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Effects of Huangqi Jianzhong Tang on hematological and biochemical parameters in judo athletes

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KEY WORDS *Astragalus membranaceus*; hematologic tests; athletic injuries

ABSTRACT

AIM: The purpose of the study was to investigate the effects of Huangqi Jianzhong Tang (HQJZT) on hematological and biochemical parameters in judo athletes. **METHODS**: Sixteen male and eight female judo athletes in Hsin-Ming senior high school were randomly and stratified divided into control and experimental group, which received placebo and HQJZT respectively during the five-week training program. The measurement of the hematological and biochemical parameters was performed twice, just before and after the training. The data was analyzed with paired-*t* test and ANOVA. **RESULTS**: The values of RBC, Hb, and Hct were obvious decreased after intervention, while the value of GOT, GPT, BUN, and CK was elevated. **CONCLUSION**: The results indicated the hematological and biochemical changes were caused by the physical training but not the effects of HQJZT. The HQJZT had no adverse effects on the judo athletes in our study.

INTRODUCTION

Training is thought to be one of the methods to improve the exercise performance. But too much intensive training and competition may cause the adverse effects in hematological and biochemical parameters and affect the health state of athletes[1]. Intensive exercise not only depresses the immune function but also increases the risk of infection[2].

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It is obvious that physical performance, endurance capacity, and resistance to fatigue are dependent on many factors. The most important factor is the oxygen carrying capacity of blood[3]. It is mainly determined by hemoglobin concentration, number of circulation erythrocytes, and the efficiency of their functions. Some studies have reported a longer term "hemodilution" following acute exercise. This type of anemia has been called "sports anemia", "athletes anemia", or "post-exercise anemia". It has been described in sportsmen, even among the members of Olympic teams. It may be because of postexercise plasma expansion, intensified hemolysis during physical efforts, iron deficiency, losses of erythrocytes by the way of bleeding into the digestive and urinary systems and also some disturbances in erythropoiesis[4]. But controversy still exists over the relevance of plasma volume interactions with plasma constituent levels, and while other investigators have focused on the plasma volume shifts. Endurance training has been shown to cause long term expansion of the plasma volume. Plasma volume changes are known to be associated with heat acclimatization, hydration state, physical training and postural changes. The above changes may differ from one experiment or exercise bout to the next.

The elevation of aspartate aminotransferase (AST)[5], alanine aminotransferase (ALT)[6], and lactate dehydrogenase (LDH) is often observed in athletes. The damage of muscle or liver cells caused by intensive training should be concerned.

Post-exercise acute renal failure also has been reported. Post-exercise proteinuria and increased blood urea nitrogen (BUN)[7] and creatinine (Cr)[8] are obvious findings of renal cell damage.

Intensive exercise may cause muscle soreness. The serum creatine kinase (CK)[5] was increased due to muscle cells lyses, while glucose[9], ammonia, glycerol, free fatty acids, albumin, LDL, VLDL cholesterol, and

leukocytes decreased significantly. Uric acid, urea, and creatine phosphokinase concentrations still remained elevated while 24 h post-exercise[10]. Lactate, creatinine, testosterone, and cortisol concentrations were significantly elevated above pre-exercise values immediately post-exercise but these had been reversed by 2 h post-exercise[10].

The athletes often regain energy by nutrition supplement. In addition to kinds of nutrition elements, some food supplement mixed with the Chinese herb recently. In order to know whether this kind of food supplement is harmful to the athletes, we designed the study to evaluate the effects of Huangqi Jianzhong Tang (HQJZT), which is often used in clinical practice, on hematological and biochemical parameters in judo athletes.

MATERIALS AND METHODS

Subjects The study subjects were 16 male and 8 female judo athletes in Hsin-Ming senior high school. They all lived in the dormitory and their meals were supplied by the school. Their training program included 3 periods: 5:30 – 7:00 am, 3:30 – 4:40 pm, and 7:00 – 9:00 pm. All training was designed and assisted by professional judo coaches.

Study design The 16 male and 8 female judo athletes were randomly and stratified divided into experimental and control group, which received HQJZT 12 g/person and placebo 12 g/person each day respectively. The placebo contained only starch. The measurement of the hematological and biochemical parameters was performed twice, just before the intervention and 5 weeks later.

Study equipments and reagents

(1) Equipments

Body height meter

Body weight meter

BECKMAN Synchron CX4CE/CX-7: for biochemical parameters measurement

Sysmex NE-1500: for hematological parameters measurement

Thermometer

Humidity meter

Centrifuge

(2) Reagents

Reagents for BUN, Cr, sGOT, sGPT, and CK purchased from BECKMAN Co

Reagents for CBC purchased from Sun-tong Co

Measurement items

(1) WBC (unit: 1×10^9/L)

(2) RBC (unit: 1×10^{12}/L)

(3) Hb (unit: g/L)

(4) Hct (unit: %)

(5) BUN (unit: 1×10^3 g/L)

(6) Cr (unit: 1×10^3 g/L)

(7) GOT (AST, unit: U/L)

(8) GPT (ALT, unit: U/L)

(9) CK (unit: U/L)

Statistical method

(1) Paired-t test: to test whether there is difference between the body weight before and after the intervention

(2) ANOVA: to analyze the changes of variables

RESULTS

Sample size There were 24 athletes at the beginning of our study. During the study period, 4 athletes were excluded. One because of traffic accident, one hurt while training, and the other 2 quitted the judo team. The detail was shown in Tab 1.

Tab 1. The objectives number before and after the study (unit: person).

Group	Before study	After study	Cause
Study	M:F = 8:4	M:F = 6:3	2-Quitted and 1-traffic accident
Control	M:F = 8:4	M:F = 7:4	1-Hurt while training
Total	24	20	4

Basic information of the subjects There was no obvious difference between the study and control group in age, body height, body weight, and judo learning period. The statistical data was shown in Tab 2.

Tab 2. The comparison of basic information between the study and control group. $\bar{x} \pm s$.

	Study group (n = 9)	Control group (n = 11)
Age/a	16.8 ± 0.7	16.6 ± 1.0
Body height/cm	168 ± 8	167 ± 7
Body weight/kg	69 ± 17	63 ± 6
Judo learning period/a	4.6 ± 2.3	4.4 ± 2.4
Gender ratio (M:F)	6:3	7:4

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Body weight change in the study and control group There was no obvious difference between the study and control group in body weight before and after intervention (Tab 3).

Tab 3. The change of the body weight between the study (n = 9) and control (n = 11) group before and after intervention. $\bar{x} \pm s$.

	Before study/kg	After study/kg	T value	P value
Study group	69 ± 17	69 ± 18	0.66	0.53
Control group	63 ± 6	63 ± 6	−0.15	0.89

Change of the WBC counts The WBC counts were increased after intervention in both the study and control group (Tab 4). The data was then analyzed with ANOVA, and no obvious difference existed between both groups or before and after intervention (Tab 5).

Tab 4. The change of WBC counts in study and control groups before and after intervention. $\bar{x} \pm s$.

	Study group (n = 9)		Control group (n = 11)	
	Before	After	Before	After
$10^{-9} \times$ WBC/L^{-1}	7.1 ± 1.7	7.2 ± 1.9	7.4 ± 1.4	7.7 ± 1.3

Tab 5. The ANOVA of change of WBC counts in both group and before and after intervention.

Variable	F value (P value) of ANOVA					
	Group		Before and after interventtion		Interaction	
	F value	P value	F value	P value	F value	P value
WBC	0.39	0.54	0.22	0.64	0.01	0.91

Changes of the RBC, Hb, and Hct values The RBC, Hb, and Hct values were decreased after intervention in both the study and control group (Tab 6). The data was analyzed advanced with ANOVA, and there was no obvious difference in the interaction between the groups before and after the intervention. Then, we explored the main effects, and found the changes of RBC, Hb, and Hct reached statistical difference (Tab 7).

Changes of the GOT and GPT The values of GOT and GPT were increased after intervention both in the study and control group (Tab 8). The data was analyzed advanced with ANOVA, and there was no obvious difference in the interaction between the groups before and after the intervention. Then, we explored the main effects, and found the changes of GOT and GPT reached statistical difference (Tab 9).

Tab 6. The changes of RBC, Hb, and Hct before and after intervention. $\bar{x} \pm s$.

Variable	Study group (n = 9)		Control group (n = 11)	
	Before	After	Before	After
$10^{-12} \times$ RBC/L^{-1}	4.7 ± 0.5	4.4 ± 0.4	4.9 ± 0.4	4.6 ± 0.4
Hb/g·L^{-1}	137 ± 12	128 ± 12	135 ± 10	128 ± 8
Hct/%	42 ± 4	39 ± 3	42 ± 3	39.5 ± 2.3

Tab 7. The ANOVA of the changes of RBC, Hb, and Hct in different groups and before and after intervention. $^cP < 0.01$.

Variable	F value (P value) of ANOVA					
	Group		Before and after interventtion		Interaction	
	F value	P value	F value	P value	F value	P value
WBC	1.24	0.28	27.23	0.0001^c	0.25	0.62
HB	0.06	0.81	37.77	0.0001^c	0.00	0.98
Hct	0.02	0.88	25.13	0.0001^c	0.04	0.85

Tab 8. The change of the GOT and GPT before and after intervention. $\bar{x} \pm s$.

Variable	Study group (n = 9)		Control group (n = 11)	
	Before	After	Before	After
GOT/U·L^{-1}	26 ± 5	36 ± 13	29 ± 8	37 ± 19
GPT/U·L^{-1}	17 ± 7	20 ± 11	19 ± 13	25 ± 15

Changes of the BUN and Cr The values of BUN and Cr were increased after intervention both in the study and control group (Tab 10). The data was analyzed advanced with ANOVA, and there was no obvious difference in the interaction between the groups before and after the intervention. Then, we explored the main effects, and found the change of BUN reached statistical difference but not the change of Cr (Tab 11).

Change of the CK The values of CK were increased after intervention both in the study and control

Tab 9. The ANOVA of the changes of the GOT and GPT in different groups and before and after intervention. $^cP < 0.01$.

Variable	*F* value (*P* value) of ANOVA					
	Group		Before and after interventtion		Interaction	
	F value	*P* value	*F* value	*P* value	*F* value	*P* value
GOT	0.17	0.68	11.83	0.003^c	0.09	0.76
GPT	0.39	0.54	9.89	0.006^c	1.52	0.23

group (Tab 12). The data was analyzed advanced with ANOVA, and there was no obvious difference in the interaction between the groups before and after the intervention. Then, we explored the main effects, and found the change of CK reached statistical difference (Tab 13).

DISCUSSION

The results indicated there was no obvious difference between the study and control group in the body weight after intervention. It may be because the drug has no effects on the weight of the athletes. But it still can not be excluded that excellent judo athletes control their weight very well.

In our study, the elevation of GOT, GPT, BUN, and CK reached obvious statistical difference after intervention, and the decrease of the RBC, Hb, and Hct also reached the statistical difference. Similar with other study, the value of WBC was not decreased after exercise. The intensive training lowered the RBC, Hb, and Hct, even less than their normal ranges. This was quite compatible with the "sports anemia"[4]. This may be due to the bump in the training and the plasma expansion after exercise. These made the RBC broken, and then short supply of oxygen, which will limit the performance of the athletes.

The elevation of GOT and GPT is the indicator of the damage of hepatic, cardiac, and blood cells. And the elevated GPT is more specific to hepatic cell damage. The elevation of GOT and GPT in our study reached the statistical difference. It was easily noted and could not be ignored that the intensive training may cause the damage of the blood and hepatic cells.

The elevation of BUN in our study indicated that the energy supplied during exercise including the degradation of protein. There was no obvious change in Cr indicated the renal function was not affected by intensive training. Many studies have focused on the mechanism why training make the CK increase. The most accepted theory was the muscle cell damage during exercise and it changed the permeability of cell membrane. Thus, CK was released from cells to the blood stream. The change of CK also reached statistical difference in our study. Just as mentioned above, the changes of the hematological and biochemical in our study were the same with the opinions of many other researchers[3-8].

There was no obvious effect on WBC, RBC, Hb, Hct, BUN, Cr, GOT, GPT, and CK in our study group. It indicated the HQJZT had no adverse effects on athletes. It could not correct the sports anemia either. HQJZT had neither protective nor harmful effects on liver cell damage and renal function.

The effects of HQJZT seemed not expressed in our study. There was neither adverse effects in athletes nor beneficial to the hematological and biochemical parameters. We may try to adjust the dose and the length of receiving HQJZT in advanced studies to see whether any different effects will appear.

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Tab 10. The changes of the BUN and Cr before and after intervention. $\bar{x} \pm s$.

Variable	*Study group* ($n = 9$)		*Control group* ($n = 11$)	
	Before	After	Before	After
$10^{-3} \times$ BUN/g·L^{-1}	14.0 ± 2.8	18 ± 4	14.4 ± 2.2	16.7 ± 2.4
$10^{-3} \times$ Cr/g·L^{-1}	1.11 ± 0.19	1.18 ± 0.16	1.11 ± 0.17	1.13 ± 0.14

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Tab 11. The ANOVA of the changes of BUN and Cr in different groups and before and after intervention. $^cP < 0.01$.

Variable	F value (P value) of ANOVA					
	Group		Before and after interventtion		Interaction	
	F value	P value	F value	P value	F value	P value
BUN	0.04	0.84	16.68	0.0007^c	0.68	0.42
Cr	0.14	0.72	3.24	0.09	1.07	0.32

Tab 12. The change of CK before and after intervention. $\bar{x} \pm s$.

Variable	Study group ($n = 9$)		Control group ($n = 11$)	
	Before	After	Before	After
CK/U·L^{-1}	267 ± 145	797 ± 487	369 ± 276	818 ± 850

Tab 13. The ANOVA of the changes of the CK in different groups and before and after intervention. $^cP < 0.01$.

Variable	F value (P value) of ANOVA					
	Group		Before and after interventtion		Interaction	
	F value	P value	F value	P value	F value	P value
CK	0.09	0.77	16.10	0.0008^c	0.11	0.75

REFERENCES

1 MacKinnon LT. Special feature for the Olympics: effects of exercise on the immune system: overtraining effects on immunity and performance in athletes. Immunol Cell Biol 2000; 78: 502 - 9.
2 Nieman DC. Special feature for the Olympics: effects of exercise on the immune system: exercise effects on systemic immunity. Immunol Cell Biol 2000; 78: 496 - 501.
3 Szygula Z. Erythrocytic system under the influence of physical exercise and training. Sports Med 1990; 10: 181 - 97.
4 Schmidt W, Maassen N, Tegtbur U, Braumann KM. Changes in plasma volume and red cell formation after a marathon competition. Eur J Appl Physiol Occup Physiol 1989; 58: 453 - 8.
5 Garry JP, McShane JM. Postcompetition elevation of muscle enzyme levels in professional football players. MedGenMed [computer file]; Medscape General Medicine. E4, 2000 Mar 3.
6 Spodaryk K. Haematological and iron-related parameters of male endurance and strength trained athletes. Eur J Appl Occup Physiol 1993; 67: 66 - 70.
7 Eliakim A, Nemet D, Shenkman L. Serum enzyme activities following long-distance running: comparison between Ethiopian and white athletes. Israel J Med Sci 1995; 31: 657 - 9.
8 Hong CZ, Lien IN. Metabolic effects of exhaustive training of athletes. Arch Phys Med Rehabil 1984, 65: 362 - 5.
9 Lehmann M, Dickhuth HH, Gendrisch G, Lazar W, Thum M, Kaminski R, *et al*. Training-overtraining. A prospective, experimental study with experienced middle- and long-distance runners. Int J Sports Med 1991; 12: 444 - 52.
10 Fry RW, Morton AR, Garcia-Webb P, Keast D. Monitoring exercise stress by changes in metabolic and hormonal responses over a 24-h period. Eur J Appl Physiol Occup Physiol 1991; 63: 228 - 34.

黄芪建中汤对柔道选手血液及生化指标效应之研究

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关键词 膜荚黄芪；血液学试验；运动损伤

目的：本研究在探讨黄芪建中汤对柔道选手血球及血清生化值的影响. **方法**：实验中以新民商工高中组柔道选手为对象，男生16名女生8名，采用分层分组的方法，分为实验组与对照组，分别服用黄芪建中汤与安慰剂. 实验期间为五周，分前、后二次测量，检验选手血液中血球及血清生化值. 结果以配对 t 检定、变异数分析法、单纯主要效果比较进行分析. **结果**：研究结果显示，血液中血球(RBC、Hb、Hct)指数于实验前后有显著降低，血清生化值(GOT、GPT、BUN、CK)于实验前后有显著升高，证实训练对血球及血清生化值有影响. **结论**：黄芪建中汤对柔道选手血球及血液生化值无显著效果，亦无不良之副作用.

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