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Effect of laser acupoint treatment on blood pressure and body weight—a pilot study

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Abstract

Objective: This study reports on the effects of laser acupuncture on blood pressure, body weight, and heart rate variability by stimulating acupuncture points and meridians on college students and faculty members.

Methods: Forty-five students and faculty members from a chiropractic college were recruited in the study. All subjects signed a written informed consent before their participation in the study. This study was a randomized controlled pilot study with subjects divided into control and experimental groups. The control group received a sham low-level laser therapy treatment with no power output to the laser during their “treatment.” The experimental group was treated with an activated laser. The acupuncture points used in this study were LI 4 and LI 11 for body weight and blood pressure. The treatment groups received 16 J of laser energy output for a total treatment time of 8 minutes (4 minutes for each of the 2 points).

Results: After using the laser treatment for 90 days (at least 12 treatments per subject), both the systolic and diastolic blood pressures decreased significantly ($P < .01$). The mean systolic blood pressure was 129.6 ± 14.7 mm Hg before the treatment and was reduced to 122.5 ± 17.2 mm Hg ($P < .001$). The mean diastolic blood pressure was 85.6 ± 8.0 mm Hg before treatment and was reduced to 77.2 ± 8.7 mm Hg ($P < .001$). Subject’s body weight was reduced in the active acupoint group, but the weight reduction did not reach a significant level. There were no significant changes in the heart rate variability.

Conclusion: It was concluded that low-level laser treatment of acupoint resulted in lower blood pressure by stimulating the LI 11 and LI 4. No significant difference was observed in both the body weight and heart rate variability after the laser acupoint treatment.

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Introduction

Acupuncture is a traditional Chinese medical technique of inserting needles at particular points on the body to balance the opposing forces of yin and yang and the smooth flow of qi.¹ Recent studies have found that acupuncture treatments lower blood pressure.²⁻⁴ The mechanism of acupuncture that lowers blood pressure is not clear, but it is believed that acupuncture works to alter central nervous system neurotransmitter activities by stimulating acupoints.⁵

Laser was first used in the medical field as a focused, high-power beam with photothermal effects in which tissue was vaporized by the intense heat. During the early phase of its use as a surgical tool, it was noted that there appeared to be less pain and inflammation after laser surgery than conventional surgery. It was postulated that this effect was related to the use of surgical lasers with a Gaussian beam mode. In this mode, the power of laser is highest at the center of the beam, with the power then falling off in a bell-shaped curve and with the weakest power at the periphery of the beam diffusing out into the undamaged tissues.⁶ This phenomenon was called the *α-phenomenon*.⁶ Thus, the “low-power” segment of the beam was postulated to be responsible for the decreased pain and inflammation in the wound. Workers in the field recognized this effect. Laser devices were manufactured in which power densities and energy densities of laser were lowered to a point where no photothermal effects occurred; but the photoosmotic, photoionic, and photo-enzymatic effects were still operative. Thus, the use of “cold” laser or “soft” laser, as it was first known, came into medical use. The latest new laser devices are designed at infrared wavelength combined with high-frequency pulses that allow the photons to penetrate deep into tissue without heat effect.⁷

Many studies have used laser to treat acupuncture point for clinical conditions.⁷ Moldovan⁸ reported the low-energy laser coherent light interaction with the skin cover on acupuncture loci for the purpose of detecting and measuring the spatial and temporal alteration of the thermal, electric, and optical properties of the LI4 (Hegu) acupoint, irradiated with a 685-nm, 30-mW, class IIIB laser. The author found that the visible laser light, with low frequency and low power, specifically modified the 3-dimensional pattern of the temperature, electric potential, and electric impedance outline of an acupuncture point, with a significant decrease of the laser reflectance index.

Acupuncture application to obese people increases excitability of the satiety center in the ventromedial nuclei of the hypothalamus.⁹ Acupuncture stimulates

the auricular branch of the vagal nerve and raises serotonin levels. Both of these activities have been shown to increase tone in the smooth muscle of the stomach, thus suppressing appetite. Among other things, serotonin enhances intestinal motility. It also controls stress and depression via endorphin and dopamine production. In addition to these effects, it is thought that the increase in plasma levels of β -endorphin after acupuncture application can contribute to the body weight loss in obese people by mobilizing the body energy depots through lipolytic effect.⁹⁻¹⁴

Using this paradigm, obesity and/or excess appetite has been conceptualized in a variety of ways, such as “heat” in the stomach and intestine, a deficiency of qi in the spleen and stomach, or a deficiency of primary qi.¹ Based on this beliefs about the causes of obesity, a variety of acupoints is targeted in the treatment of obesity, including Neiguan (P6), Fenglong (St40), Liangmen (St 21), Guanyuan (R4), Zusanli (St36), Tianshu (St25), and Quchi (LI11), where P refers to a pericardium, St to stomach, R to Ren, and LI to large intestine meridians.^{15,16} Many people today understand that diet and exercise can help them lose weight, but the biggest problem they come across is how to suppress their appetite.⁹ Studies have shown that stimulating certain acupuncture points on the human body can raise the serotonin levels and also excite the vagal nerve, both of which may reduce appetite.¹²

Increased body weight is often associated with increased blood pressure, which is a significant risk factor for cardiovascular and renal diseases.^{17,18} It is the researchers’ intention to investigate the correlation of laser acupuncture treatment with hypertension and body weight.

The specific aims of the study were to test the effectiveness of laser acupuncture on specific acupuncture point on (1) blood pressure, (2) body weight, and (3) heart rate variability (HRV). The hypothesis was that the stimulation of a pattern of acupoints with the laser was effective in reducing body weight and blood pressure and in increasing HRV. This research is designed to study the effects of laser acupuncture on blood pressure and body weight by stimulating certain acupuncture points and meridians on college students and faculty members.

Methods

Subjects

Forty-seven subjects from a college of chiropractic students and faculty were recruited in the study via

school-wide e-mail notification or personal contact. All subjects came from the college's tri 1 and tri 2 students who were under similar study environment. Students were asked to come in for blood pressure screening. No faculty members participated in the study. No special instructions were given to any individual on blood pressure and body weight controls. The sample size was an estimate based on the d (effect size) of .50, $\alpha 1 = .05$ ($\alpha 2 = .10$), and power of 0.75, which required a sample size of 44 for the study. There were no interim analyses and preset stopping rules except in case of discomfort occurring in the subjects. All study procedures were approved by the institutional review board at a chiropractic college and explained to each subject before testing. All subjects had to sign a written informed consent before their participation in the study. All data collection was conducted at the research department of a chiropractic college.

Inclusion criteria

Men and women with mild hypertension (systolic blood pressure, 160-125 mm Hg; diastolic blood pressure, 110-81 mm Hg) and naive to low-level laser therapy were recruited.

Exclusion criteria

Individuals with heart, kidney, or thyroid disorders; diabetes; chronic disease or illness; neurologic diseases; and skin or bleeding disorders, and those currently taking drugs or medications were not recruited in the study. A health history questionnaire was used to screen subjects.

Study design

This study was a randomized controlled study with subjects divided into control and experimental groups. A random table was used for the randomization. A series of random numbers was selected from the random table (from the first line, left to right) to assign each subject based on odd or even number. An odd number assigned a subject into the treatment group, and an even number assigned a subject into the control group. The control group was given a sham low-level laser therapy treatment with no power output to the laser during the "treatment." The experimental group received an activated laser during treatment. Both groups had identical instructions, interactions with research team members, and blood pressure measure-

ments. The subjects were blinded for the real laser and sham laser treatments.

The treatment group received active laser treatment to the LI 4 (Hegu) and LI 11 (Quchi). All subjects' baseline data were collected before any treatments were given. The second data collection was 45 days after treatment, and the third and final data collection was at 90 days of treatment. During the treatment period, each subject received 2 treatments per week for 12 weeks with at least 12 active or sham treatments. Subjects who received less than 12 active or sham treatments were counted as dropouts.

Instrumentation

Blood pressure: A Biopac manual blood pressure monitor (Biopac, Santa Barbara, CA) was used in the blood pressure measurements. Researchers were trained in the correct blood pressure measurement technique and had at least 2 years of experience in blood pressure research. Blood pressure measurements were taken at sitting position after a 5-minute rest. The manual sphygmomanometer cuff was placed on the left arm at the heart level. The blood pressure reading was taken twice during data collection, and the average was used for data analysis.

Body weight was taken with a 6-way weight scale made by Chirotron, Inc (Biocom, Seattle, WA).

Heart rate variability: Biocom's Active ECG Scanner was used in the HRV data collection with digital signal processing software. The heart scanner records an electrocardiograph (ECG) signal, computing the instantaneous changes of HRV after each recording session. The scanner connects to the subjects through 3 small electrodes that attach to the left arm, right arm, and left leg. A baseline HRV was recorded before treatment was given. The HRV recording was taken in the sitting position for 5 minutes for all subjects. No additional gels were needed for the electrodes. Special care was given to clean the skin surface to improve skin conductance. Data cleaning techniques were used to remove noise in the ECG signals to improve the quality of HRV measurements. This includes checking each ECG tracing to make sure that accurate ECG R-R intervals are recorded for HRV analysis. The HRV waveform was represented by R-R interval tachogram. The spectral analysis of this signal was obtained from a successive discrete series of R-R duration values taken from the ECG signal sampled at 256 Hz and transformed by the fast Fourier technique. The power spectrum was divided into 3 major frequency ranges: very low frequency at 0.01 to 0.08 Hz, low frequency at 0.08 to 0.15 Hz, and

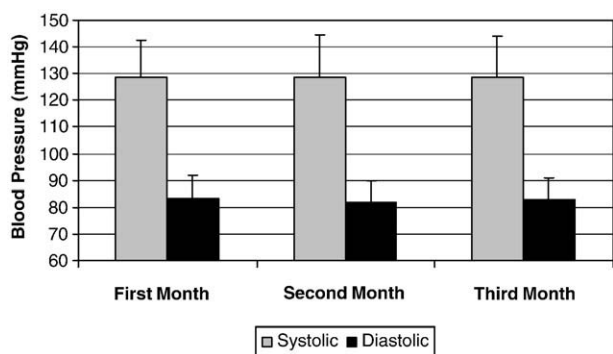


Fig 1. Blood pressure in the control group. White bar is systolic blood pressure, and dark bar is diastolic blood pressure.

high frequency at 0.15 to 0.5 Hz. The integral of the power spectrum within each region was calculated.

The Insight 40 infrared laser (USA Laser, Richmond, VA): The study used 100% modulation with a frequency of 10 kHz. The energy output of the treatment was 16 J for a total of 8 minutes. Each acupoint received 4 minutes of treatment.

Data treatment and analysis

One-way repeated-measures analysis of variance was used to assess the differences of blood pressure, body weight, and HRV changes before and after taking the supplement for 90 days. Significance was determined at *P* less than or equal to .05. SigmaStat 3.5 statistical software (SigmaStat, Point Richmond, CA) was used for the data analysis.

Results

A total of 120 students were screened for higher blood pressure, and 47 subjects (31 male) qualified for

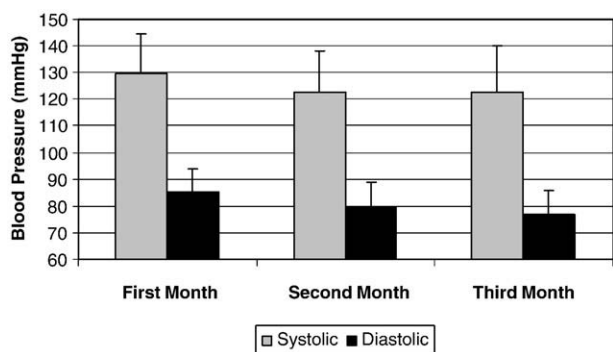


Fig 2. Blood pressure in the treatment group. White bar is systolic blood pressure, and dark bar is diastolic blood pressure.

Table 1 Control group descriptive statistics

Column	Size	Mean	SD	SE	CI of Mean
Baseline S	22	129.583	14.72	3.005	6.216
Baseline D	22	85.625	8.037	1.641	3.394
45-d S	22	122.909	15.203	3.241	6.741
45-d D	22	79.864	8.956	1.91	3.971
90-d S	22	122.5771	17.206	3.755	7.832
90-d D	22	77.238	8.774	1.915	3.994

S, Systolic; D, diastolic.

the study. Forty-five subjects completed the study, and 2 subjects dropped out of the study. Most subjects completed the study within a 2-month period for treatment twice a week up to 12 visits. The average age of the subjects was 25 ± 5 years old. The youngest subject was 20 years old, and the oldest was 56 years old. The study population consisted of 45 students currently enrolled in a chiropractic college.

After the 12 laser treatment sessions, both the systolic and diastolic blood pressures decreased significantly (Figs 1 and 2). The mean systolic blood pressure was 129.6 ± 14.7 mm Hg before the treatment started and was reduced to 122.9 ± 15.2 mm Hg (*P* < .001) after 45 days of treatment and to 122.6 ± 17.2 mm Hg at the end of the 3-month treatment (*P* < .05). The mean diastolic blood pressure was 85.6 ± 8.0 mm Hg before treatment started and was also reduced to 79.9 ± 8.9 mm Hg (*P* < .001) the first time it was measured and to 77.7 ± 8.7 mm Hg (*P* < .001) (Tables 1 and 2) at the end of the 3-month laser treatment period. The body weight decreased in the experiment group, but it did not reach a statistically significant level (Figs 3 and 4). The HRV did not show any significant changes.

Discussion

It has been well documented that both ear acupuncture and body acupuncture have obvious therapeutic

Table 2 Experimental group descriptive statistics

Column	Size	Mean	SD	SE	CI of Mean
Baseline S	23	129.583	14.72	3.005	6.216
Baseline D	23	85.625	8.037	1.641	3.394
45-d S	23	122.909	15.203	3.241	6.741
45-d D	23	79.864	8.956	1.91	3.971
90-d S	23	122.571 *	17.206	3.755	7.832
90-d D	23	77.238 *	8.774	1.915	3.994

* *P* < .05.

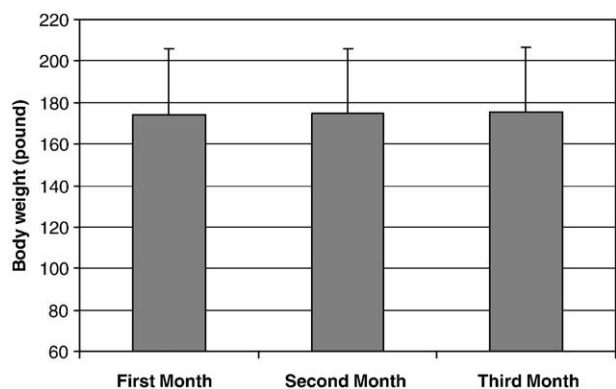


Fig 3. Body weight in the control group.

effects on juvenile simple obesity and have some actions on blood lipids and blood pressure.^{8,9} It has been observed that laser acupuncture application to obese people increases excitability of the satiety center in the ventromedial nuclei of the hypothalamus. Acupuncture stimulates the auricular branch of the vagal nerve that raises serotonin levels. Both of these activities have been shown to increase the tone in the smooth muscle of the stomach, thus suppressing appetite.⁹ The results of the present study did not show significant decrease of body weight on the subjects tested. Both control group and experimental group maintained the same weight throughout the whole length of the study. It was expected that some increased vagal tone would be seen during the study, but it was not observed using the HRV analysis.

The major finding of the study was a significant decrease on the subjects' blood pressure. After comparing the 2 groups, subjects in the experimental group that received the actual treatment had a noticeable decrease on their blood pressure measurements. According to a study made by Sobetskii,¹⁸ approximately 368 patients with hypertensive disease stage I and II were examined and treated either with laser puncture or acupuncture. Laser puncture was effective at stage I of hypertensive disease, whereas acupuncture had a more potent hypotensive effect and can be used in both hypertensive disease I and II. According to the study done by the Department of Acupuncture, China Medical University Hospital, treating the point GB34 not only lowered blood pressure, but also prevented hypertrophy of cardiac muscle cells in spontaneously hypertensive rats.¹⁸

There were many limitations in the study. Most noticeable were the small sample size in a clinical study involving human subjects and the lack of follow-up after the treatment period. The current

study recruited 47 subjects, and 45 subjects completed the data collection. However, it was noted during the data collection period that some subjects could not maintain the twice-a-week schedule throughout the study. Therefore, the researchers had to count the number of visits up to 12 visits to determine the success rate of completion of the study for each subject. This leads to variations of completion times for subjects. Some subjects completed the study within 2 months, and some completed the study within 3 months. Another limitation of the study was using only the student population in a chiropractic college setting. Many of the students were under stress with extensive study workload, which hindered the treatment effect of laser acupoint on blood pressure and body weight. The most noticeable effect could be on the body weight, as most students spent hours in the classroom. In future studies, it is beneficial to include subjects outside the student population. The researchers did not provide information to subjects on controlling blood pressure and body weight during the study period. It is believed that the best results of hypertension management could be achieved by combining laser treatment with patient education. This important component may be added in future studies, as the effectiveness of acupuncture treatment on hypertension is still under investigation.⁴ More studies are needed to investigate the effect of laser acupuncture therapy on blood pressure and body weight.¹⁹⁻²¹

Conclusion

Laser acupuncture treatment showed positive effect in reduction of blood pressure, but no changes were found in the body weight and HRV analysis.

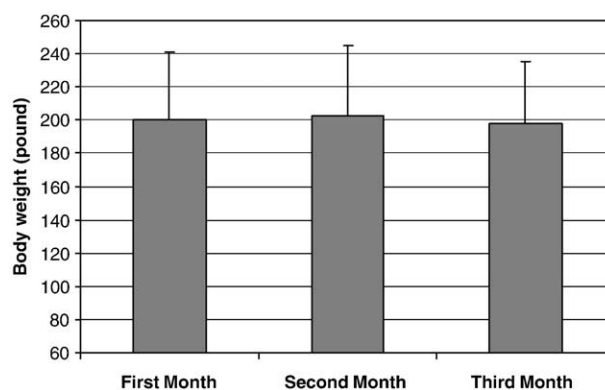


Fig 4. Body weight in the treatment group.

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