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Effects of Meridian Scraping on Immune Function and Athletic Ability in Endurance Training Rats

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Abstract: Aim of the study-To investigate the effects of meridian scraping on immune function and athletic ability in endurance training rats. Materials and methods-Twenty four adult male Sprague-Dawley rats were randomly assigned to non-training group (A), training control group (B) or meridian scraping and training group (C). Rats in groups B and C were loaded with incremental endurance training for 7 weeks and body weight, indices of immune organs, levels of serum immunoglobulin G (IgG), IgM, IL-6, β-endorphin and time to strength exhaustion of rats in running plate on the first day of the 8th week, were measured. Results-Meridian scraping effectively modulated the changes in body weight and immune function induced by endurance training. Meridian scraping treatment also inhibited the training-induced decrease of serum IgG, but increased serum IL-6 and β-endorphin levels and prolonged the time to strength exhaustion. Conclusions-Meridian scraping increased the athletic ability of rats in endurance training, delayed the occurrence of sports fatigue and improved immune function.

Keywords: Athletic ability, endurance training, immune function, meridian scraping

INTRODUCTION

During the past decade, the relationship between immune function and sports has received significant attention. Modern sports medicine suggests that strenuous exercise can induce over-consumption of energy and cause metabolic disorders, resulting in decreased immune functions (Folsom *et al*., 2001). Currently, a series of studies in the field of sport and medicine have been performed to improve athletic ability and immune function using Chinese Traditional Medicine, with significant outcomes (Dong *et al*., 2008). However, little is known about the health-care therapy of Chinese Traditional Medicine. Scraping is a procedure based on and guided by Chinese Traditional Medicine theory including viscera, meridians and collaterals and acupuncture, with effects on health-care and multiple diseases (Cheng and Cheng, 2004). Currently, the effect of Scraping on immune function and athletic ability during training is unknown (Yu Sumei, 2007). The present study investigated the effect of Scraping on rats during endurance training, which we hope will proof-of-principle for the application of Scraping in the field of sports medicine (Fleshner *et al*., 2002).

MATERIALS AND METHODS

Experimental animals and training model: Male rats (180-220 g) were provided by the Experimental Animal Centre of Chinese Traditional Medicine Institute and bred at 23±5°C, between 40-70% relative humidity with a natural light cycle. After 1 week, the rats were randomly assigned to three groups: non-training group:

A : Training control group
B : Scraping and training group
C : (n = 8 rats per group)

The endurance training model was modified from Benford *et al*. (Bedford *et al*., 1979). The training occurred for 5 days continuously with rest over a two-day period and included: 20 min training on the running plate everyday during the first 5 weeks with a speed of 15 m/min in the 1st week, 22 m/min in the 2nd week, 27m/min in the 3rd week, 31 m/min in the 4th week, 35 m/min in the 5th week and 35 m/min for 30 min in the 6th and 7th week. In addition, strength exhaustion was performed on the 1st day of the 8th week for group B and C rats. Strength exhaustion criteria included the following: if the rat failed to follow the pre-set speed, the hip was pressed on the posterior wall of the cage and the hind-limbs moved onto the rotating belt for up to 30s, if brush stimulation failed. The behavioral features observed included: deep and fast respiration with large amplitude, respiratory fatigue, a prone position and failure of reaction to stimuli.

Scraping therapy: During the training period, rats in group C received Scraping according to the Standard

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Acupoint iconography of Experimental Animals in Chinese Traditional Medicine. Fur at the acupoint area was shaved before Scraping was performed. Notifying Scraping along the meridians and collateral meridians and collaterals with mild supplementation and discharge at a moderate intensity was applied. Gentle and even Scraping was applied with 15-20 repetitions every 3rd day without inducing rash (sha). Selected acupoint included the commonly selected Tsusanli (St-36) for anti-fatigue Scraping and stomach meridians and collaterals of foot-yangming, Guanyuan and Ren meridians and collaterals, Shenyu (Bl-23) and bladder meridian (Ma, 2003). Scraping for Shenyu and bladder meridian was performed from top to bottom bilaterally along the spine. Scraping for Guanyuan and Ren meridians and collaterals was performed on the Ren meridians and collaterals of the abdominal midline and was enhanced at the Guanyuan acupoint (Lv, 1996). Scraping for Tsusanli and stomach meridians and collaterals of foot-yangming was performed on part of the stomach meridians and collaterals of foot-yangming at the anterior of the knee joint and was focused on Tsusanli (Hou and Lu, 1999).

Sample collection and measurement: After strength exhaustion on the 1st day of the 8th week of training, the first blood sample was collected from the retro-orbital vein under slight anesthesia and the second sample after euthanasia. The blood was mixed with corresponding anti-coagulants for serum or plasma preparation, based on the requirement of the indices and manufacturer's instructions. Immunoglobulin (IgG) measurement was performed using a kit from the China Institute of Atomic Energy and interleukin-6 (IL-6) and β-endorphin were measured using ELISA kits from the Second Military Medical University, according to the instructions. Immune organs including the spleen and thoracic gland were weighed after removal of blood. Organ indices were calculated as the organ weight/body weight.

Statistic analysis: All data were expressed as the mean value±SD. Statistical analysis was performed using SPSS version 12.0 using the Student's t-test between groups. A p value <0.05 was considered statistically significant.

RESULTS AND DISCUSSION

Effect of Scraping on the time to strength exhaustion of rats in endurance training: The result indicated that the time to strength exhaustion was significantly prolonged in the Scraping plus training group compared with the training only control group, with a change of 30.41% (Table 1). There was a significant difference in motor duration between groups (p<0.01), suggesting that Scraping significantly enhanced the athletic ability of rats during long-term endurance training.

Effect of Scraping on the body weight of rats in endurance training: Results in Table 2 showed that the body weight increase of rats in group B was significantly lower than in group A (p<0.01). The body weight increase in group C was significantly greater (p<0.05) than group C but smaller than group A (p<0.05).

In sports medicine, the measurement of body weight may represent the effect of training on the body and the adaptation of the body to the training. If the body weight decreases gradually, it suggests that training is not suitable or there may be underlying disease (Feng and Li, 2002). In the present study, rats in group B increased body weight slowly during the high intensity training, suggesting that the motor intensity was too large, which affected the normal growth of rats. The results indicated that Scraping could inhibit the descending trend of body weight obtained during high intensity training.

Effect of Scraping on the indices of immune organs: Results of Table 3 indicated that the spleen and thoracic gland indices in group B were significantly lower than group A (p<0.05, p<0.01, respectively) and group C (p<0.05), as shown in Table 3.

Table 1: Effect of scraping and plate running on the time to strength exhaustion of rats during endurance training

Group	Training control group (B)	Scraping + training group (C)
Time to strength exhaustion (min)	87.13 ± 8.39	113.63 ± 10.72△△
Change rate of strength exhaustion	–	30.41%

△△: p<0.01 vs training control group

Table 2: Effect of scraping and plate running on the body weight of rats during endurance training

Name	Quiet group (A)	Training control group (B)	Scraping + training group (C)
Body weight pre-training (g)	198.25±5.99	200.62±9.02	199.13±8.84
Body weight post-training (g)	315.63±10.95	287.25±11.15	301.98 ±11.09
Body weight increase	117.38±10.47	86.63±8.85**	102.85±9.98*△
Increase rate	59.20%	43.18%	51.65%

**: p<0.01 vs group A; *: p< 0.05 vs group A; △△: p< 0.01 vs group B; △: p<0.05 vs group B

Table 3: Effect of scraping and plate running on the indices of immune organs of rats during endurance training

Name	Quiet group (A)	Training control group (B)	Scraping + training group (C)
Spleen (mg/g)	2.48±0.21	2.22±0.17*	2.49±0.22△
Thoracic gland (mg/g)	1.26±0.17	0.98±0.13**	1.15±0.11△

**: p<0.01 vs group A; *: p< 0.05 vs group A; △: p<0.05 vs group B

Table 4: Effect of scraping and plate running on serum IgG and IgM levels in rats during endurance training

Name	Quiet group (A)	Training control group (B)	Scraping+training group (C)
IgG (mg/mL)	11.94±1.13	8.85±0.87**	10.14±0.96*△
IgM (mg/mL)	0.72±0.08	0.59±0.06*	0.67±0.06△

**: p<0.01 vs group A; *: p< 0.05 vs group A; △: p<0.05 vs group B

Table 5: Effect of scraping and plate running on IL-6 and β-endorphin of rats during endurance training

	Quiet group (A)	Training control group (B)	Scraping + training group (C)
IL-6 (pg/mL)	317.31±32.08	432.34±44.36**	353.55±37.59*△△
β-EP(ng/mL)	508.11±49.96	631.90±65.89**	564.42±57.88*△

**: p<0.01 vs group A; *: p< 0.05 vs group A; △△: p< 0.01 vs group B; △: p<0.05 vs group B

Organ indices may reflect the nutrition state and pathologic situation of vesicles in experimental animals and indirectly reflect the immune function of organs. Long-term strength exhaustion could damage organs such as the liver and spleen and decrease immune functions (Miao, 1997). The spleen and thoracic gland indices of rats in group C were higher than group B. Based on the biological principle of consistency between structure and function, an increase in the organ indices suggested that the basic metabolic ability and biological functions were enhanced and that immune function was increased, which may enhance athletic ability. The increase of immune organ indices suggested that Scraping could enhance the basic metabolic rate and possibly immune function, in rats.

Effect of Scraping on the serum IgG and IgM levels: Results in Table 4 indicated that IgG and IgM levels in group B were significantly decreased compared with group A (p<0.05, p<0.01) while the IgG and IgM levels in group C were significantly increased compared with group B (p<0.05). The IgG levels in group C were also significantly increased compared with group A (p<0.05).

Serum IgG and IgM are the major effectors of systemic humoral immunity and may have effects in sports medicine (Nemet *et al*., 2004). In the present study, IgG levels were significantly decreased in group B rats after strength exhaustion, suggesting that exhaustive sports over a long-term could stimulate the immune stress response and deplete IgG levels. This may result in a decrease of immune function, consistent with a previous study where Scraping effectively relieved the over-consumption of IgG and IgM during training (Wu, 2007). The mechanism of the effects of Scraping on the enhanced discharge of metabolites and activation of IgG-related syntheses, which increases the synthesis and decreases the destruction of IgG remain to be further investigated.

Effect of scraping on serum IL-6 and β-endorphin levels: Results in Table 5 indicated that IL-6 and β-endorphin (β-EP) in group B were significantly increased compared with group A (p<0.01) while IL-6 and β-EP in group C were significantly decreased compared with group B (p<0.05). IL-6 and β-EP in group C were significantly increased compared with group A (p<0.01, p<0.05, respectively), as shown in Table 5.

IL-6 has an important role in sports-mediated functional regulation and therefore is termed "exercise factor" and receives attention in sports medicine (Wang *et al*., 2007). A study by Keller *et al*. (2003) and Pedersen *et al*. (2003) indicated that suitable long-term endurance training could enhance serum IL-6 levels. Previous studies indicated that endurance training could also enhance muscle glycogen. However, increased muscle glycogen can inhibit the production of IL-6 (Keller *et al*., 2003). The present study indicated that muscle glycogen in group B was decreased while serum IL-6 was significantly increased when compared with group A, suggesting that long-term strength exhaustion may induce IL-6. Animals may then be susceptible to immune stress resulting in decreased sports ability. Serum IL-5 in group C was significantly lower than in group B, suggesting that Scraping might maintain serum IL-6 levels and enhance the immune system. β-endorphin is a neuropeptide which has immunomodulatory functions, mainly in the bi-directional regulation of red blood cells. The current study indicated that serum β-endorphin in group B rats was significantly increased after strength exhaustion, which may cause over-fatigue. Serum β-endorphin in group C was significantly lower than group B, suggesting that Scraping could effectively enhance the body's defense against the stress response induced by high intensity sports. Thus, Scraping may improve immune modulation of stressed rats and reduce endogenous β-endorphin release to maintain normal physiological immune function.

Scraping can inhibit immune disorders induced by endurance sports with high strength exhaustion, by enhancing immune function and preventing over-fatigue. The mechanisms induced by Scraping include:

- Autohemolysis of epidermal hem stasis and subsequent production of a histamine-like substance, which is distributed around the body following the blood circulation, Qi and blood. Therefore, Scraping mediates its effects by blood vessel expansion, capillary rupture and formation of static blood maculas in local skin. This new stimulation increases local circulation, enhances the metabolism, recovers the balance between Yin and Yang and increases the total quality and anti-disease capability of the whole body. Thus, autohemolysis is a positive weak stimulating process that can enhance the immune function.

- Scraping can directly stimulate nerve terminals, modulate the neuroendocrine system, promote lymph circulation, enhance phagocytes, increase cellular and humeral immunity, increase serum IgG and enhance the immune system. A number of reports have been published on the effects of Scraping on the endocrine system (Gao and Wang, 2005).
- The effects of CarPoint's selected in the present study are important for the effects of Scraping. Ren meridians and collaterals are the source of Yin in the body, governing growth and death; the bladder meridian and kidney meridians and collaterals of foot-Shaoyin are alternatively exterior and interior for each other; the stomach meridians and collaterals of foot-yangming are termed the root of later heaven, governing spleen-stomach, assisting transportation and transformation, notifying Qi and blood and maintaining the whole body. Tsusanli, Guanyuan and Shenyu acupoints can tonify kidney and culture sources, replenish Qi and notify blood and strengthen the body. It was reported that acupuncture or moxibustion of Tsunamis, Shenyu and Guanyuan could enhance sports ability and immune functions in rats and mice (Lin, 2005).

CONCLUSION

The present study indicated that Scraping may enhance the sports ability of rats during endurance training, delay sports fatigue, prevent the decrease of body weight and immune organ indices following training, inhibit the reduction of serum IgG and reverse the increase of serum IL-6 and β-endorphin. These results suggest that Scraping may reduce the inhibition of immune function induced by over-training. Chinese Traditional Medicine can be labeled a "green therapy", with features of simple manipulation, low cost and no toxic effects of chemicals. Application of such strategies may be beneficial for sports medicine.

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