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Electroacupuncture Therapy for Weight Loss Reduces Serum Total Cholesterol, Triglycerides, and LDL Cholesterol Levels in Obese Women

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Abstract: Our purpose in this study was to investigate the effect of acupuncture therapy on body weight and on levels of the serum total cholesterol, triglyceride, high-density lipoprotein (HDL) cholesterol and low-density lipoprotein (LDL) cholesterol in obese women. Fifty-five women were studied in three groups as follows: (1) control group (n = 12; mean age = 43.3 ± 4.3, and mean body mass index {BMI} = 32.2 ± 3.4); (2) electroacupuncture (EA) (n = 22; mean age = 39.8 ± 5.3, and BMI = 34.8 ± 3.3); and (3) diet restriction (n = 21; mean age = 42.7 ± 3.9, and BMI = 34.9 ± 3.3). EA was performed using the ear points, Sanjiao (Hungry) and Shen Men (Stomach), and the body points, LI 4, LI 11, St 25, St 36, St 44 and Liv 3, once daily, for 30 minutes, for 20 days, whereas patients on diet restriction had a 1425 Kcal diet program, that consisted of 1425 Kcal daily for 20 days. There was a 4.8% weight reduction in patients with EA application, whereas patients on diet restriction had a 2.5% weight reduction. There were significant decreases in total cholesterol and triglyceride levels in EA and diet groups compared with the control group ($p < 0.05$ in both cases). Furthermore, there was a decrease in LDL levels in the EA group compared with the control group ($p < 0.05$). No significant changes could be found in HDL levels among the three groups. Our results suggest that EA application in obese women may decrease the serum total cholesterol, triglyceride, and LDL cholesterol levels by increasing the serum beta endorphin level. This lipolytic effect of EA may also reduce the morbidity of obesity by mobilizing the energy stores that result in weight reduction.

Keywords: Electroacupuncture; Obesity; Total Cholesterol; Triglycerides; LDL Cholesterol.

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Introduction

Obesity, defined as the illness of our century in many developed countries, is a chronic and progressive disease that decreases physical activity, and may also result in social and psychological problems in the affected people. It adversely affects the quality of life due to the metabolic changes that may further cause other morbidities. Chronic diseases such as coronary heart disease, hypertension, atherosclerosis, hyperlipidemia, and type II diabetes are frequently seen in obese people (De Fronzo and Ferrannini; 1991; Leonhardt *et al*., 1999). The android-type obesity, known as abdominal obesity, was reported to be closely linked with the increased risk of metabolic complications such as dislipidemia, hyperinsulinemia and also diabetes mellitus and cardiovascular diseases (Rattarasarn *et al*., 2003).

Obesity results from a higher caloric intake than is needed. The main principle in the treatment of obesity is to achieve a balance between caloric intake and expenditure. Diet restriction, increase in physical activity, pharmacotherapy, surgical methods and acupuncture application are effective therapeutic approaches to treating obesity (Ernst, 1997; Richards and Marley, 1998; Lyznicki *et al*., 2001). Therefore, decision making on these methods plays a crucial role in obesity treatment.

Acupuncture, one of the traditional Chinese medicine methods, is commonly used in obesity treatment. Electroacupuncture (EA) results in weight loss in obese people, when it is applied to particular points that are effective for obesity treatment (Zhan, 1993; Sun and Xu, 1993). Acupuncture application has been demonstrated to reduce the appetite (Shiraishi *et al*., 1995), and to relieve emotional factors such as stress (Mulhisen and Rogers, 1999) by increasing plasma endorphin levels (Richter *et al*., 1983; Vettor *et al*., 1993).

It has been previously shown that the decrease of plasma lipid levels is associated with both weight loss and reduced risk of many diseases, such as cardiovascular diseases (Rattarasarn *et al*., 2003). Therefore, we studied serum lipid levels including total cholesterol, triglyceride, high-density lipoprotein (HDL) cholesterol, and low-density lipoprotein (LDL) cholesterol in obese people following EA application and diet restriction therapy.

Materials and Methods

In this study, EA application was performed in a private acupuncture treatment clinic, and serum samples were studied at the laboratories of the Department of Physiology, the Meram Faculty of Medicine of Selcuk University.

Subjects

Informant consent was obtained from volunteers for EA application following the protocol approval by institutional ethics committees. The study included women, ages 35 to 50 with a body mass index (BMI) between 30 and 40. Fifty-five women were studied in three groups as follows: (1) control group (n = 12; mean age = 43.3 ± 4.3, and mean

Table 1. The Age, Waist/Hip Ratio, Height, Body Weight and BMI in the EA, Diet and Control Groups

Characteristics	EA Group (n = 22)	Diet Group (n = 21)	Control Group (n = 12)	F	P
Age	39.8 ± 5.3	42.7 ± 3.9	43.3 ± 4.3	2.97	0.060
Waist/Hip Ratio	0.84 ± 5.7	0.83 ± 4.3	0.83 ± 4.5	0.25	0.781
Height (cm)	1.60 ± 4.4	1.58 ± 6.0	1.58 ± 5.4	0.87	0.426
Body weight (kg)	87.5 ± 11.9	84.1 ± 10.5	78.9 ± 18.0	1.71	0.190
BMI	34.8 ± 3.3	34.9 ± 3.3	32.2 ± 3.4	2.97	0.060

EA: Electroacupuncture; BMI: body mass index.

body mass index {BMI} = 32.2 ± 3.4); (2) electroacupuncture (EA) (n = 22; mean age = 39.8 ± 5.3, and BMI = 34.8 ± 3.3); and (3) diet restriction (n = 21; mean age = 42.7 ± 3.9, and BMI = 34.9 ± 3.3). No statistically significant differences could be found in the mean values of age, waist/hip ratios, height, body weight, and BMI among these three groups (Table 1).

Control and Diet Groups

The 12 women in the control group were instructed to maintain their normal daily activities. A diet of 1425 kcal was given to the subjects in the diet group that provided the minimal calorie intake over their basal metabolism.

Electroacupuncture

Acupuncture points were determined by an electronic detector (Biotron 1000, ANDI Electromedical, Holbaek, Denmark), that gives a special light signal when it touches the relevant point, as "Personal Cun," a measurement unit in traditional Chinese medicine. The Hungry and Shen Men ear points, and the Hegu (LI 4), Quchi (LI 11), Tianshu (St 25), Zusanli (St 36), and Neiting (St 44) body points were used in the obesity treatment. The Hungry ear point is located at the junction of the lines drawn horizontally from the apex of tragus and vertically from the intertragic notch, whereas the Shen Men point is located at the one-third point of the lateral side of the upper edge of the triangular fossa.

The LI 4 point of the body is located at the dorsal face of the hand between the first and second metacarpal bones and in the middle of the radial side of the second metacarpal bone. The LI 11 point is located between the Lu 5 (Chise) and lateral epicondilus of the humerus, when the elbow is in flexion position at the end of the transversal cubital line. This point is the most lateral point of the elbow transversal curve when the arm is in maximal flexion position. The St 25 point is 2 cun lateral of umbilicus. The St 36 point is 3 cun below the low edge of the patella and between the tibials anterior muscle and the flexor digitorium communis muscle. The St 44 point is between the second and the third phalanges on the foot and at the lateral and distal sides of the second metatorsodigital joint.

EA was applied for 30 minutes from 8.00 to 8.30 am. Body EA was performed everyday and ear EA was performed every other day. After EA application, permanent ear needles were placed on the Hungry points. The body acupuncture needles were 5 cm long and the ear acupuncture needles were 3.5 cm long, with a 0.22 mm diameter. EA application was performed using a "Biotron 1000" instrument that conveyed an electrical stimulus for 0.05 msec at 2 Hz frequency and 3 V in square wave form, which has positive and negative alternanses. In this study, electrodes were connected to the Hungry and Stomach points on both ears and on LI 4 and LI 11 with St 36 and St 44 on the body symmetrically in pairs. Acupuncture alone was applied on the St 25 and Liv3 points.

Weight and the Height of the Subjects

Weight of the subjects was measured with standard scales (sensitivity, ± 0.5 kg), before breakfast. Height of the subjects was measured with a steel rule (sensitivity, ± 0.5 cm). The BMIs of the subjects were calculated by dividing the weights (kg) to the square of the corresponding heights (m^2).

Serum Cholesterol and Triglyceride Levels

Peripheral blood (5 ml) was drawn from the antecubital veins of the subjects in the control and study groups before and after diet or EA therapy on the 1st and 20th days. Blood samples were centrifuged at 1000 rpm for 10 minutes. The supernatants were obtained and stored at −80°C for further analysis.

Serum cholesterol levels including total, LDL, HDL and triglyceride levels were determined by an enzymatic color test using the "Olympus System Reagent 5000" kit (Olympus Diagnostica GmbH, Lismeehan, Ireland). Normal values were considered as follows: Total cholesterol, between 120 and 240 mg/dl; triglyceride levels, between 35 and 150 mg/dl; and HDL levels, between 35 and 60 mg/dl. Levels of LDL cholesterol were calculated using the following formula: LDL cholesterol = [Total cholesterol − (HDL cholesterol + triglyceride)].

Statistical Analysis

Categorical variables were compared among the groups and between the values before and after therapy using the one-way variation analysis and Tukey HSD test. A $p < 0.05$ was considered as significant.

Results

Changes in Weight Loss

A 4.8% weight reduction in the EA group and a 2.9% weight reduction in the diet group were observed after 3 weeks of therapy (Table 2). The weight reduction in the EA group

Table 2. Body Weight in the EA, Diet and Control Groups

	EA Group	Diet Group	Control Group	F	P
Body Weight (kg) 1st Day	87.5 ± 11.9	84.1 ± 10.5	78.9 ± 18.0		
Body Weight (kg) 20th Day	83.3 ± 11.8*	81.7 ± 10.3†	78.6 ± 18.3	137.66	0.0001

*$p < 0.05$ according to the diet and control groups; †$p < 0.05$ according to the control group; EA: electroacupuncture.

Table 3. Cholesterol, Triglyceride, HDL Cholesterol, LDL Cholesterol Levels of EA, Diet and Control Groups on 1st and 20th Days

	EA Group	Diet Group	Control Group	F	P
Total Cholesterol (mg/dl)					
1st Day	222.5 ± 53.7	203.5 ± 39.5	210.4 ± 23.9		
20th Day	183.5 ± 46.8*	188.4 ± 42.5*	211.9 ± 30.2	6.02	0.004
Triglyceride (mg/dl)					
1st Day	160.5 ± 71.7	152.9 ± 66.8	160.8 ± 63.8		
20th Day	112.5 ± 54.3*	112.0 ± 56.9*	145.0 ± 59.4	3.49	0.038
HDL Cholesterol (mg/dl)					
1st Day	41.0 ± 12.1	36.0 ± 11.0	41.9 ± 15.0		
20th Day	38.4 ± 11.8	38.2 ± 11.7	38.1 ± 15.5	1.53	0.226
LDL Cholesterol (mg/dl)					
1st Day	153.3 ± 48.8	136.9 ± 31.1	134.6 ± 24.8		
20th Day	124.0 ± 43.6*	127.3 ± 35.8	144.1 ± 31.0	4.17	0.021

*$p < 0.05$ according to the control group; EA: electroacupuncture.

was significant compared to that of both the diet and the control groups ($p < 0.05$). Furthermore, the weight reduction in the diet group was significant compared to that of the control group ($p < 0.05$).

Cholesterol and Triglyceride Levels

There were significant decreases in total cholesterol and triglyceride levels in EA and diet groups compared to those of the control group ($p < 0.05$ in both cases), whereas the difference in total cholesterol levels between the EA and the diet groups was not significant (Table 3). Furthermore, there was a decrease in LDL levels in the EA group compared to those of the control group ($p < 0.05$). However, the differences in LDL levels between the

EA and the diet groups and between the diet and the control groups were not statistically significant (Table 3). No significant changes could be found in HDL levels among the three groups either ($p = 0.226$).

Discussion

The goals in obesity treatment are to lose weight, to maintain the reduced body weight as long as possible, and to control the associated risk factors of obesity. Increased serum triglyceride and LDL cholesterol levels and decreased serum HDL cholesterol levels may particularly cause cardiovascular diseases in obese people (Lyznicki *et al*., 2001). In this study, we demonstrated that serum cholesterol levels could be regulated by both EA therapy and diet therapy in obese people.

It was reported that abdominal- or android-type obesity in which the ratio of waist circumference to hip circumference was above 0.80 in women and 0.90 in men, was associated with an increased risk of diabetes mellitus and cardiovascular diseases (Rattarasarn *et al*., 2003). In this study, the subjects in all three groups were obese people with android type.

Acupuncture application has been shown to suppress the appetite by increasing serotonin levels in the central nervous system (Wenhe and Yucun, 1981) and activating the fullness center at the hypothalamus (Shiraishi *et al*., 1995). It also controls stress by stimulating the enkephalin and dopamine secretions (Mulhisen and Rogers, 1999). Application of ear acupuncture was demonstrated to increase the fullness feeling, whereas diet or physical exercise did not affect the fullness feeling (Asomoto and Takeshige, 1992). In this study, weight loss more in the EA group compared to that of the diet group may be a result of increased fullness feeling, which resulted in less food intake following acupuncture application.

In this study, we used the Hungry and Stomach ear acupuncture points and the LI 4, LI 11, St 25, St 36, St 44 and Liv 3 body points to increase the fullness feeling, regulate intestinal motility and cause sedation. Stimulation of the Hungry ear points was effective in weight loss by increasing the fullness feeling and suppressing the hunger feeling (Asomoto and Takeshige, 1992). It was shown that stimulation of the LI 4, LI 11 and ST 25 body acupuncture points regulated intestinal motility (Maciocia, 1989a) and stimulation of St 36 and St 44 increased excitability of the satiety center in the ventromedial nucleus of the hypothalamus (Zhao *et al*., 2000). In traditional Chinese medicine, the St 36 body acupuncture point has been used for the treatment of both diarrhea and constipation. This point has been reported to regulate the gastrointestinal motility by increasing the motility in people with hypoactive intestinal motility and conversely by decreasing the motility in people with hyperactive intestinal motility (Li *et al*., 1992). Stimulation of this point also increases the amplitude and frequency of gastric peristalsis in normal people that shortens gastric emptying time and delays the contraction time (Li *et al*., 1992). Furthermore, stimulation of the Liv 3 body point causes sedation (Maciocia, 1989b).

Changes in body weight were observed following ear acupuncture on the Shen Men (Stomach), Sanjiao (Hungry) points in obese people (Huang *et al*., 1996). In Huang's study, EA was performed on selected ear points on one ear in the first session and the opposite ear in the next session and so on. In our study, EA application was performed on both ears on the Hungry and Stomach points and on body acupuncture points in each session. Interestingly, we observed a 4.8% weight reduction by performing EA over 20 days, whereas Huang's study reported a similar weight reduction by performing EA for 56 days. Therefore, our results suggest that our EA procedure using both ear and body points might be more effective than the regular EA in obesity therapy.

Liu *et al*. (1992) applied ear and body acupuncture to 102 obese people and studied the changes in body weight and plasma levels of total cholesterol, triglycerides, HDL cholesterol, and LDL cholesterol using the ear and body acupuncture points in traditional Chinese acupuncture. Ear acupuncture was applied once every 5 days and body acupuncture was performed once every 3 days, 20 minutes in each session, for 1 month. In Liu's study, a weight loss with a mean value of 3.3 kg was found, and a decrease in plasma levels of total cholesterol, triglyceride, and LDL cholesterol and an increase in HDL cholesterol levels were observed. We observed a similar weight loss with a mean value of 4.2 kg after 20 days. Furthermore, a decrease in the serum levels of total cholesterol, triglyceride and LDL cholesterol was also observed in our study by applying EA on both ear and body points with increased frequencies and for a longer period, five sessions per week for 30 minutes in each session. However, we did not observe any changes in the levels of HDL cholesterol. Similarly, Sun and Xu (1993) performed ear and body acupunctures on obese people and analyzed the changes in body weight, and levels of total cholesterol, triglyceride, and HDL cholesterol. They applied acupuncture to the Mouth, Esophagus, Stomach, Shen Men, Endocrine and Lung acupuncture points on one ear once every 3 to 5 days, and on the other ear in the next session by using small seeds that are among the traditional Chinese acupuncture methods. They also applied acupuncture needles to the St 25, St 36, Sp 6, P 6 and St 40 body points once every 3 to 5 days. Similar to our study, decreases in plasma levels of total cholesterol and triglyceride associated with a weight loss were observed in their study. And they did not find any change in HDL cholesterol levels either. Although different acupuncture points were used, we found similar results in the serum levels of total cholesterol, triglyceride and HDL as Sun and Xu's study.

EA application on animals and human subjects increases β-endorphin levels in the central nervous system and the plasma (Malizia *et al*., 1979; Jin *et al*., 1996; Takeshige *et al*., 1993; Pan *et al*., 1996; Petti *et al*., 1998). EA application with a current of low frequency (2 Hz) has been shown to increase β-endorphin concentration in the central nervous system (Ullet *et al*., 1998; Han *et al*., 1999). In our study, EA was performed using a current of 2 Hz.

When β-endorphin was applied to isolated rabbit fat cells, free fatty acids and glycerol levels were found to be increased in the plasma that could be blocked by naloxone (Richter *et al*., 1983). β-endorphin has also been shown to increase glycerol secretion from the isolated fat cells (Vettor *et al*., 1993). In these studies, it was concluded that β-endorphin

triggered the lipolysis in animals (Richter *et al*., 1983) and human subjects (Vettor *et al*., 1993). Our results suggest that EA application in obese people may decrease serum levels of total cholesterol, triglyceride, and LDL cholesterol by increasing β-endorphin levels that stimulate lipolysis.

In conclusion, EA therapy may be a useful approach to treatment of obesity that could mobilize the energy stores in the body and potentially decrease the risk factors associated with obesity. Therefore, EA should be the choice of therapy, especially in obese patients with increased risk factors for cardiovascular diseases or with associated cardiovascular diseases.

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