Relationship Between Salivary Lactate Concentration with Blood Lactate and Heart Rate

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Abstract: We studied the relationship between salivary lactate concentration with blood lactate and heart rate of male soccer players during a soccer-exercise session. Twelve trained soccer male players with mean Age 18±0.7 years; Height 173.6±4.4 cm, Weight 67.8±4.6 kg, Body Fat%: 14.3±3.8; VO2max: 54±3 ml/kg/min enrolled in this study. Subjects undertake a kind of soccer small-sided game (3 v 3) inside the marked area (25×25 meters). Intensities of game were controlled by heart rate at six stages (rest, warm up, after five min playing with %60, %70, %80 and %90 of reserve heart rate). Each stage had five min rest and blood and saliva samples were collected in rest period. Data were analyzed by repeated measured and Spearman correlation at significance level 0.05. The results revealed the significant difference between six stages of protocol in blood and saliva lactate concentrations. In addition, there was significant correlation between saliva and blood lactate concentrations in stages five and six [r=0.79, p<0.05; r=0.56, p<0.05] of protocol respectively. There was correlation between heart rate and saliva lactate concentration [r=0.6, p<0.05; r=0.68, P<0.05] in stages five and six respectively. Based on this study results, concluded that this kind of procedure would be valid as a non invasive method for physiological investigations. The breakpoints of blood and salivary lactate were similar during the games. Thus the visual lactate threshold (VLT) would have been used by this kind of protocols. On the other hand, In this study field technique of salivary lactate analysis was found for first time and this will be very important for clinical, biological and physiological studies about physical activity.

Key words: Salivary lactate concentration · Heart rate · Soccer-exercise session · Ventilatory thresholds · Noninvasive estimation of lactate threshold · Aerobic capacity

INTRODUCTION

The lactate level of blood and its threshold are one of the most important indexes of aerobic endurance and performance. The average exercise intensity during soccer has been reported to be approximately 75% of VO2max, near the anaerobic threshold. It has also been shown that players with the highest aerobic power cover the greatest distances during a game [1]. However, the association between aerobic capacity and distance covered does not necessarily mean that aerobic capacity is the primary determinant of performance in soccer [2,3]. It has been shown that the training status of professional male soccer players increases through changes in lactate and ventilatory thresholds that occurs with no change in VO2max. Therefore, lactate studies, its determination and effective factors on it are very important. For example heart rate at lactate threshold may vary based on mode of exercise and when using heart rate to estimate blood lactate concentration, coaches and athletes should be aware that different modes of exercise elicit a different blood lactate concentration at a given heart rate depending on exercise mode used [4]. The most reliable method to lactate investigation and its changes is blood sampling and it is an invasive method [5-8]. Salivary sampling for analysis of lactate has advantages compared with blood sampling as it is a low stress, noninvasive method. Some of noninvasive methods

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have been used to determine of lactate threshold [9-14]. On the other hand, some studies have used salivary electrolytes and lactate as a non invasive method [3, 4-8]. There are any studies with soccer specific protocol in this field.

The aim of this study was noninvasive estimation of lactate threshold by using specific soccer training with emphasis to training specificity principle with use determination of correlation between blood and salivary lactate and between heart rate and salivary lactate to determine visual lactate threshold.

**MATERIALS AND METHODS**

Twelve youth and amateur soccer players in one group (VO2max:54±3.5 ml/kg/min, age: 18±0.7) participated in this study (Table1).

Participants undertook a kind of soccer small-sided game (3V 3) without a goalkeeper or goal inside the marked area (25×25 meters) [12]. The sided game consisted of keeping the ball despite the opponent's efforts to take the ball. Intensities of game were controlled by heart rate (polar beat T31, N22965) at six stages (rest, warm up, after five min playing with 60%, 70%, 80% and 90% of reserve heart rate and every 30 second was recorded to control intensity thus there were 10 heart rate during five min activity) (Fig. 2). Each stage had five min rest and blood (fingertip) and salivary nonexcited samples [23] were collected in rest period.

Data were analyzed by repeated measured, Spearman correlation at significance level 0.05 and scheffe follow-up test.

Salivary lactate was analysed with enzymatic method by spectrophotometr and blood lactate was analysed by portable lactometer analyzer. (Lactate SCOUT) (Table 2).

**RESULTS**

Table 1 shows the subjects demographic data.

The results showed significant difference between six stages of protocol in blood and saliva lactate concentrations. In addition, there was significant correlation between saliva and blood lactate concentrations in stages five and six \[ r_s=0.79, \ p_s<0.05; \ r_h=0.56, \ p_s<0.05 \] in protocol respectively. There was correlation between heart rate and saliva lactate concentration in stages five and six respectively \[ r_s=0.6, \ p_s<0.05; \ r_h=0.68, \ P_s<0.05 \]. (Table3.4,5,6).

**DISCUSSION AND CONCLUSION**

Lactate concentrations of blood and saliva were changed from 1.57, 0.31 MmOl/L at rest to 5.55, 0.68 in end of sixth stage respectively. It means that blood and saliva lactate increased when training intensity increased (Fdi=32.93, P<0.001) and (Fdi=13.18, P<0.001). It was in agreement with most of studies about blood lactate
[2, 1, 5, 11, 18, 20, 22, 25, 30, 31] and saliva lactate [3, 4, 9, 28, 33]. The correlation between saliva and blood lactate concentrations in stages five and six was in agreement with Santos and Segura [28, 29]. Our saliva and blood lactate correlation results was contrary with Askari et al. [3]. It is not known how long it takes for the salivary lactate to form after the blood goes into the salivary gland, but this time did not influence the results found in our experimental model, because the Blood and saliva collections were carried out simultaneously.

However, this is an important factor to consider when researchers study the behavior of salivary lactate concentrations in progressive tests whose stages last less than 3 min when the interval among each sample is short and the lactate concentration could not be in balance with plasma lactate [28]. Thus this process may be has influence their results. Correlation between heart rate and blood lactate has been shown in many studies [1, 2, 5, 11, 18, 20, 22, 25, 30, 31] but there are any studies that investigate correlation between heart rate and salivary lactate same as present study. However, the model of blood and saliva lactate variations related to training intensity (shape and slope) in present study was same as other methods with cycle ergometer and treadmill (Figure 1). From this standpoint, we can transfer physiological studies from laboratory to field and reduce costs. On the other hand, we can relate this studies to training specificity principle. To pay attention to variation of curve slope and with performing of specific training for many kind of sports, determination of lactate threshold by noninvasive salivary lactate analysis is possible. Onset of salivary lactate accumulation (OSLA) same as OBLA can be defined and we use it to control training intensity.

In this study we found field technique of salivary lactate analysis for first time and this will be very important for clinical, biological and physiological studies about physical activity.

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