significant in all positions in comparison to passive recovery.

In the study of Menzies et al. (14) conducted on 10 male participants who were moderately trained, subjects ran for 5 minutes at 90% of VO_{2max} and then rested in passive recovery and under active recovery conditions at various levels of lactate threshold. As a result of this study, it was found that active recovery was significantly better than passive recovery in terms of lactate recovery, whereas this effect of active recovery was only possible when runs were performed at a level close to high lactate thresholds and that runs performed at 40% of the maximal lactate threshold even yielded results similar to passive resting. In parallel to this data, our study demonstrated that active recovery was significantly better than passive recovery, but unlike the aforementioned study, our results were obtained by keeping the intensity of recovery constant at a heart rate between 40-60% of $VO_{2\,max}$. It was thought that the possible differences between Menzies' study and our study could stem from the fact that the run had an intensity and duration that increase blood lactate nearly to 4 mmol/l and that the subjects were moderately trained amateur athletes. In contrast, maximal blood lactic acid level of the subjects in our study occasionally got even higher than 20 mmol/l after the field protocol.

In a study conducted by Harbili et al. (15) on 22 male athletes, the subjects were actively rested for 10 minutes on a bicycle ergometer with a load equivalent to 35% of VO_{2max} or passively rested for 10 minutes by sitting on a chair after Wingate test followed by blood lactic acid measurements from venous blood. According to the obtained results, it was reported that there was no significant difference between lactic acid levels of the athletes that had certain lactate accumulations with the Wingate test in terms of the two recovery methods, and yet active recovery was more effective (15). The reasons why the effect of active recovery could not be proven to be significant include short resting periods or athletes not reaching a sufficient level of fatigue due to a submaximal exercise. In our study, active recovery application was found to be significantly more effective than the other two methods in terms of lactic acid elimination. However, variation of this effect by positions could not be proven.

In a study conducted by Lane and Wenger (16), subjects exercised for 18 minutes and then they were subjected to methods such as active resting by cycling at an intensity equivalent to 30% of $VO_{2\,max}$ for 15 minutes, massage of the legs for 15 minutes, immersion of legs for 15 minutes in a 15 degrees C water bath or sitting for 15 minutes. Superiority of any of these methods over the others could not be statistically proven. However, it was reported that active recovery and recovery in water were more effective than massage. In our study, the effectiveness of active recovery was proven for all positions and it was found to be more effective than massage and passive recovery. It was seen that massage recovery was more effective in lactic acid elimination as compared to passive recovery.

A similar study conducted by Monedero et al. (9) on 18 professional cyclists investigated the effectiveness of active recovery, passive recovery, massage recovery and combined (active and massage) recovery methods in lactate elimination after a 5 km cycling exercise and consequently, it was reported that the most effective method for eliminating lactic acid in the blood was the combined recovery method and this was statistically more significant than the other applications. In the same study, they reported that active recovery was more effective than the rest of the methods in the 9th minute of a 20-minute recovery period. However, contrary to our study, they also reported that massage recovery did not have any superiority over passive recovery (9). This might possibly stem from the variability of massage application for each person or how much the person, who is getting the massage, likes or dislikes massage.

The study has some limitations. Limitations of the study include the sample size not being larger, not including groups on which the recovery methods evaluated in this study were applied in a combined manner (for example, a group that has massage and active recovery at the same time) and not including goalkeepers while investigating football player positions. Future studies might be planned accordingly.

CONCLUSION

Thirty-six football players were evaluated in this study, which was conducted in order to investigate the most effective method in eliminating lactic acid that accumulates in the blood after maximal exercise in professional or professional candidate football players and to assess whether positions provide an advantage for players in this respect. The results of our study are as follows:

In this study, there are differences between methods for eliminating lactate accumulating in a football player's blood after a maximal run.

The most effective recovery method was determined as the active recovery and its effect was proven even in a 15-minute ap-

plication. Therefore, it was thought that football players can get ready for the second half of the game in an active manner in the resting halls during half-time in football games.

Massage recovery was found to be significantly more effective than passive recovery; however, it was less effective than active recovery.

It was found that the effectiveness of lactic acid recovery methods did not exhibit any differences in terms of position.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Gaziantep University (Approval no. 2017/383).

Informed Consent: Written informed consent was obtained from patients who participated in this study.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept – D.S.K., M.B.; Design – D.S.K.; Supervision – D.S.K.; Resources – M.B.; Materials – M.B.; Data Collection and/or Processing – M.B.; Analysis and/or Interpretation – D.S.K.; Literature Search – M.B.; Writing Manuscript – D.S.K., M.B.; Critical Review – D.S.K., M.B.

Conflict of Interest: The authors have no conflicts of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

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How to cite:

Kaplan DS, Bozkurt M. Investigating the Most Commonly Applied Lactate Recovery Method According to the Positions in Football. Eur J Ther 2018; 24(4): 229–33.