POWER SUPPLY CHARACTERISTICS OF BASKETBALL PLAYERS AT DIFFERENT TRAINING INTENSITIES

CARACTERÍSTICAS DO CONSUMO DE ENERGIA DOS JOGADORES DE BASQUETE COM DIFERENTES INTENSIDADES DE TREINAMENTO

CARACTERÍSTICAS DEL CONSUMO DE ENERGÍA DE LOS JUGADORES DE BALONCESTO CON DIFERENTES INTENSIDADES DE ENTRENAMIENTO

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ABSTRACT

Introduction: In competitive basketball sports, athletes must repeatedly perform movements of maximum intensity quickly, followed by rest. A training mode called high-intensity interval training (HIIT) has the same characteristics. Objective: Explore basketball players' energy supply characteristics and training changes under different exercise intensities. Methods: The effects of different recovery methods in the intermittent period on exercise capacity and aerobic metabolic energy supply of young male basketball players during high-intensity intermittent interval training (HIIT) were presented. Results: Increased aerobic energy production during HIIT was closely related to the acceleration of kinetics. However, although the time to exhaustion, a parameter characterizing exercise capacity, increased by 3.5% and 4.6%, respectively, in the HIITa group compared to HIITs and HIITp, there was no significant difference. After analyzing each group for the 30s, a gradual increase in strength was noticed. Conclusion: The use of HIIT as training is an important way to improve the physical performance of athletes. ***Level of evidence II; Therapeutic studies - investigation of treatment outcomes.***

Keywords: High-Intensity Interval Training; Exercise; Energy Consumption.

RESUMO

Introdução: Na competição esportiva do basquete, os atletas precisam realizar repetidamente movimentos de intensidade máxima rapidamente, seguidos de repouso. Há um modo de treinamento chamado de treinamento de intervalo de alta intensidade (HIIT) que possui as mesmas características. Objetivo: Explorar as características de consumo de energia e as mudanças de treinamento dos jogadores de basquetebol sob diferentes intensidades de exercício. Métodos: Foram apresentados os efeitos de diferentes métodos de recuperação em período intermitente sobre a capacidade de exercício e fornecimento de energia metabólica aeróbica de jovens jogadores masculinos de basquetebol durante o treinamento intermitente de alta intensidade (HIIT). Resultados: O aumento da produção de energia aeróbica durante o HIIT foi estreitamente relacionado com a aceleração da cinética. Entretanto, embora o tempo de exaustão, parâmetro que caracteriza a capacidade de exercício, tenha aumentado em 3,5% e 4,6% respectivamente no grupo de HIITa em comparação com HIITs e HIITp, não houve diferença significativa. Depois de analisar cada grupo durante 30s, percebeu-se um aumento gradual da força. Conclusão: O uso do HIIT como treinamento demonstrou-se um meio importante para melhorar o desempenho físico dos atletas. ***Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.***

Descritores: *Treinamento Intervalado de Alta Intensidade; Exercício Físico; Consumo de Energia.*

RESUMEN

Introducción: En los deportes de baloncesto de competición, los atletas necesitan realizar repetidamente movimientos de máxima intensidad de forma rápida, seguidos de descanso. Existe una modalidad de entrenamiento llamada entrenamiento por intervalos de alta intensidad (HIIT) que tiene las mismas características. Objetivo: Explorar las características del suministro de energía y los cambios en el entrenamiento de los jugadores de baloncesto bajo diferentes intensidades de ejercicio. Métodos: Se presentaron los efectos de diferentes métodos de recuperación en período intermitente sobre la capacidad de ejercicio y el suministro de energía metabólica aeróbica de jóvenes jugadores de baloncesto durante el entrenamiento de intervalos intermitentes de alta intensidad (HIIT). Resultados: El aumento de la producción de energía aeróbica durante el HIIT estaba estrechamente relacionado con la aceleración de la cinética. Sin embargo, aunque el tiempo hasta el agotamiento, un parámetro que caracteriza la capacidad de ejercicio, aumentó un 3,5% y un 4,6% respectivamente en el grupo HIITa en comparación con los HIIT y HIITp, no hubo diferencias significativas. Tras analizar cada grupo durante 30 segundos, se percibió un aumento gradual de la fuerza. Conclusión: El uso del HIIT como entrenamiento ha demostrado ser una forma importante de mejorar el rendimiento físico de los atletas. ***Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.***

Descriptores: *Entrenamiento de Intervalos de Alta Intensidad; Ejercicio Físico; Consumo de Energía.*

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INTRODUCTION

Unaccustomed / continuous high-intensity training (especially when muscle strength training) can cause muscle injury and fatigue, which is manifested in the increase of blood lactic acid, delayed skeletal muscle soreness, muscle stiffness, strength loss, and the increase of muscle protein levels such as creatine kinase and myoglobin in blood, which eventually leads to the decrease of sports performance.[1] In severe cases, life-threatening exertional rhabdomyolysis can occur. Typical symptoms (TRIAD) include myasthenia, myalgia and black urine (MB urine). Therefore, timely recovery of physical function is of positive significance to improve training effect and avoid sports injuries.[2] Some studies have shown that intermittent positive recovery (moderate to low intensity aerobic exercise or stretch exercise) during HIT has a better effect on athletes' performance and athletic ability than negative recovery, but there is still a lack of strong evidence, some studies have negative results, and even contradictory conclusions. "If the motivation to restore more negativity recovery can really improve the sport ability, is the former can significantly promote the aerobic anaerobic metabolism and/or power (that is, the energy release), but this assumption is not experimental verification, recovering and HIT break motivation of energy release and the influence of the aerobic and anaerobic metabolic pathways for energy proportion is unknown. To solve this research problem, Wei W and others took VO_{2max} as the standard of exercise intensity in recovery period.[3] The research of Trapero J and others confirmed that after high-intensity intermittent training, 27% VO_{2max} actively recovered, and its blood La clearance rate was significantly higher than 38% VO_{2max} exercise intensity, suggesting that low-intensity aerobic exercise is conducive to the functional recovery of the body.[4] Liu H and others used VT as the basis for the formulation of exercise intensity and found that the recovery mode of 80% VT was the best for the clearance rate of blood La, and the content of plasma CK was the lowest, suggesting that the effect of active recovery was dependent on exercise intensity.[5] Based on the current research, in order to explore the energy supply characteristics and training changes of basketball players under different exercise intensity. The effects of different recovery methods in intermittent period on the exercise ability and aerobic metabolic energy supply of young male basketball players during high-intensity intermittent training (HIT) were put forward. The increase of aerobic energy production during hi-ta is closely related to the acceleration of VO_2 kinetics. However, although exhaustion time, a parameter characterizing exercise ability, increased by 3.5% and 4.6% respectively in HI-TA compared with HITS and HITP, there was no significant difference. After analyzing the VO_2 (data not given) of each group for 30s, we found that VO_{2mean} gradually increased with the extension of 30s. Active recovery is an important means to improve sports performance during HIT.

METHOD

Research object

20 young male basketball players, aged 17-22, are national first-class athletes. The subjects were in good health, without acute and chronic diseases, smokeless and alcohol addiction, and no recent sports injury. The subjects were instructed to eat a light diet 48 hours before the experiment and avoid strenuous exercise. Before the experiment, inform all subjects of the purpose and precautions of the experiment, and sign the informed consent.[6]

Overall design of the experiment

The subjects completed 7 experiments within 5 weeks. The first three experiments were completed within one week, including familiarity with the experimental process, measurement of human morphology (height, weight and body composition), determination of maximum ima Loxy gen up take (VO_{2max}) and maximum imal power output (W_{max}).[7] After one week, VO2 power regression equation and pedal economy were measured by power bicycle to estimate oxygen demand during high-intensity exercise. HIT was performed once a week for the next three weeks, and three different recovery methods were performed during the interval. The test sequence (recovery method) of each subject was random.[8]

Human morphology

(Height, weight, body composition) The height and weight of the subjects were measured by standard electronic height and weight meter, and the bodymassindex (BMI) was calculated. The body composition was measured by the body composition instrument. The body composition was measured in the early morning fasting state and after emptying the urine and urine. The detection indexes include fat content, fat free body weight and body fat percentage.[9]

Be familiar with the experimental process

It includes being familiar with the experimental process and the use of power bicycles, conducting an incremental load exhaustion experiment and an extreme exercise experiment.[10] The subjects first carried out 17min preparation activities: 5min jogging, 5min stretching exercise, 7min submaximal pedaling exercise (the exercise load was 80, 100, 120, 140, 120, 100 and 80W respectively), and each level of load lasted for 1min. Then an incremental load exhaustion experiment was carried out. The starting load was 80W and increased by 20W every 1min until exhaustion. The hyperkinetic exercise experiment was carried out on a selected day.

Determination of VO_{2max} and W_{max}

VO_{2max} and W_{max} of subjects were measured by electric braking power bicycle. Ventilation and gas exchange parameters were recorded synchronously by exercise cardiopulmonary metabolic system (once every 20s), in which the coefficients of variation of VO_2 and VCO_2 were < 5%. Test procedure: pedal for 3min (40W) after 10min preparation activity, then set the starting load as 80W, increase 20W every 2min, and maintain the speed of 60rpm until exhausted. If the maximum value of VO_2 lasts for 20s, it is considered to reach VO_{2max}, and the corresponding power is W_{max}.

VO_2 kinetic determination

During HIT, the subjects wore exercise cardiopulmonary metabolic system and collected data every 10s. Plot the scatter diagram of VO_2 with time (t), and use the fitting curve to obtain the exponential regression equation with t as the independent variable and VO_2 as the dependent variable. Since the data of the first 10s were unstable and could not truly reflect the oxygen exchange and the actual oxygen uptake level of muscles, they were excluded. The regression equation includes amplitude term (A), delay constant (TD) and time constant (TC).

Peak oxygen uptake (peak VO_2, VO_{2peak}) was collected every 10 s when HIT was measured, and C was defined as the level that peaked and lasted for 10 s during each exercise during HIT. 4 VO_{2peak} data are obtained for each HIT.

The average oxygen uptake ( ) and aerobic energy output measured is the ratio of the integral over time and the exercise time in the fitted curve of each group during exercise in HIT. The total D(total,) during each exercise was taken as aerobic energy output.

The mean oxygen uptake (mean VO_2, VO_{2mean}) and aerobic energy output measured VO_{2mean} was the VO_2 in the fitted curve of each group during exercise in HIT, the integral over time and the ratio of exercise time. The total VO_2 (total VO_2, VO_{2total}) during each exercise was taken as aerobic energy output.

Statistical analysis

All data are represented by "mean ± standard deviation", and the data analysis software is Spss20.0 for windows. Three different recovery methods were compared by one-way ANOVA, the same recovery method was compared at different time points by repeated measurement, and both were compared by LSD test. $P < 0.05$ was regarded as having statistical difference.

There is no need for a code of ethics for this type of study.

RESULTS AND ANALYSIS

Aerobic energy output

There was no significant difference in VO_2, kinetics (TC), VO_{2peak}, VO_{2mean} and VO_{2total} among the three different recovery methods ($P > 0.05$). Compared with group 1, the TC of HITA and the VO_{2mean} and VO_{2total} of HITA, HITS and HITP decreased significantly when completing HIT in groups 2, 3 and 4 ($P < 0.05$). After the completion of HIT in three groups (groups 2 ~ 4), the VO_{2peak}, VO_{2mean} and VO_{2total} of HITA were higher than those of HITS and HITP ($P < 0.05$), while TC was lower than those of HITS and HITP ($P < 0.05$). See Figure 1, 2, 3 and 4.

DISCUSSION

The main finding of this study is that compared with negative recovery (HTTP) and stretch exercise (HITS), positive recovery (HITA) during HIT interval can improve exercise ability (i.e. work done) by increasing aerobic energy output, while the proportion of anaerobic energy supply has no significant change. The increase of aerobic energy production during hi-ta is closely related to the acceleration of VO_2 kinetics. However, although exhaustion time, a parameter characterizing exercise ability, increased by 3.5% and 4.6% respectively in HITA compared with HITS and HITP, there was no significant difference. After analyzing VO_2 (data not given) of each group for 30s, we found that VO_{2mean} gradually increased with the extension of 30s.

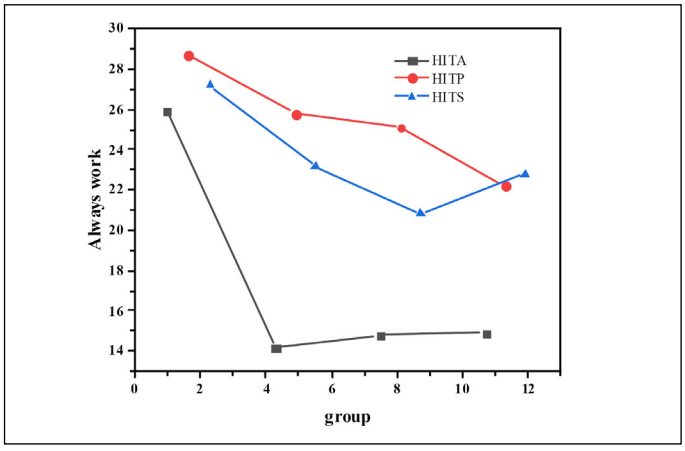

Figure 1. 3 Comparison VO_2 of kinetics (TC).

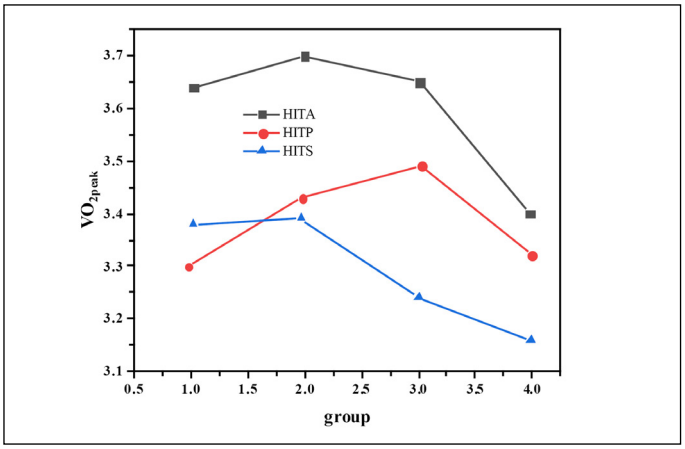

Figure 2. 3 Comparison of different recovery means VO_{2peak}.

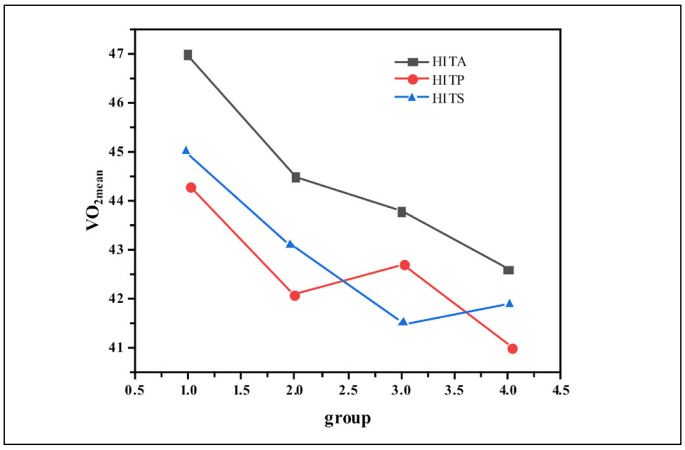

Figure 3. 3 Comparison of the different recovery means VO_{2mean}.

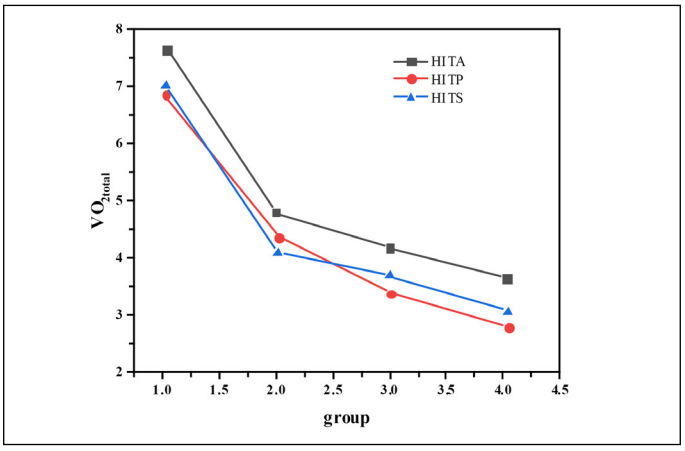

Figure 4. 3 Comparison of the different recovery means VO_{2total}.

CONCLUSION

This paper puts forward the energy supply characteristics and training changes of basketball players under different exercise intensity. The recovery of enthusiasm can improve the proportion of aerobic metabolism in the total energy supply during exercise (VO_{2total}). Compared with the other two recovery methods, the work amount VO_{2peak} and VO_{2mean} of HITA increased, suggesting that the oxygen utilization rate was improved during positive recovery. The TC of HITA decreased after the completion of HIT in groups 2, 3 and 4, and the TC of HITA was lower than that of HITS and HITP in groups 3 (groups 2-4), suggesting that the acceleration of VO2 kinetics (TC reduction) is an important reason for the improvement of oxygen utilization during enthusiasm recovery. The effect of positive recovery at 20% VO_{2max} during HIT interval on exercise ability (work done) is better than negative recovery and stretching exercise. Its mechanism may be related to the increase of aerobic metabolic energy output during positive recovery. It is worth noting that although the improvement of exhaustion time during positive recovery is very small (3% - 5%), for fierce competitive competition, a small advantage may determine the outcome. Therefore, using positive recovery during HIT is an important means to improve sports performance.

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