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Clinical Study

A comparative study of the effect of low-frequency electroacupuncture on blood lipids between men and women with simple obesity

低频电针对男女单纯性肥胖症患者血脂影响的比较

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Abstract
Objective: To observe the difference of the effect of low-frequency electroacupuncture (EA) on blood lipids between male and female patients with simple obesity due to damp induced by spleen deficiency.
Methods: Eighty patients with simple obesity were recruited, including 37 males and 43 females, to receive low-frequency EA by selecting Yinlingquan (SP 10), Sanyinjiao (SP 6), Zusanli (ST 36), Fenglong (ST 40), Quchi (LI 11), Tianshu (ST 25), Zhongwan (CV 12), Shuifen (CV 9), Qihai (CV 6) and Guanyuan (CV 4), with needles retained for 30 min. The treatment was given once a day, 10 sessions as a treatment course, for 2 courses in total. The contents of body fat percentage (F%), total cholesterol (TC), triglyceride (TG), high-density lipoprotein (HDL), low-density lipoprotein (LDL), blood glucose (Glu) and adiponectin (ADPN) in serum were observed to see the changes, and the two groups were compared and analyzed.
Results: After the treatment, F%, and serum contents of TC, TG, LDL, Glu and ADPN dropped significantly in the two groups (P<0.05 or P<0.01) and the serum content of HDL increased significantly in male group (P<0.05). The decrease of F% in female group was more significant than that in male group (P<0.01); the decrease of ADPN in male group was more significant than that in female group (P<0.05).
Conclusion: EA can regulate the disordered blood lipids in male and female patients with simple obesity, with certain differences between genders. The decrease of subcutaneous fat content is more significant in females than that in males, while the decrease of ADPN is more significant in males.
Keywords: Acupuncture Therapy; Electroacupuncture; Obesity; Sex Characteristics; Lipids; Blood Glucose; Adiponectin

【摘要】目的：探讨低频电针对脾虚湿盛型男女单纯性肥胖症患者血脂调节作用的差异性。**方法：**共纳入单纯性肥胖症患者80例，其中男性组37例，女性组43例，均采用低频电针刺激阴陵泉、三阴交、足三里、丰隆、曲池、天枢、中脘、水分、气海及关元治疗，每次留针30 min，每天治疗1次，10次为1个疗程，共治疗2个疗程。观察两组患者治疗后患者体脂百分率(F%)及血清胆固醇(TC)、甘油三酯(TG)、高密度脂蛋白胆固醇(HDL)、低密度脂蛋白胆固醇(LDL)、血糖(Glu)及脂联素(ADPN)含量变化，并进行两组比较、分析。**结果：**治疗后两组患者F%及血清TC、TG、LDL、Glu和ADPN含量均较治疗前明显下降(P＜0.05或P＜0.01)，男性组血清HDL含量升高(P＜0.05)；女性组患者F%较男性组降低明显(P＜0.01)，男性组患者血清ADPN含量较女性组降低明显(P＜0.05)。**结论：**电针对男女单纯性肥胖症患者紊乱的血脂有明显的调节作用，但存在一定的性别差异，在降低皮下脂肪含量方面，女性优于男性，在降低血清ADPN方面，男性优于女性。
【关键词】针刺疗法；电针；肥胖症；性别特征；血脂；血糖；脂联素
【中图分类号】R246.1　　**【文献标志码】**A

Simple obesity mainly manifests as overweight and may complicate with metabolic disorders. It happens when calorie intake is more than the consumption and stored as fat in the body. Numerous literatures have declared that electroacupuncture (EA) produces significant efficacy in treating simple obesity[1-3]. Our previous studies of EA in treating simple obesity rats have found that different efficacies existed between genders[4-6]. Gender differences were also found by clinical trials in which EA was used to regulate insulin secretion in simple obese patients: body mass index

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(BMI) and serum insulin were improved more significantly in men than in women; women had a more significant decrease of serum leptin than men[7]. To further investigate the gender differences in the regulation of simple obesity by EA, between March 2014 and October 2015, we observed the effects of EA on the contents of body fat percentage (F%), total cholesterol (TC), triglyceride (TG), high-density lipoprotein (HDL), low-density lipoprotein (LDL), blood glucose (Glu) and adiponectin (ADPN), and compared the values between women and men with simple obesity. The report is given as follows.

1 Materials and Methods

1.1 Diagnostic criteria

By referring to the *Diagnosis and Efficacy Evaluation Criteria of Simple Obesity* modified by the Fifth National Academic Conference on Obesity in 1997[8].

1.1.1 Diagnostic criteria of Western medicine

Overweighed by over 20% compared to the standard (overweight is defined as that the actual weight overweighs the standard weight by ＜ 20%; overweighed by 20%-30% as mild obesity; 30%-50% as moderate obesity; ＞50% as severe obesity); F% ＞ 30% (for male, 25%-30% as overweight, 30%-35% as mild obesity, 35%-45% as moderate obesity, and ＞40% as severe obesity; for female, 30%-35% as overweight, 35%-40% as mild obesity, 40%-50% as moderate obesity, and ＞50% as severe obesity); BMI ＞25 (25-26 as overweight, 26-30 as mild obesity, 30-40 as moderate obesity, and ＞40 as severe obesity). Simple obesity can be diagnosed when at least 2 of the above items were conformed.

1.1.2 Diagnostic criteria of traditional Chinese medicine (TCM)

Dampness due to spleen deficiency: Dropsy, lassitude, a heavy sensation, oliguria, poor appetite, and abdominal fullness. Light red tongue body, with thin greasy coating. The syndrome of dampness due to spleen deficiency was diagnosed when 2-3 of the above symptoms presented, together with eligible pulse and tongue manifestations.

1.2 Inclusion criteria

Conforming to the diagnostic criteria of simple obesity of Western medicine and the syndrome of TCM; aged 18-40 years old; disease duration 1-10 years; not receiving other interventions for obesity 1 month prior to the study and during the study, and willing to receive follow-up study; no organic diseases; willing to take part in the study and having signed informed consent form.

1.3 Exclusion criteria

Secondary obesity according to medical history, physical examination and laboratory tests; breast-feeding or pregnant women, women ready for conception or in 1 year after delivery; severe cardiocerebrovascular, liver, kidney or hematopoietic diseases, mental disorders, or immune deficiency; diabetes, connective tissue disease, malignant tumor, multiple organ failure, hemophilia, or bleeding tendency; participated in other clinical trials in the recent 1 month; unable to adapt to the treatment used in this study.

1.4 Statistical analysis

The SPSS 13.0 version statistical software was adopted to process data. Measurement data in normal distribution were expressed as mean ± standard deviation ($\bar{x} \pm s$): intra- group comparisons were analyzed by paired *t*-test, and between-group comparisons were analyzed by independent sample *t*-test. Data in non-normal distribution were processed by nonparametric test. Two-tailed test was used in all the tests, and $P<0.05$ was considered to have a statistical significance.

1.5 General data

A total of 95 patients with simple obesity were recruited in this trial, including 45 male and 50 female patients. However, 15 cases dropped out during the study, and 80 cases completed the whole intervention finally (Figure 1).

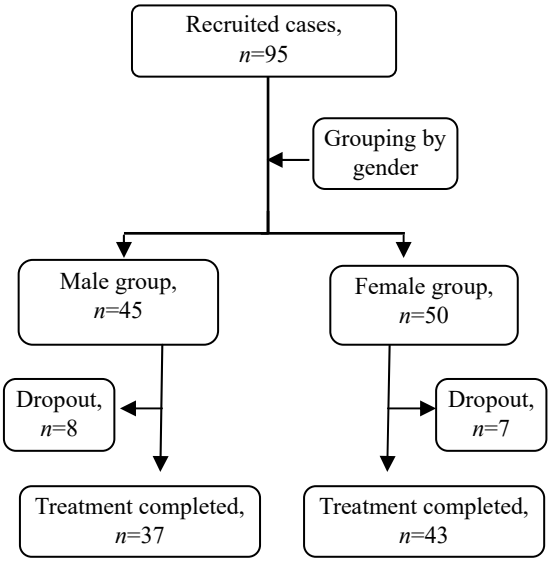

Figure 1. The flow chart

The 80 patients were from the Outpatient Departments of Hebei University of Chinese Medicine and Hebei Institute of Traditional Chinese Medicine Hospital. There were no significant differences in comparing the general data between the two groups (all $P>0.05$), indicating the comparability (Table 1).

Table 1. Comparison of general data

Group	*n*	Average age ($\bar{x}$ ±*s*, year)	Average duration ($\bar{x}$ ±*s*, day)	BMI ($\bar{x}$ ±*s*, kg/m^2)
Male	37	23.1±2.5	3.5±1.5	28.7±1.5
Female	43	23.7±3.9	3.7±1.4	28.1±1.3

2 Treatment Methods

The male group and female group followed the same treatment protocol.

Points: Zhongwan (CV 12), Shuifen (CV 9), Qihai (CV 6), Guanyuan (CV 4), Ashi points (2-4 points in abdominal region where fat's accumulated), bilateral Yinlingquan (SP 9), Sanyinjiao (SP 6), Zusanli (ST 36), Fenglong (ST 40), Quchi (LI 11) and Tianshu (ST 25).

Method: Patients were asked to take a supine position. Filiform needles of 0.30-0.34 mm in diameter and 40-75 mm in length were used. After standard sterilization, limb points were perpendicularly punctured, and abdominal points were treated with point-toward-point needling method, Zhongwan (CV 12) toward Shuifen (CV 9), Qihai (CV 6) toward Guanyuan (CV 4), and Ashi towards Ashi (after needling qi arrived, the needle tip was pulled to the layer of fat and then pushed along the fat layer towards the target point). When needling qi was obtained, 2-3 pairs of points from the same body side were connected to EA apparatus (SDZ-II, Hwato Brand), with continuous wave at 20 Hz, with the two sides of points connected alternately. The treatment was given once per day, with needles retained for 30 min, 10 sessions as a treatment course at 2-day interval, for 2 successive treatment courses.

3 Observation of Results

3.1 Observation indexes and methods

3.1.1 Height and body weight

Specially-assigned person took one same vernier caliper to measure subscapular and triceps skinfold thickness before and after the treatment. By referring to the body density (D) table, F%＝(0.570÷D－4.142)×100%.

3.1.2 Biochemical items in serum

The contents of serum TC, TG, HDL, LDL, Glu and ADPN were detected before and after the treatment.

Before and after the treatment, 5 mL venous blood was drawn to inject into a tube containing 30 μL 10% ethylenediaminetetraacetic acid disodium (ETDA-2Na) and 40 μL aprotinin, centrifuged for 10 min at 3 000 r/min. Afterwards, serum was separated and reserved at −20 ℃. Glu was measured by glucose oxidase method; TC by oxidase method; TG by enzymatic-colorimetric assay; HDL and LDL by one-step method; ADPN by double antibody ABC-ELISA. All the tests were performed by the Experimental Center of Hebei University of Chinese Medicine.

3.2 Results

3.2.1 Comparison of F%

BMI was taken as the equilibrium parameter of obesity. Under normal condition, women have higher F% than men. Hence, with the same BMI, women's F% is much higher than that of men. In this study, F% dropped significantly in both groups after the treatment (P＜0.01), and the improvement in female group was more noticeable than that in male group (P＜0.01), (Table 2).

Table 2. Comparison of F% between the two groups ($\bar{x}$ ±*s*)

Group	*n*	Pre-treatment	Post-treatment	Difference
Male	37	33.45±3.46	30.04±3.40[1)]	3.98±2.13
Female	43	39.32±5.70	34.34±3.88[1)]	4.98±2.30[2)]

Note: Intra-group comparison, 1) P<0.01; compared with male group, 2) P<0.01

3.2.2 Comparison of blood lipids, Glu, and ADPN

After the treatment, the contents of serum TC, TG, LDL and ADPN in both groups, as well as Glu in male group dropped significantly, and the content of HDL in male group increased significantly (P＜0.05 or P＜0.01); the content of ADPN dropped more significantly in male group compared with female group (P＜0.05), (Table 3).

Table 3. Comparison of contents of blood lipids, Glu, and ADPN between the two groups ($\bar{x}$ ±*s*)

Group	*n*	Time	TC (mmol/L)	TG (mmol/L)	HDL (mmol/L)	LDL(mmol/L)	Glu (mmol/L)	ADPN (ng/mL)
Male	37	Pre-treatment	5.10±0.91	4.94±0.78	3.06±1.15	1.96±0.61	4.74±0.60	3056.11±762.27
		Post-treatment	4.90±0.86[2)]	4.67±0.90[2)]	3.18±1.16[2)]	1.82±0.76[2)]	4.51±0.69[2)]	2793.57±690.01[1)]
		Difference	0.21±0.10	0.27±0.11	0.12±0.06	0.14±0.09	0.23±0.08	263.16±96.30[3)]
Female	43	Pre-treatment	4.89±0.64	4.73±0.70	2.95±1.10	2.13±0.53	4.61±0.65	2773.48±580.18
		Post-treatment	4.75±0.73[2)]	4.59±0.79[2)]	3.04±1.01	2.03±0.69[2)]	4.59±0.61	2574.94±537.04[1)]
		Difference	0.12±0.08	0.15±0.09	0.09±0.05	0.10±0.07	0.05±0.02	199.14±84.85

Note: Intra-group comparison, 1) P<0.01, 2) P<0.05; compared with female group, 3) P<0.05

4 Discussion

From the long-time clinical experience, we've found that the syndrome of dampness due to spleen deficiency is predominant in simple obesity. To supplement spleen to resolve dampness and dissolve phlegm, and to unblock Fu organs to descend the turbid and eliminate fat[9], we selected the Meridians of Foot Taiyin, Hand and Foot Yangming, and Conception Vessel for treatment. Yinlingquan (SP 9), Sanyinjiao (SP 6) and Zusanli (ST 36) can reinforce spleen to dispel dampness, and help transformation and transportation; Fenglong (ST 40) and Zhongwan (CV 12) function to supplement spleen and resolve phlegm, and harmonize stomach and descend the turbid; Quchi (LI 11) and Tianshu (ST 25) work to regulate and unblock intestines and descend the turbid to dissipate fat; Shuifen (CV 9), Qihai (CV 6) and Guanyuan (CV 4) can tonify spleen and kidney, supplement qi and yang, and improve gasification and the movement of water. The above points were used concurrently to reduce food intake and lose weight through improving the function of spleen and stomach, dispelling dampness and phlegm, and unblocking Fu organs to eliminate the turbid[10-13].

It's found by modern research that simple obesity patients usually have dyslipidemia, presenting as hypertriglyceridemia and abnormal lipoprotein. The increased calorie intake of fatty tissues in simple obesity patients will lead to increased synthesis and storage of TG. Meanwhile, the content of HDL goes down, leading to impaired ability to clear away TC, subsequently causing dyslipidemia. In simple obesity, increased Glu level makes glycogen unable to decompose but transform into fat instead. ADPN is a type of factor produced by fatty tissue[14]. As an fatty tissue-derived insulin sensitizer[15], it promotes the absorption of glucose via activating AMP-activated protein kinase, and is positively correlated with HDL[16-17].

This study showed that acupuncture at the above points down-regulated F%, serum TC, TG, LDL, Glu, and ADPN, and up-regulated the content of HDL in both men and women with simple obesity. It evoked the sensitization of insulin via inhibiting the level of ADPN, and consequently reduced the contents of blood lipids. At the same time, gender difference was discovered in the modulation of lipid metabolism: the decrease of F% was more significant in women, while men had advantage in down-regulating ADPN. It's possibly because that ovary is the target organ of leptin[18] and female body chose to consume body fat for self-protection. While, ADPN works better in improving the sensitization of body to insulin under the action of androgen[19]. Unlike the previous studies, the current trial showed that there were no significant differences between women and men in the modulation of blood lipids and Glu, which was plausibly because of the limited sample size, or because that predominant subjects in this study were young, with normal range of blood lipids and Glu, reacting insignificantly to hormone intervention. To sum up, this study preliminarily revealed the differences between men and women with simple obesity in the regulation of EA on blood lipids and its possible action mechanism, and provided scientific evidences to the treatment of simple obesity of different genders in acupuncture clinic.

Conflict of Interest

The authors declared that there was no potential conflict of interest in this article.

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Statement of Informed Consent

Informed consent was obtained from all individual participants included in this study.

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