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Efficacy of transcutaneous electrical acupoint stimulation compared to electroacupuncture at the main acupoints for weight reduction in obese Thai women

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ABSTRACT

Introduction: Obesity can result in a reduced quality of life, substantial morbidity and mortality. Acupuncture therapy is an effective treatment for weight reduction but there are associated problems of needle shock and internal injuries.

Aim & objectives: This study is aimed at researching the effect of transcutaneous electrical acupoint stimulation (TEAS) as an anti-obesity treatment option for obese patients.

Methods: A prospective randomized open-label study was conducted in the Acupuncture Clinic in Srinakharinwirot University Hospital. Fifty-five obese women, who had body mass index (BMI) > 23 kg/m^2, were randomized to receive either TEAS or Electroacupuncture (EA) using 10 acupoints per session, two sessions a week for an 8-week period. Anthropometric parameters were measured throughout the treatment period. Weight reduction was considered as the primary outcome. Student's t-test and paired t-test were used to compare the continuous data between groups and intra-group, respectively. The effects of obese type (according to Traditional Chinese Medicine) and treatment methods on weight reduction were tested using a univariate analysis of variance.

Results: At the end of the study, weight and BMI reduction of the TEAS (1.2 kg and 0.47 kg/m^2, respectively) group were significantly decreased from the base line and were comparable with the reduction of those in the EA group (1.3 kg and 0.51 kg/m^2, respectively). There were no significant effects of treatment methods (F=0.052; P=0.82) and TCM types (F=3.487; P=0.07) on weight reduction.

Conclusions: TEAS was found to be an effective method for weight reduction as seen with EA. TEAS was found to be safe and feasible as a method for weight reduction in obese women.

Keywords: Electroacupuncture, transcutaneous electrical acupoint stimulation, obesity

Introduction and Background

Obesity is a grave and recalcitrant problem, the cause of substantial morbidity and mortality throughout the globe, and reduction of quality of life [1]. It is well established that obesity can be an underlying cause of many disorders such as arthritis, lung disease, diabetes, hypertension, coronary artery disease, heart failure, cataracts, cancer, and even early death [2, 3, 4]. The psychological effects are serious and may include depreciation of body self-image, poor quality of life and depression [3, 5].

Despite traditional treatment options, a noteworthy percentage of the elderly population remains obese. Because of the prevalent and stubborn nature of obesity, many investigators have started to focus on the various treatment options to solve this problem. Some recommend completely abandoning the dieting paradigm, which is has been found to be ineffective and even harmful [2, 6, 7]. This approach can only produce psychological changes without resulting in an actual weight loss [2, 7]. Some authors suggest the intake of the foods that cause obesity should be reduced, and support the use of herbs or nontraditional methods such as acupuncture for obese patients [2]. Comprehensive published data relating to acupuncture in the treatment of obesity is not to be found in the international literature.

A few reports showed acupuncture therapy was effective for reduction of weight in obesity [2, 8, 9, 10], but some negative reports also existed [11, 12]. Electroacupuncture (EA) was found to reduce body weight by decrease in food intake, by increase in energy expenditur or by both routes. However, common complications with EA are needle shock, organ puncture, sometimes resulting in internal injuries, especially when performed by inexperienced or unlicensed individuals. A new method of acupuncture, transcutaneous electrical acupoint stimulation (TEAS), is considered to be safe, and a useful treatment without adverse reactions. This study is aimed at determining the effect of TEAS as an option for anti-obesity treatment.

Materials and Methods

A prospective randomized open-label study was conducted in overweight or obese women by the Acupuncture Clinic, Srinakharinwirot University Hospital, during the period March to July 2010. Forty-five overweight or obese women aged over 15 years with body mass index (BMI) > 23 kg/m^2[13] and waist circumference > 80 cm were recruited for the study. Women with any history of bleeding disorders, pacemaker, epilepsy, uncontrolled hypertension, active dermatological problems at the area of acupuncture points, or currently committed to other methods for weight reduction, were excluded from the study. Pregnancy and lactatation were also exclusion factors.

The study protocol was approved by the ethics committee of the Faculty of Medicine, Srinakharinwirot University. Written informed consent was obtained from all participants before enrolment in the study.

Groups and intervention

Study participants were randomized to TEAS (n=23) or EA (n=22) groups using computer-generated random numbers and women in both groups received each treatment protocol over a period of 8 weeks. Ten acupoints were used for treatment: one point each at Guanyuan (RN 4), Qihai (RN 6), Xiawan (RN 10), Zhongwan (RN 12), and 2 points each at Tianshu (ST 25), Shuidao (ST 28), and Daheng (SP 15) (Figure 1). At each acupoint, subjects assigned to EA group were needled with disposable needles (0.25 x 25mm) while electrodes (1 x 1 cm) were attached for the subjects in the TEAS group. An electrical stimulator model HM Stim2 fit® (Wuxi Jiajian Medical Instrument Co Ltd, Wuxi, China) was applied with 0.2 ms pulses, at 40 Hz in the constant mode within the subject's tolerance level via the needles or electrodes, in accordance with their group. The needles or electrodes were left for 30 minutes and then removed. The treatment was rendered twice weekly for 8 weeks by a licensed acupuncturist (LR) with a minimum of 3 years

experience. To adjust for the response to treatment by distinction of types of obesity recognized by traditional Chinese medicine (TCM), all participants were sorted into one of two groups: the excessive type (excessive of the spleen and stomach) and the deficiency type (spleen deficiency or primary Qi deficiency)[14]. The main manifestations of the excessive type are excessive fat deposition, especially over the lumbar area with strong muscles, whereas the characterizing features of the deficiency type are obvious obesity in face, neck, abdomen or gluteal regions, and with lax muscles. During the study period, no specific instruction was given to the participants in regard to diet or exercise and medication for weight reduction.

Measurements

Demographic data and anthropometric parameters including age, weight, height, waist and hip circumference were recorded at the beginning and the end of the study [15]. Weight was additionaly measured at the 2nd and 4th week. Weight was measured to the nearest 0.1 kg using an electronic scale (Tanita®, BF-680W, Tokyo, Japan). Height, waist and hip circumferences were measured by tape to the nearest 0.1 cm.

Waist circumference was measured at the midpoint between the lower costal margin and the top of the iliac crest while the subject was in a standing position. Hip circumference was measured in the standing position at the maximum circumference over the buttocks [15]. The body mass index was calculated as the ratio of weight/ (height) ^{2} [kg/m^2][13]. All measurements were carried out by trained staff. Any adverse events during the treatment were recorded.

Statistical analysis

After being tested for normal distribution by Kolmogorov-Sminov test, all anthropometric data were found normally distributed and were descriptively presented as mean, standard deviation and 95% confidence interval. Differences of anthropometric characteristics and their change from baseline at each measure week between two groups were examined using student's t-test. The outcome measures at the end of the study were compared with the measures obtained at baseline using the paired t-test. A univariate analysis of variance was used to test the main and interaction effects of categorical variables of treatment methods and TCM classification on weight change during treatment. Statistical analysis was performed with SPSS (version 11.0, SPSS, Chicago, IL, USA). A p-value <0.05 was considered as statistically significant.

Results

After randomization of 45 women subjects, 23 women received transcutaneous electrical acupoint stimulation (TEAS) and 22 women received electroacupuncture (EA) therapy. All participants completed the study without withdrawal. Mean age of the study population was 33.6±7.0 (range 21-59 years). Baseline characteristics of the study population are detailed in Table 1. At the beginning of the study, subjects in TEAS and EA group were not significantly different in age, weight, BMI and hip circumference. Only the waist circumference was found significantly different (99.4±9.7 (EA) vs 92.8±5.5 (TEAS); $p<0.01$) between the two groups.

Of 23 participants in TEAS, 9 and 14 participants were classified as excess type and deficiency type, respectively. Of the 22 participants in EA, 9 and 13 participants were

classified as excess type and deficiency type, respectively. In each treatment group, there were no significant differences in any anthropometric data at the beginning of the study between TCM types. Mean body weight, BMI, waist and hip circumferences of excess type and deficiency types of obesity were 71.4 kg vs. 73.7 kg, 28.39 kg/m2 vs. 29.57 kg/m2, 96.5 cm vs. 95.8 cm, and 101.9 cm vs. 105.2 cm, respectively ($P > 0.05$).

At the end of the study, all anthropometric parameters of the participants in both groups significantly decreased from the baseline measures of study ($P < 0.01$). Furthermore, none of the parameters were significantly different between the groups. Waist circumference which was larger in subjects EA group than subjects in TEAS group at the beginning of the study (99.4 and 92.8 cm, respectively; $P<0.01$) was found to be non-significant at the end of the study (90.7 and 89.3 cm, respectively; $P = 0.60$). During the study, weight and BMI gradually decreased. Table 1 represents the changes in parameters at the end of study.

A univariate analysis of variance revealed no significant major effect of treatment methods ($F=0.052$; $P=0.82$), TCM classification ($F=3.487$; $P=0.07$) and interaction effects ($F=0.01$; $P=0.98$) on weight reduction at the end of treatment from the beginning of study. Table 2 represents the changes observed during the study. No adverse events were reported by the participants.

Discussion

The present study showed that at the 8th weeks of TEAS treatment, various indicators of obesity were significantly reduced as they were seen after the EA treatment. The study established that TEAS is as effective as the conventional treatment of acupuncture in reducing body weight, although it was seen that the EA group had a greater reduction in waist circumference compared to TEAS. The possible explanation could be the direct effects of needle puncture in the deep tissue rather that transit electrical energy penetration through skin as in TEAS. However, it is worth mentioning that the TEAS treatment produced less pain and is also free from the complications of needle acupuncture. Interestingly, the changes in anthropometric parameters were more consistent after each treatment of TEAS. The treatment had started to show its effectiveness after 2 weeks and from then on produced more success in the results. BMI was also found to be improved after treatment.

Previous research of acupuncture as a treatment option for obesity have focused on weight reduction and most of the trials indicated modest effect on weight reduction [16]. A meta-analysis review showed that acupuncture therapies, with various durations and protocols of treatment, had resulted in weight reduction ranging from 1.5 to1.9 kg compared with various control settings[16]. Compared to previous studies, the results of the present study did not show the same degree of weight reduction, which might be explained by the single intervention used and a lower initial body weight and BMI of the participants.

The present study using either TEAS or EA has shown the significant weight reduction of 1.2-1.3 kg in 8 weeks of treatment, equal to 1.7% reduction in body weight. This figure may not be comparable with previous studies which employed multiple forms of treatment, including diet and exercise therapy in conjunction with acupuncture[9, 17]. Previous studies using combined therapies produced weight reduction of 4.8-5.6 %, however, diet restriction alone had resulted in a 2.5% weight reduction in the same study [9]. Neither diet modification nor exercise programs were

included in the present study; therefore, we can emphasize the weight reduction was the real effect of either TEAS or EA. However, further study of combined therapy of TEAS and diet modification or exercise is advocated to clarify the optimal efficacy of this method.

Subjects in the present study might have lower initial body fat tissue than other studies as we used the diagnostic criteria of obesity for Asian (> 23 kg/m^2) rather than those for European populations (> 30 kg/m^2). Previous study showed the reduction of body fat percentage in the same degree of weight reduction in patients who received acupuncture therapy[18]. Moreover, there was some evidence that weight reduction by acupuncture therapy might relate to its lipolitic activity[19]. Further study comparing the efficacy of TEAS treatment for various degrees of obesity may elucidate those different responses.

Even the overall weight reduction from the present might not be comparable with other studies; some interesting points might be drawn from the present study. From our previous work in the same clinical setting as the present study, without any interventions, Thai obese women (BMI > 23 kg/m^2) who were on the list waiting for acupuncture treatment had an average weight gain of 1.2 kg/month[10]. As the weight trended to increase in the obese women, acupuncture could control and stop the rising weight without any adverse reaction observed. Weight reduction in the present study might be lower than our previous study which reduced weight for 2.6 kg in 8 weeks[10]. This might be explained by the differences in location and numbers of acupoints. However, the present study still supports our concept to simplify acupuncture therapy to use a common set of acupoints for all types of obesity classified by TCM rather than the specific set of acupoints for each type of obesity[20, 21] Our recommended acupoints, which achieved weight reduction in both types of obesity, may help the acupuncturists who have no experience to classify the correct obesity type. Moreover, all of the applied acupoints were not on the back. Our recommended acupoints only on the abdominal wall may help patients to restrict movement so they can lie steadily on their back during acupuncture which may last for over 30 minutes. Use of a portable gadget of TEAS, as in the present study, might give an option for persons wishing to control weight for a longer period.

In the present study, either TEAS or EA was used as a sole intervention for weight reduction differs from other studies reporting the combined effects of acupuncture, diet and exercise[22, 23, 24]. The present study reports acupuncture as the sole treatment without the confounding factors of other interventions.

The exact mechanism of acupuncture for weight reduction is not well elucidated. In TCM theory, the imbalance of life force (Qi) is believed to be the cause of obesity. Stimulation of the specific acupoints helps to correct this imbalance and leads to weight loss[2]. In the scientific concepts, they observed that acupuncture increased the neural activity of the ventromedial and lateral hypothalamus leading to decrease of appetite in the animal models[25, 26]. Increase of serotonin level in both central nervous system (CNS) and plasma was also observed in acupuncture model which induced weight loss by suppressing appetite and rearranging the psychomotor balance[19, 27]. Various studies of acupuncture therapy also showed the increase of beta endorphin both in CNS and serum which induced the lipolitic activity and caused weight loss [28, 29, 30]. However, the exact mechanism of weight loss resulting from acupuncture is outside the scope our study. Further study to elucidate this mechanism is advocated.

In conclusion, transcutaneous electrical acupoint stimulation is as effective as conventional electroacupuncture for weight reduction in obese Thai women. Additionally, TEAS is a practical and safe method for weight reduction in obese women.

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Conflict of interest: The authors have no conflict of interest to report.

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Table 1: Anthropometry at baseline and at the end of study (week 8) in study population

	TEAS (n=23)		EA (n=22)		P value
	Mean±SD	Paired t-test (*p* value)	Mean±SD	Paired t-test (*p* value)	Between groups
Age (yr)	34.4±7.7		32.7±6.3		0.45
Weight (kg)					
▪ Baseline (wk 0)	71.2±8.5		74.6±10.3		0.24
▪ End of study (wk 8)	70.1±8.4	< 0.01	73.3±10.6	< 0.01	0.26
BMI (kg/m^2)					
▪ Baseline (wk 0)	28.26±3.13		29.97±3.68		0.10
▪ End of study (wk 8)	27.79±3.13	< 0.01	29.45±3.76	< 0.01	0.11
Waist (cm)					
▪ Baseline (wk 0)	92.8±5.5		99.4± 9.7		< 0.01
▪ End of study (wk 8)	89.3±4.5	0.01	90.7±11.2	< 0.01	0.60
Hip (cm)					
▪ Baseline (wk 0)	102.3±5.8		105.5±6.7		0.09
▪ End of study (wk 8)	100.3±4.8	< 0.01	101.1±7.1	< 0.01	0.67
Waist/ Hip ratio					
▪ Baseline (wk 0)	0.91±0.04		0.94±0.07		0.05
▪ End of study (wk 8)	0.89±0.04	< 0.01	0.90±0.08	< 0.01	0.80

Table 2: Change in anthropometric characteristics from the beginning of the study

	TEAS (n=23)	EA (n=22)	P-value
Weight change (kg)[1]			
• At 2 weeks	0.6±0.8 (0.3-1.0)*	0.6±1.3 (-0.01-1.1)	0.87
• At 4 weeks	0.6±1.1 (0.1-1.0) *	0.7±1.3 (0.1-1.3) *	0.78
• At 6 weeks	0.8±1.7 (0.1-1.5) *	1.0±1.6 (0.3-1.7) *	0.58
• At 8 weeks	1.2±1.7 (0.5-1.9) *	1.3±1.6 (0.6-2.0) *	0.84
BMI change[1]			
• At 2 weeks	0.25±0.32 (0.11-0.39) *	0.22±0.51 (-0.01-0.46)	0.86
• At 4 weeks	0.23±0.44 (0.04-0.42) *	0.27±0.53 (0.03-0.51) *	0.79
• At 6 weeks	0.30±0.66 (0.02-0.59) *	0.42±0.64 (0.13-0.70) *	0.56
• At 8 weeks	0.47±0.66 (0.18-0.75) *	0.51±0.65 (0.22-0.80) *	0.80
Waist change at 8 wk[1]	3.5±4.2 (1.6-5.3) *	8.8±7.0 (5.6-11.9) *	<0.01
Hip change at 8 wk[1]	2.0±2.6 (0.9-3.1) *	4.4±4.8 (2.3-6.5) *	0.04
Waist/ hip ratio change at 8 wk[1]	0.02±0.05 (-0.003-0.04)	0.05±0.07 (0.01-0.08) *	0.11

(*Significant differences from the beginning of the study (P<0.05); [1]presented as Mean±SD (95%CI))

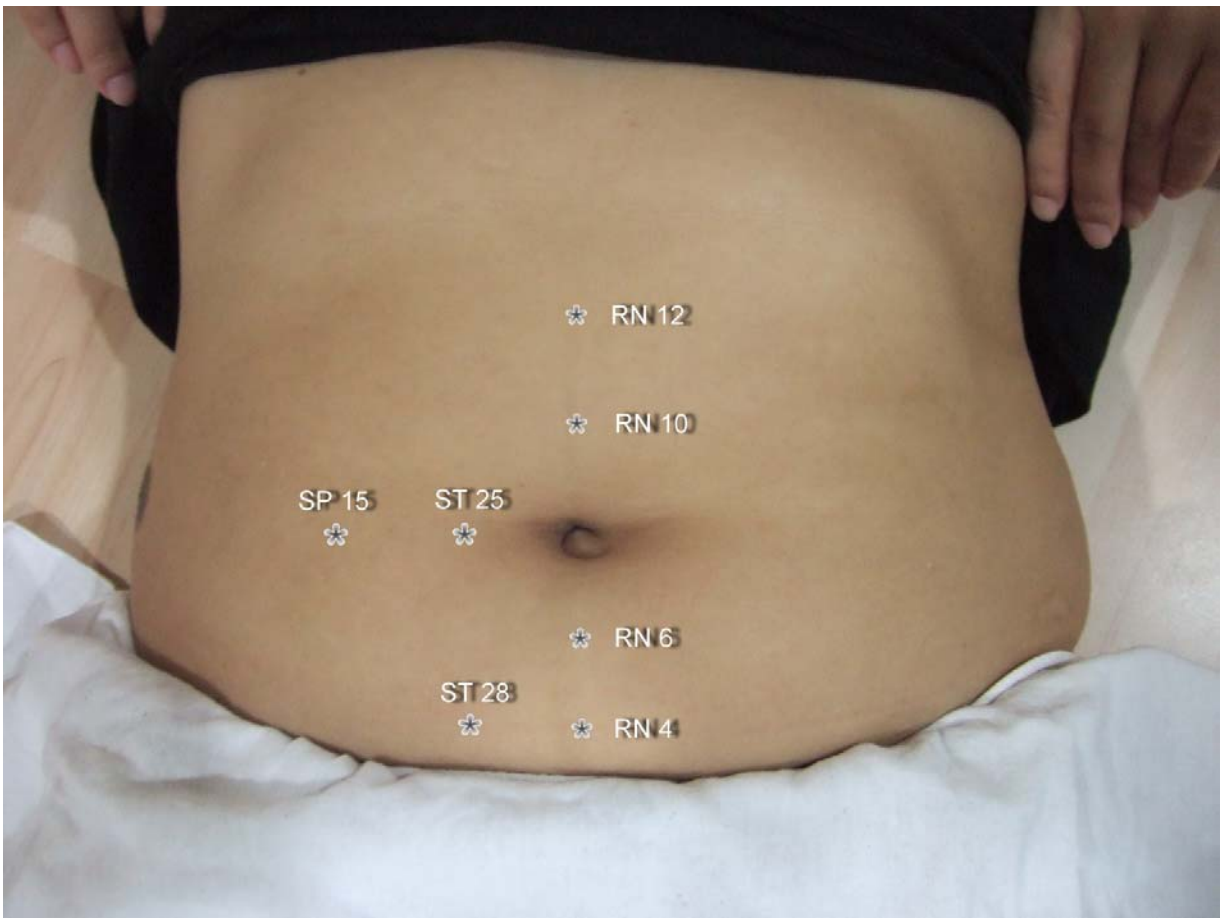

Figure 1: Demonstrate acupuncture points which were used in the study

Guanyuan (RN 4), Qihai (RN 6), Xiawan (RN 10), Zhongwan (RN 12), Tianshu (ST 25), Shuidao (ST 28), and Daheng (SP 15)