

DOCTORAL THESIS

A comparative study on the treatment of exercise induced fatigue between qi-supplementing herbs and qi-rectifying herbs

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**A Comparative Study on the Treatment of Exercise Induced
Fatigue between Qi-supplementing Herbs and Qi-rectifying
Herbs**

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Abstract

Fatigue is a complex and multifaceted phenomenon. Physical exercise can induce fatigue. Studies showed that the central nervous system played an important role in the exercise-induced fatigue. Hypotheses have been developed that neurotransmitters may be involved in the origination of central nervous system fatigue. Besides central nervous system fatigue, a variety of studies have demonstrated that the exhaustive exercise induces considerable depression in the function of the immune system. In China, most physicians consider that over-training causes exercise-induced fatigue. Usually the over-training induces the Qi- deficiency(氣虛), so they often use the Qi-supplementing (補氣, QS) herbs to eliminate exercise-induced fatigue. Radix Astragali (黃芪) was one of the most often used QS herbs in treatment of exercised induced fatigue. But in clinical study, it was considered that Qi-deficiency is not the only cause of fatigue, the Qi depression and stagnation (氣滯) was another reason of the fatigue besides the deficiency of Qi. Therefore, we used the Qi rectifying(理氣, QR) herbs with QS herbs to treat fatigue, and have achieved the desired effect in the clinical treatment.

According to the clinical research , the Chinese herbs Rhizoma Cypei (香附) and Fructus Aurantii (枳殼) were effective to treat the Qi depression and stagnation in fatigue. They were selected as a combining group of QR&QS (理氣補氣) to treat fatigue. To evaluate the efficacy of QR&QS(理氣補氣) herb group, Radix Astragali (黃芪) was used as QS (補氣) herb to compare with QR&QS(理氣補氣) herbs group.

In the first part of the study, the animal model of exercise-induced fatigue was successfully established by the heavy treadmill exercise. It was found that 5-weeks of heavy exercise significantly reduced the rats' exercise performance in treadmill exhaustion tests. Heavy exercise exhibited an increase-immobility effect on the tail suspension test. From the result of the treadmill exhaustion test and the tail suspension test, it can be concluded that the heavy exercise caused the fatigue in the rats.

In the second part of the study, the effect of heavy exercise on the nervous system was observed. It was found that the heavy exercise increased the serotonin and decreased the dopamine synthesis and the metabolism. It was also found that 5-week heavy exercise induced the reduced c-fos mRNA expression in the cortex but enhanced c-fos protein expression in the CA1, CA2 field of the hippocampus.

In the third part of the research, the effect of the heavy exercise on the immune system was observed. The 5-week heavy exercise induced an increase in serum IL-6 concentration; a decrease in the ratio of T-helper / T-cytotoxic cell in T cell subsets, which means that 5-weeks of heavy exercise induced depression in immune function of the rats.

Comparing the effect of the Chinese herbs group of QR&QS(理氣補氣) and Chinese herbs of the QS(補氣), it was found that both of the two kinds of herbs can improve the exercise performance (increase the time of exhaustion running), exhibit an anti-depression effect during the heavy exercise (decrease the duration of the immobility in tail suspension test). Both of them improved the c-fos mRNA expression in the cortex. Both of them can blunt the decrease of the ratio of T-helper / T-cytotoxic cell in T cell subsets. But there are significant differences between the effects of these two kinds of herbs. The Chinese herb of QS not only increased the noradrenergic cell and the dopaminergic cell activity but also reduced the IL-6 level in serum after heavy exercise. The Chinese herbs group of QR&QS cannot reduced the IL-6 level in serum after heavy exercise. The Chinese herbs group of QR&QS not only can increase DA synthesis and metabolism but also can decrease the serotonin concentration in the rat brain. The Chinese herb of QS cannot blunt the increase of the level of serotonin induced by the heavy exercise. This means both QR&QS and QS herbs are effective to treat the exercise-induced fatigue, but their mechanisms are different.

摘要

疲勞是一種複雜的現象。所謂疲勞是指持久或過度勞動後引起機體不適和工作效率降低。1982年第五屆國際運動生化學術討論會上將疲勞定義為“機體生理過程不能持續其機能在特定水平上和(或)不能維持預定的運動強度”。衆所周知運動能誘發中樞疲勞。但是運動誘發的中樞疲勞的機制還不清楚。有假說認為多種神經遞質與疲勞的產生有關。

除中樞神經系統疲勞之外，越來越多證據表明高強度的運動可以誘發免疫系統的功能下降。大部分醫生認為運動性疲勞是由過度訓練引起的。《素問·舉痛論篇》說：“勞則氣耗，勞則喘息汗出，內外皆越，故氣耗矣。”過勞可以導致氣虛，所以，他們經常用補氣藥來治療運動性疲勞。黃芪是最常用的治療運動性疲勞的補氣藥。它還能改善免疫系統的功能。在臨床研究中，我們認為氣虛不是產生疲勞唯一原因，氣滯是另一個產生疲勞的重要原因。因此，我們在補氣藥中加入理氣中藥來治療疲勞，並在臨床的治療中達到了預期效果。枳殼和香附可以有效治療疲勞引起的氣滯。這樣，由中藥枳殼、香附和黃芪組成了理氣補氣中藥來治療疲勞。

在本研究的第一部分中，通過高強度運動訓練成功地建立了運動性疲勞的動物模型。5星期大強度訓練減少了跑台力竭試驗的力竭運動時間，增加了懸尾試驗中的靜止時間。從跑台力竭試驗和懸尾試驗的結果可以證明大運動量訓練引起了大鼠的疲勞。

在本研究的第二部分中，著重觀察了高強度運動訓練引起的神經系統的變化。高強度運動訓練能增加5-羥色胺，減少多巴胺在大腦中的合成和代謝。另外，5星期的高強度運動訓練能夠誘發靜止時期大鼠海馬的CA1、CA2區的c-fos蛋白表達增強和皮層的c-fos mRNA表達下降。

本研究的第三部分，著重觀察了高強度運動訓練對於免疫系統的影響。5星期的

高強度運動訓練引起了血漿IL-6濃度的增加，T細胞亞群中輔助性T細胞/抑制性T細胞的比率的下降。實驗結果表明：5星期的高強度運動訓練導致大鼠的免疫功能下降。

比較補氣藥和理氣補氣藥，兩者都能改善疲勞大鼠的運動能力（力竭運動時間增加）；都能改善疲勞大鼠的中樞抑制狀態（減少懸尾試驗中的靜止時間）。他們都能增加皮質c-fos的mRNA表達。兩種中藥都能增加T細胞亞群中輔助性T細胞/抑制性T細胞的比率。

但是，兩種中藥的藥理作用也有明显的差異。

補氣藥不僅能促進去甲腎上腺素和多巴胺在大腦中的合成和代謝，還有外周性抗疲勞作用，補氣藥能減少疲勞大鼠血漿IL-6濃度。理氣補氣藥不僅可以增強多巴胺在大腦中的合成和代謝，還可以明顯減少疲勞大鼠大腦5-羥色胺的合成和代謝。理氣補氣藥不能夠降低疲勞大鼠血漿IL-6濃度，而補氣藥不能減少疲勞大鼠大腦5-羥色胺的合成和代謝。上述結果表明補氣藥和理氣補氣藥均可有效地治療運動性疲勞，但是作用機制不同。

Table of Contents

	Page
Declaration	i
Abstract	ii
Acknowledgments	vi
Table of Contents	vii
List of Tables	xii
List of Figures	xiii
List of Abbreviations	xvi
List of Chinese medicine terms	xix

CHAPTER 1 INTRODUCTION

1.1	Exercise Induced Fatigue	1
1.1.1	Introduction of the Exercise Induced Fatigue	1
1.1.2	The Immune System and Exercise Induced Fatigue	3
1.2	Review of the Exercise Induced Fatigue	5
1.2.1	Mechanisms of Exercise Induced Central Nervous System Fatigue	5
1.2.1.1	Neurotransmitters and Exercise Induced Fatigue	6
1.2.1.2	Brain Acetylcholine and Exercise Induced Fatigue	6
1.2.1.3	Brain Catecholamine and Exercise Induced Fatigue	7
1.2.1.3.1	Norepinephrine and Exercise Induced Fatigue	9
1.2.1.3.2	Brain Dopamine and Exercise	10
1.2.1.4	Brain Serotonin and Exercise	17
1.2.1.5	The Relationship Between the Role of the Dopamine and Serotonin in Exercise Induced Central Nervous system Fatigue	23
1.2.1.6	C-fos Expression and Exercise	24
1.2.2	Exercise induced fatigue and the immune system response	29
1.2.2.1	Introduction of the immune system	30
1.2.2.2	Acute exercise and immune system	33
1.2.2.3	The moderate exercise and the immune system	37
1.2.2.4	Long-term heavy exercise and the immune system	39
1.3.	Chinese herbs treatment to exercise induced fatigue	44
1.3.1	Introduction	44
1.3.2	Chinese herbs treatment to fatigue in clinic	44
1.3.3	Chinese medicine treatment to exercise induced fatigue	45
1.3.4	Chinese herbs of Qi-rectifying	47

1.3.5	Chinese herbs of Qi supplementing	47
1.3.6	Herbs in the Qi supplementing& Qi rectifying herbs group	48
1.3.6.1	Fructus Aurantii	49
1.3.6.2	Rhizoma Cypei	50
1.3.6.3	Radix Astragali	51
1.4	Introduction of the detection of the catecholamine neurotransmitters in the brain of the rat	52
1.5	Aims of the study	55

CHAPTER 2 MATERIALS AND METHODS

2.1	Materials	56
2.1.1	Exercise training	56
2.1.1.1	Sprague Dawley rats	56
2.1.1.2	Treadmill Exerciser for the training	57
2.1.2	Detection of Monoamines and Metabolites in the rat brain	59
2.1.2.1	The HPLC-EC equipment	59
2.1.2.1.1	The waters 510 pump	59
2.1.2.1.2	Electrochemical Detector	59
2.1.2.1.3	The Perkin-Elmer ODS HC-18 reverse phase column	59
2.1.2.1.4	The eluting solvent	60
2.1.2.1.5	The homogenizing solution	60
2.1.2.1.6	The internal standard	60
2.1.2.1.7	The external standards for the detection of the neurotransmitters	61
2.1.3	The immunostaining of c-fos protein in the hippocampus	61
2.1.3.1	The brain fixation solution	61
2.1.3.2	The ABC staining for c-fos protein	61
2.1.4	The c-fos mRNA expression by northern blot	62
2.1.5	Immunocytochemical staining of T cell subsets	63
2.1.6	Serum IL-6 ELISA Assay	64
2.2.	Methods	65
2.2.1	The training procedure of the rats.	65
2.2.2	Preparation of the Chinese herbs for the perfusion stomach to the rats	67
2.2.3	The tail suspension test for rats	69
2.2.4	Treadmill exhaustion Test	71
2.2.5	Determination of the neurotransmitters and metabolites by the HPLC system	72
2.2.5.1	Sample preparation	72
2.2.5.2	Preparation of external standards	73
2.2.5.3	Calculation of the neurotransmitters	76
2.2.6	The c-fos mRNA expression by the Northern blot analysis	78
2.2.6.1	Total RNA extraction.	78

2.2.6.1.1 Tissue preparations	78
2.2.6.1.2 Total RNA extraction by TRIZOL reagent	78
2.2.6.1.3 RNA precipitation	79
2.2.6.1.4 RNA wash	79
2.2.6.1.5 RNA concentration/purity estimation	80
2.2.6.2 First strand cDNA synthesis	81
2.2.6.3 Amplification of the c-fos cDNA	81
2.2.6.4 Purification of DNA from PCR Amplifications	85
2.2.6.5 The ligations of the c-fos c DNA to pGEM®-T Vectors	86
2.2.6.6 Transformation of competent cell DH5 α with pGEM®-T /c-fos ligation reactions	88
2.2.6.7 The selection of the transformants	89
2.2.6.8 The plasmid preparation	91
2.2.6.9 Plasmid Digestion	93
2.2.6.10 The extraction of the c-fos DNA from the gel	95
2.2.6.11 The sequencing of the c-fos cDNA probe	97
2.2.6.12 Formaldehyde agarose gel electrophoresis	101
2.2.6.13 The northern hybridization	103
2.2.7. Staining of c-fos protein in the hippocampus of rat	105
2.2.7.1 Sample preparation	105
2.2.7.1.1 Perfusion and fixation	105
2.2.7.1.2 Sagittal cutting of the brain	106
2.2.7.2 The c-fos protein staining by avidin-biotin-peroxidase reaction	108
2.2.7.3 The double fluorescence staining of c-fos protein and D1 receptor	110
2.2.8 Measurement of Serum IL-6 by Elisa method	112
2.2.9 Analysis of T cell subsets by flow-cytometer system	115
2.2.10 Statistical Analysis	120

CHAPTER 3 RESULTS

3.1 The effect of the heavy exercise on the rats' body weight	121
3.2 The Treadmill exhaustion Test	123
3.2.1 Introduction	123
3.2.2 Results	123
3.3.2 Discussion	124
3.3 Tail Suspension Test	126
3.3.1 Introduction	126
3.3.2 Results	126
3.3.3 Discussion	127
3.4 The effect of Chinese herbs on the neurotransmitters in the rats' brain	129

3.4.1	The effect of Chinese herbs treatment on concentration of the norepinephrine in the exercise induced fatigue rats' brain	129
3.4.1.1	Introduction	129
3.4.1.2	Results	130
3.4.1.3	Discussion	130
3.4.2	The effect of Chinese herbs treatment on the concentration of dopamine in the exercise induced fatigue rats' brain	134
3.4.2.1	Introduction	134
3.4.2.2	Results	134
3.4.2.3	Discussion	135
3.4.3	The effect of Chinese herbs treatment on the concentration of the dihydroxyphenylacetic acid in the exercise induced fatigue rats' brain	137
3.4.3.1	Introduction	137
3.4.3.2	Results	137
3.4.3.3	Discussion	138
3.4.4	The effect of Chinese herbs treatment on the concentration of the serotonin in the exercise induced fatigue rats' brain	140
3.4.4.1	Introduction	140
3.4.4.2	Results	140
3.4.4.3	Discussion	141
3.4.5	The effect of Chinese herbs treatment on the concentration of the 5-hydroxyindoleacetic acid in the exercise induced fatigue rats' brain	143
3.4.6	The Relationship Between the brain Dopamine and Serotonin in Exercise Induced Central Nervous system Fatigue	145
3.4.6.1	Introduction	145
3.4.6.2	Results	145
3.4.6.3	Discussion	146
3.5	The level of the c-fos mRNA expression in the rat cortex	148
3.5.1	Introduction	148
3.5.2	Results	148
3.5.3	Discussion	150
3.6	The c-fos protein expression in the hippocampus of the rats	152
3.6.1	Introduction	152
3.6.2	Results	152
3.6.3	Discussion	154

3.7	The relationship between the c-fos expression and brain Dopamine and serotonin	164
3.8	The effect of Chinese herbs treatment on the immune system of the exercise induced fatigued rat	169
3.8.1	Effect of Chinese Medicine on the changes of serum concentration of IL-6 in different rat groups	169
3.8.2	The exercise and the Chinese herbs treatment effect on the T cell subsets	172
3.8.2.1	Introduction	172
3.8.2.2	Results	172
3.8.3	Discussion	179

CHAPTER 4 GENERAL DISCUSSION

4	General discussion	181
	Further Studies	186
	References	187
	Publications	214
	Curriculum Vitae	215