CHANGES OF SERUM CARDIAC TROPONIN I IN EXERCISE STRESS TEST AND AFTER EXERCISE

MUDANÇAS NO SORO CARDÍACO TROPONINA I EM TESTES DE EXERCÍCIOS DE ESTRESSE E APÓS O EXERCÍCIO

CAMBIOS EN LA TROPONINA CARDÍACA I EN PRUEBAS DE EJERCICIOS DE ESTRÉS Y TRAS EL EJERCICIO

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ABSTRACT

Introduction: Cardiac Troponin (CTN) has a strong organ specificity, which indicates that myocardial injury is present. However, it is worth noting that the increase does not suggest that the myocardium necessarily presents ischemic necrosis. Objective: To observe the changes in serum kerocalin I (CTNI) content after exercise, explore the effects of exercise training on hematocytes and that cause damage to myocardial cell stimulation. Methods: 18 rats were divided into three groups in this study, and three exercises were conducted separately. Results: After 6 weeks of exercise training, the number of red blood cells increased and the content of troponin I (CTNI) in the serum also significantly increased. The serum CTNI of the disposable large strength group was significantly higher than that of the quiet group (P <0.001). The serum CTNI in the 6-week exercise group was significantly higher than that of the quiet group (P <0.001), but the serum CTNI level between the two sports groups was not different. Conclusions: The motion training model used in this study can improve the number of red blood cells in the blood, improve synchronous blood capacity, and help the body's aerobic capacity increase. ***Level of evidence II; Therapeutic studies - investigation of treatment results.***

Keywords: Exercise; Exercise test; Anemia, dyserythropoietic, congenital; Troponin.

RESUMO

Introdução: A troponina cardíaca (CTN) tem uma alta especificidade orgânica, o que indica que lesões do miocárdio estão presentes. No entanto, vale observar que seu aumento não sugere que o miocárdio, necessariamente, apresenta necrose isquêmica. Objetivo: Observar as mudanças no conteúdo do soro kerocalino I (CTNI) após o exercício, explorar os efeitos do treino de exercícios nos hematócitos e que causam danos ao estimulo celular do miocárdio. Métodos: 18 ratos foram divididos em três grupos neste estudo, e três exercícios foram conduzidos separadamente. Resultados: Após seis semanas de treino com exercícios, o número de células vermelhas no sangue aumentou, e o conteúdo de troponina I (CTNI) no soro também aumentou consideravelmente. O soro CTNI do grupo descartável de alta força foi consideravelmente mais alto do que o do grupo imóvel (P <0,001). O nível CTNI de soro no grupo de exercícios de seis semanas foi significativamente mais alto do que aquele do grupo imóvel (P <0,001), mas o nível CTNI do soro entre os dois grupos de exercício não diferiu. Conclusões: O modelo de treino móvel usado neste estudo pode recuperar o número de células vermelhas no sangue, melhorar a capacidade sincrônica do sangue e auxiliar no aumento da capacidade aeróbica do corpo. ***Nível de evidência II; Estudos terapêuticos – investigação de resultados de tratamento.***

Descritores: *Exercício; Teste de esforço; Anemia diseritropoiética congênita; Troponina.*

RESUMEN

Introducción: La troponina cardíaca (CTN) tiene una alta especificidad orgánica, que indica que lesiones del miocardio están presentes. Sin embargo, vale observar que su aumento no sugiere que el miocardio necesariamente presente necrosis isquémica Objetivo: Observar los cambios en el contenido del suero cardíaco troponina I (CTNI) tras el ejercicio, explorar los efectos del entrenamiento de ejercicios en los hematocitos y que causan daños al estímulo celular del miocardio. Métodos: Se dividió 18 ratones en tres grupos en este estudio, y se condujo tres ejercicios separadamente. Resultados: Tras seis semanas de entrenamiento con ejercicios, el número de células rojas en la sangre aumentó, y el contenido de troponina I (CTNI) en el suero también aumentó considerablemente. El suero CTNI del grupo desechable de alta fuerza fue considerablemente más alto que del grupo inmueble (P<0,001). El nivel CTNI de suero en el grupo de ejercicios de seis semanas fue significativamente más alto que en el grupo inmueble (P<0,001), pero el nivel CTNI de suero entre los dos grupos de ejercicio no difirió. Conclusión: El modelo de entrenamiento mueble usado en este estudio puede recuperar el número de células rojas en la sangre, mejorar la capacidad sincrónica de la sangre y auxiliar en el aumento de la capacidad aeróbica del cuerpo. ***Nivel de evidencia II; Estudios terapéuticos – investigación de resultados de tratamiento.***

Descriptores: *Ejercicio; Prueba de estrés; Anemia diseritropoyética congénita; Troponina.*

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INTRODUCTION

It is a convenient, efficient and relatively accurate method to evaluate the degree of cardiac injury by detecting the level of cardiac biomarkers in circulating blood. Cardiac troponin (CTN) is highly organ-specific and its elevation indicates myocardial injury, but it should be noted that it does not necessarily indicate ischemic necrosis of the myocardium. A large number of studies have found that the level of plasma cTn I increases after strenuous exercise or prolonged exercise, which may be caused by the release of cTn I in myocardial tissue due to the increased permeability of myofascial membrane. Repeated short periods of high-intensity intermittent exercise can produce endogenous protective effects on the heart, thereby reducing ischemia and hypoxia injury caused by subsequent long periods of intense exercise. This method is called exercise preconditioning (EP). EP is a preconditioning method with minimal injury. Our previous research results showed that exercise preconditioning can effectively reduce the plasma CTN I content and reduce the degree of ischemia and hypoxia injury in rats after exhaustive treadmill exercise. This paper reviewed the research status of cTn I in myocardial injury and protection during exercise, so as to provide updated theoretical basis for heart biomarker cTn I in the field of myocardial injury and protection during exercise.[1]

Exercise has been well applied in the regulation and management of cardiovascular diseases. Regular exercise can reduce the incidence of various cardiovascular diseases. However, more and more studies have shown that after vigorous exercise or a long exercise, the content of C, Tn, I in circulating blood will increase correspondently in healthy individuals. Most of the literature on exercise and cTn I published before the turn of the century measured cTn I after exercise in participants in endurance sports such as long periods of strenuousness, such as triathlons, ultra-long marathons, and road cycling.[2,3]

METHOD

Material

A total of 18 clean male Spra-gue-Dawley (SD) rats with a body weight of (198 ±10)g were provided by the Laboratory Animal Center. Free diet, national standard rodents conventional feed feeding.

Drugs and reagents

Rat cTnI kit is provided by BPBBiomedicals Company in the United States, SOD, MDA, CAT kit is provided by Nanjing Jiancheng Institute of Biological Engineering, Ex Taq enzyme, DnTP, DLmarker is provided by Guangzhou Reizen Company (brand TAKARA). The other reagents were all domestic analytical pure.

Experimental Method

1. Grouping and model preparation

A total of 18 male Sprague-Dawley(SD) rats were randomly assigned to three groups: 6 rats in the quiet control group (group A), 6 rats in the one-time intense exercise group (group B), and 6 rats in the six-week intense exercise group (group C). Specific groups are as follows:

Group A was fed regularly for 6 weeks without training. Group B was routinely fed without training. At the end of the 6th week, exhaustive exercise was carried out with 8% one-time weight; With reference to the experimental model modified by Chen et al., group C received adaptive training for one week the water temperature was (30 ±2)°C, the water depth of the swimming pool was 26-35cm, and swimming training with 8% weight on the tail was carried out for 15min every day, during the week, the swimming exercise was gradually increased to 120min swimming exercise per day with 8% weight, which was maintained for 6d per week for a total of 6 weeks. At the end of the 6th week, exhaustive exercise with 8% weight was carried out at one time.

2. Methods of animal death and specimen collection and treatment

Because cTnI is released into the blood by the injured cardiomyocytes, and its concentration needs to be maintained for a period of time, rats in each group were given intraperitoneal injection of sodium pentobarbital (45mg/Kg) 24h after exercise at the 6th weekend, 4mL of blood was drawn from the abdominal aorta, placed for 1h, centrifuged at 2000r/ min for 15min, and the serum was collected and stored at -70°C. Then the rats were killed by decapitated body, the hearts were removed and washed with ice normal saline, and the attached connective tissue was cut off .[4,5]

Detection indexes and methods

1. Serum cTnI level was detected

Peripheral blood was centrifugally extracted and stored at -70°C. According to the requirements of the kit, ELIZA method was used for operation and detection. Tecansunrise enzyme-plate instrument made in Austria was used for detection. Add 50μl enzyme-labeled solution to the standard well and sample well; Incubate at (36 ±)2°C for 60min; Wash each well with 300μL detergent solution, let it stand for 10-20 seconds at a time, then shake off the washing solution, print the dry plate, repeat 5 times; Add chromaticity A and chromaticity B 50μl to each well, slightly mix for 5s; The reaction was incubated at (36±2)°C for 15min without light. Add 50μl Stop Solution to each well. Gently mix to stop the reaction for 30s. Stop the reaction until the blue in the well turns yellow. The OD value of each well was read on a 450nm wavelength plate instrument within 30min, and the corresponding concentration was calculated after drawing the standard curve.

2. The activities of SOD and CAT and the content of MDA were detected

The activities of SOD and CAT and the content of MDA in myocardial tissue were measured by chemical colorimetry. The tissue weight was accurately weighed and tissue homogenate was prepared for measurement. The operation was carried out in accordance with the kit instructions.

Statistical Methods

SPSS13.0 statistical software package was used for statistical processing, and the data were expressed as mean ± standard deviation. Firstly, homogeneity of variance test and analysis of variance were carried out. Levene homogeneity of variance test showed significant difference in the mean between groups. Multiple comparisons were made, and one-way analysis of variance was used to compare multiple sample means and sample means. The correlation between the two variables was analyzed by bivariate correlation, and $P<0.05$ was considered to be significant.

RESULTS

Serum cTnI level

The serum cTnI level of rats in group B was significantly higher than that in group A ($P<0.001$), and that in group C was significantly higher than that in group A ($P<0.001$), but there was no significant difference in serum cTnI level between the two exercise groups.[6,7] (Table 1)

Activities of SOD and CAT and content of MDA in myocardial tissue

The results showed that the SOD activity of myocardium in group B was significantly lower than that in group A ($P<0.001$), and the SOD activity of myocardium in group C was significantly lower than that in group A. The CAT activity in group C was significantly lower than that in groups A and B ($P<0.001$ and $P< 0.05$), and the content of MDA in group C was higher than that in group A ($P<0.001$). (Table 2)

Table 1. Influence of exercise on serum cTnI level in each group(X±SD, n=6).

Indicators	Group A	Group B	Group C
CTnI(ng/ml)	2.13±1.25	5.31±0.20**	5.69±0.28**

Note: * * Indicates the ratio with group A, P<0.01.

Correlation analysis of serum cTnI and several factors after exercise

According to Pearson correlation analysis, cTnI was significantly correlated with μcalpain mRNA expression in serum. There was a significant negative correlation between serum cTnI and antioxidant system indexes, and there was a significant negative correlation between serum cTnI and SOD activity (P<0.001), but no significant correlation with CAT activity. There was a significant correlation between serum cTnI and MDA content (P <0.05).[8,9] (Table 3)

Table 2. The effects of exercise on the activities of SOD and CAT and the content of MDA in myocardial tissue(X±SD, n=6).

Indicators	Group A	Group B	Group C
SOD active (U/mgprot)	117.37±16.89	72.33±12.60**	87.03±10.73*#
CAT active (U/mgprot)	27.83±7.94	23.45±2.73	18.15±8.91**#
MDA content (nmol/mgprot)	2.60±0.56	4.08±0.69	5.22±0.82**

Note: * Denotes comparison with group A, P<0.05; * * denotes the ratio with group A, P<0.001; # indicates comparison with group B, P<0.05.

Table 3. Correlation analysis of serum cTnI and several factors.

Indicators	cTnI(ng/ml)	
	r	P value
MCalpainmRNA express	0.64	0.001*
SOD active (U/mgprot)	-0.78	000**
CAT active (U/mgprot)	-0.50	0.033
MDAcontent (nmol/mgprot)	0.67	0.002*

DISCUSSION

The results showed that the expression of μcalpain mRNA, the activities of SOD and CAT, and the content of MDA in myocardial cells were changed during strenuous exercise, it is suggested that the change of cTnI concentration in serum is related to the antioxidant system and the activity of cTnI hydrolase. From the analysis of serological marker results, the level of cTnI in rats was significantly higher than that in the control group after strenuous exercise, but there was no significant difference between the two exercise groups. The results of this study are consistent with the conclusion that high-intensity exercise leads to increased cTnI release in human and animal serum. The results suggested that the decrease of antioxidant enzyme activity and the increase of the content of MDA, a metabolite of reactive oxygen species, might be one of the causes of tissue damage. Due to the increase in the generation of oxygen free radicals, the lipid peroxidation of biofilm is aggravated, SOD activity is reduced, and the content of lipid peroxides and metabolite MDA in cells is increased, which damages the integrity of the membrane, and will continue to be aggravated for a period of time after exercise.[10]

From the results of this experiment, it was speculated that the concentration of catecholamines increased due to intense exercise, the generation of a large number of oxygen free radicals caused by oxidative stress reaction, and the intracellular calcium overload activated μcalpain activity, resulting in the degradation of cTnI, however, it was found that there was no time dependence on the activation of μcalpain activity after strenuous exercise. The effect of strenuous exercise on cardiac injury may be related to the changes of intracellular calcium ion concentration, but the dynamic changes of intracellular calcium ion concentration, μcalpain activity and serum cTnI remain to be further investigated .

CONCLUSION

To sum up, the exercise training mode adopted in this topic can improve the number of red blood cells in the blood, improve the blood's oxygenic capacity, and contribute to the improvement of the body's aerobic capacity. The increase of cTnI content in serum also indicated that exercise had a strong stimulating effect on myocardial tissue and caused certain damage to myocardial cells. However, due to the lack of the standard of myocardial injury in rats, the extent of injury could not be determined and further study was needed.

All authors declare no potential conflict of interest related to this article

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