



Effects of electrical stimulation of acupuncture points on blood pressure^{☆,☆☆}

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Abstract

Objective: Arterial hypertension is considered a major contributor to coronary arterial disease. The purpose of the study was to investigate the effects of Hans electrical stimulation of acupuncture points on blood pressure.

Methods: Subjects with normal and elevated blood pressure were recruited and randomly assigned into control and experimental groups. Only the experimental subjects received active Hans electrical stimulation on 2 acupuncture points for 30 minutes each session, twice a week for 5 weeks.

Results: Twenty-seven subjects (17 male) were recruited and completed the study. The average age of the subjects was 25 ± 5 years. The youngest subject was 20 years old and the oldest was 36 years old. After using the Hans electrical stimulation on acupuncture points for 5 weeks, the systolic blood pressure decreased significantly in the experimental group with active treatment. The mean systolic blood pressure was 117.8 ± 4.2 mm Hg before the treatment and was reduced to 110.8 ± 5.5 mm Hg ($P < .05$) in the third week and to 110.1 ± 5.8 mm Hg in the fifth week ($P < .05$). The mean diastolic blood pressure was 78.1 ± 5.0 mm Hg before treatment and was reduced to 77.4 ± 4.3 mm Hg ($P > .05$) in the third week and to 74.8 ± 4.3 mm Hg ($P > .05$) in the fifth week, but both did not reach statistically significant levels. The systolic and diastolic blood pressures in the control group did not show statistically significant changes. The mean systolic blood pressure was 115.6 ± 13.3 mm Hg before the treatment and was reduced to 113.0 ± 12.6 mm Hg ($P > 0.05$) in the third week and to 112.2 ± 10.3 mm Hg in the fifth week ($P > .05$). The mean diastolic blood pressure was 76.4 ± 7.9 mm Hg before treatment and was reduced to 76.5 ± 6.9 mm Hg ($P > .05$) in the third week and to 73.9 ± 5.4 mm Hg ($P > .05$) in the fifth week.

Conclusion: It was concluded that Hans electrical stimulation of acupuncture points reduced systolic blood pressure but not the diastolic blood pressure in the current subject population with normal and elevated blood pressure.

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Introduction

After medicine and dentistry, chiropractic care is the third largest health care profession in the United States.¹ A US national survey suggested a 50% increase in visits to alternative medical practitioners between 1990 and 1997, the first time that visits to such practitioners exceeded the total visits to all US primary care physicians. A total of 629 million patient visits were to alternative therapists in 1997, spending an estimated \$21.2 billion.¹ A follow-up survey between 1997 and 2002 showed a similar trend.² The major changes in the second survey were a greater increase in the use of herbal medicine from 12% to 18% and a decrease in chiropractic treatment from 9% to 7%.² As more people begin to consider alternative treatments in their health care options, chiropractors have included many important treatment modalities and methods in their practices.³ This has included acupuncture, which is a form of ancient Chinese treatment that uses a needle to stimulate points on the body surface along meridians. It was believed that this method of treatment would harmonize Qi and allow the body to maintain an internal balance.^{4,5} The number of practicing acupuncturists in the United States (about one third of whom also have conventional medical degrees) is also increasing, with the current number of registered practitioners being about 11 000, projected to quadruple by 2015.⁶

To further the understanding of the electrical acupuncture treatment, we investigated the effects of Hans electrical stimulation on blood pressure for simplicity and effectiveness. The Hans electrical stimulator has been used in research projects on pain and drug addictions.^{7,8} Many of the studies come from the neuroscience research institute at Peking University that developed this device.⁹

The current research was designed to study the effects of Hans electrical stimulation on blood pressure by stimulating certain acupuncture points and meridians in hypertensive subjects. The point selection for treatment of hypertension was different in each study.¹⁰ We selected LI 4 and LI 11 based on the published study of Zhou et al¹¹ for 2 reasons. First, these 2 points were important in the traditional Chinese medicine and were most commonly used for varying conditions including hypertension. Second, these 2 points were on the upper arm so it is very easy for researchers to access and apply treatments. This approach was supported by the study of Jacobsson et al¹² using the same Hans unit

treating 2 points on the forearm showed significant reduction in blood pressure.

The specific aims of the study were to test the effectiveness of Hans electrical stimulation on specific acupuncture points on blood pressure in healthy and hypertensive subjects. The hypothesis was that the stimulation of a pattern of acupoints with electrical stimulation was effective in reducing blood pressure.

Methods

Subjects

Subjects from a college of chiropractic students were recruited for the study via school-wide e-mail notification or personal contact. All study procedures that were approved by the institutional review board at Logan College of Chiropractic were explained to each subject before testing. All subjects signed a written informed consent before their participation in the study. Random numbers were used to assign subjects to the experimental and a control group. Subjects with odd random numbers were assigned to the experimental group with active Hans treatments.

No special instructions were given to any individual regarding diet, exercise, or medications for their blood pressure. The sample size was an estimate based on $\alpha = .05$, power of 0.8, SD of 5.0, and mean difference of 4.0 mm Hg, which required a sample size of 26 for the study. The researchers who performed treatment and data collection were blinded for data analysis.

Inclusion and exclusion criteria

To be included for the study, males or females with normal blood pressure or with mild hypertension (systolic BP between 165 and 120 mm Hg, diastolic BP between 80 and 110 mm Hg) were recruited. Individuals with heart, kidney, thyroid disorders; diabetes; chronic disease or illness; neurologic diseases; skin or bleeding disorders; and currently taking drugs or medications were not recruited. In addition, individuals who had a pacemaker and/or were pregnant were not recruited. A health history questionnaire was used to screen subjects. Subjects with blood pressure out of the range of the inclusion criteria were not recruited. All subjects had to answer the prescreening questionnaire. This was to ensure each subject met the inclusion and exclusion criteria. Every subject signed an informed consent before beginning of the study.

Procedure

All subjects were treated twice a week for 5 weeks (a total of 10 treatments) using the Hans electrical stimulation (Han's Acupoint Nerve Stimulator Model LH 202H, Beijing Huawei LTD, Beijing, China). The experimental group was treated with an activated Hans unit. The acupuncture points used in this study were LI 4 (Hegu, on the dorsum of the hand, between the first and second metacarpal bones and on the radial side of the midpoint of the second metacarpal bone) and LI 11 (Quchi, located in the elbow in the depression at the lateral end of the transverse cubital crease and the lateral epicondyle of the humerus, Fig 1) for blood pressure.¹³ The treatment group received 2/100 Hz from the Hans unit for 15 minutes on each point so the total time of treatment was 30 minutes. The control group received a sham treatment with no power output from the Hans unit during their "treatment."

Outcomes

Auscultatory blood pressure measurement was conducted by a manually operated sphygmomanometer (American Diagnostic Corp, Hauppauge, NY). During each subject's visit, blood pressure was measured twice and a single average number was recorded. A cuff for adults was used for blood pressure

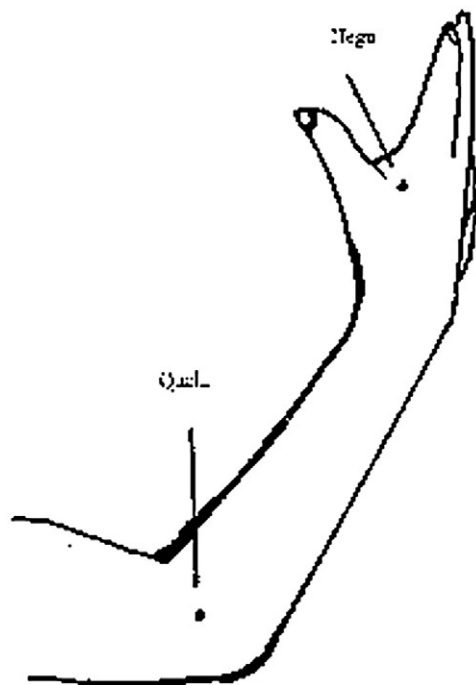


Fig 1. Acupuncture points Hegu (LI 4) and Quchi (LI 11) used in the study.

measurements with the subject in a sitting position and the cuff on the left arm. All subjects were scheduled to take the blood pressure measurement at the same time of the day. Subjects were given 5 minutes to rest before taking blood pressure measurements. Individuals performing the blood pressure measurements were trained in the proper use of the device with at least 1 year experience in conducting human blood pressure measurements.

Side effects

It was not expected in the study to see any side effects from the application of the Hans electrical stimulation. However, the subjects were asked to contact the researchers for a consultation if such complications arose. These possible complications were outlined in the written consent form.

Statistical analysis

One-way repeated measurement was used in the study with a significance of .05. Significance was determined at $P \leq .05$. SigmaStat 3.5 statistical software (Systat Inc, San Jose, Calif) was used for the data analysis.

Results

Twenty-seven student subjects currently enrolled at the college (17 males) were recruited and completed the study. Fourteen subjects (9 males) were randomized into the control group and 13 in the experimental group (8 male). No subjects dropped out of the study. All subjects completed the required total number of treatments for both groups, and the subjects had no prior experience of Hans electrical stimulation treatment. The average age of the subjects was 25 ± 5 years (range, 20-36 years).

After using the Hans electrical stimulation on acupuncture points for 5 weeks, the systolic blood pressure decreased significantly in the experimental group with active treatment (Figs 2 and 3). The mean systolic blood pressure was 117.8 ± 4.2 mm Hg before the treatment and was reduced to 110.8 ± 5.5 mm Hg ($P < .05$) in the third week and to 110.1 ± 5.8 mm Hg in the fifth week ($P < .05$). The mean diastolic blood pressure was 78.1 ± 5.0 mm Hg before treatment and was reduced to 77.4 ± 4.3 mm Hg ($P > .05$) in the third week and to 74.8 ± 4.3 mm Hg ($P > .05$) in the fifth week, but both did not reach statistically significant

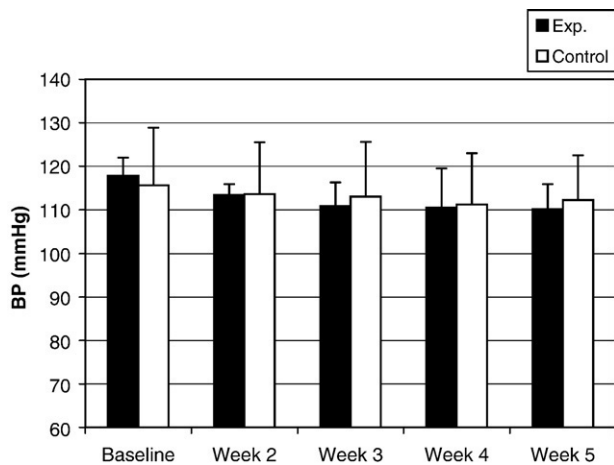


Fig 2. Systolic blood pressure reduced in the experimental group after electrical stimulation of acupoints but showed no significant reduction in the control group.

levels. The systolic and diastolic blood pressures in the control group did not show statistically significant changes. The mean systolic blood pressure was 115.6 ± 13.3 mm Hg before the treatment and was reduced to 113.0 ± 12.6 mm Hg ($P > .05$) in the third week and to 112.2 ± 10.3 mm Hg in the fifth week ($P > .05$). The mean diastolic blood pressure was 76.4 ± 7.9 mm Hg before treatment and was reduced to 76.5 ± 6.9 mm Hg ($P > .05$) in the third week and to 73.9 ± 5.4 mm Hg ($P > .05$) in the fifth week. The 2-way repeated measurements analysis did not find significant difference between group effects ($P > .05$).

Discussion

The major finding of the study was a significant decrease in the subjects' systolic blood pressure after Hans electrical stimulation treatment on acupuncture points. When the experimental and control groups are compared, only the experimental group had a statistically significant decrease in blood pressure. This finding is similar to a study by Sobetskii¹⁴ on 368 patients with stage I and II hypertension treated by acupuncture. They found that acupuncture had a more potent hypotensive effect and can be used both in hypertensive disease I and II. According to a study by the Department of Acupuncture, China Medical University Hospital, the authors found that stimulation of the point GB34 not only lowered blood pressure but also prevented hypertrophy of cardiac muscle cells in spontaneous hypertensive rats.¹⁵ They concluded that acupuncture could be a good treatment modality for hypertension and hypertrophy of the heart.

Flachskampf et al¹⁶ have found that the acupuncture treatment was a safe and effective treatment of hypertension. There are a number of studies that support the use of acupuncture in patients with hypertension.¹⁶⁻¹⁸ A study funded by the National Institutes of Health "Stop Hypertension with the Acupuncture Research Program" enrolled 192 participants with untreated hypertension.¹⁹ The study found that active acupuncture treatment, using both doctor-selected points and study-assigned points, lowered blood pressure. However, the interesting finding of the study was that this blood pressure-lowering effect was not significantly different when compared with the control group with random needle insertion.¹⁹

Arterial hypertension is a major contributor to coronary arterial disease and increased morbidity and mortality in the general population. A recent study published in *Circulation* investigated the effect of acupuncture on hypertension in 140 outpatients with uncomplicated arterial hypertension in a single-blind fashion with a 6-week course of active acupuncture or sham acupuncture (22 sessions of 30 minutes' duration).¹⁶ The study's primary outcome parameters were mean 24-hour ambulatory blood pressure levels after 3 and 6 months of treatments. They reported a significant ($P < .001$) difference in posttreatment blood pressures adjusted for baseline values between the active and sham acupuncture groups at the end of treatment. In the active acupuncture group, mean 24-hour ambulatory systolic and diastolic blood pressures decreased significantly after treatment by 5.4 and 3.0 mm Hg, respectively. At 3 and 6 months, mean systolic and diastolic blood pressures returned to pretreatment levels in the active treatment group. The authors

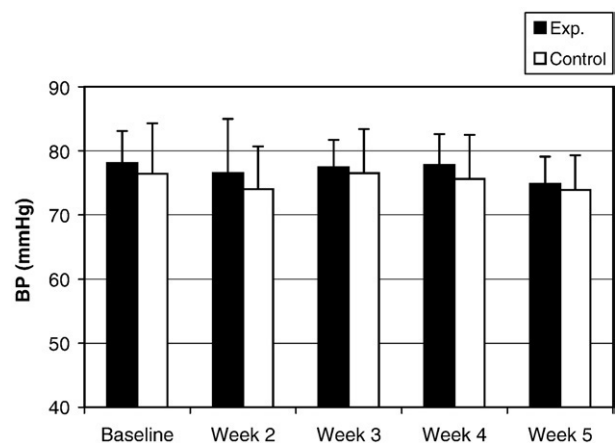


Fig 3. Diastolic blood pressure did not show significant changes in the experimental group or the control group after electrical acupoint treatment.

concluded that acupuncture according to traditional Chinese medicine, but not sham acupuncture, after 6 weeks of treatment significantly lowered mean 24-hour ambulatory blood pressures; the effect disappeared after cessation of acupuncture treatment.¹⁶

The mechanism of electrical acupuncture that reduces blood pressure is not well understood.²⁰ Studies seem to suggest a link of a blood pressure-lowering effect with syntheses of nitric oxide.^{21,22} Kim et al²³ tested the hypothesis that acupuncture on stomach 36 point (ST-36) to reduce hypertension by activating nitric oxide synthase signaling mechanisms. They used the 2-kidney, 1-clip renal hypertension hamster model with electroacupuncture treatment and found that 30-minute daily electroacupuncture treatment for 5 days significantly reduced mean arterial pressure compared with sham-operated hamsters. They also found that electroacupuncture increased periarteriolar nitric oxide concentration from 309.0 ± 21.7 to 417.9 ± 20.9 nmol/L in the hamster cheek pouch microcirculation when measured with NO-sensitive microelectrodes. Hypertension reduced endothelial nitric oxide synthase (eNOS) and neuronal nitric oxide synthase (nNOS) proteins relative to the sham-operated control. They concluded that electroacupuncture on stomach meridian prevented the reduction of eNOS and nNOS associated with hypertension and showed even higher eNOS and nNOS expressions than sham-operated control in stomach and cheek pouch tissues.²² Another study by Huang et al²² reported changes of the neuronal and inducible nitric oxide synthase (nNOS and iNOS) and their messenger RNAs in the rostral ventrolateral medulla (RVLM) of stress-induced hypertensive rats before and after acupuncture treatment. They applied electroacupuncture at points “Zusanli” (St. 36) and “Lanwei” (Extra 37) on the same hindlimb with dense sparse wave (4-20 Hz) and 4 mA intensity. Their results suggested that the systolic blood pressure of stress group rats was increased significantly ($P < .01$). They found that the expression of nNOS in the RVLM, including the immunoreactive neuron number ($P < .05$), the optical density (OD) ($P < .01$), and the messenger RNA ($P < .01$), were elevated, whereas those of iNOS ($P < .05$, $P < .01$, and $P < .01$) were lowered in the stress-induced hypertensive rats. They concluded that the curative mechanism of acupuncture on stress-induced hypertension was related to the changes of nNOS and iNOS in the RVLM of rats.²²

There were limitations to our study. The main limitation was the small sample size for the pilot study and lack of follow-up after the treatment period. The reported findings might change if more subjects were

recruited. The long-term effect of this reduction of blood pressure is not known at the present time without sufficient follow-up period. Using only 2 acupuncture points for blood pressure could be another limitation of the study. Most clinicians in acupuncture practice use more than 2 points at a time. Another limitation was the normal blood pressure population. It was interesting to see that even subjects with normative blood pressure responded to the electrical stimulation treatment. The reason for recruiting normative individuals to the study was considering the fact that the blood pressure standards for hypertension have been lowered in the recent year.²⁴ In some instances, subjects with hypertension may appear to have normal blood pressure.²⁴ More studies are needed to address above limitations in the future electrical stimulation of acupuncture point on blood pressure investigations.

Conclusion

For the participants in this study, it was concluded that Hans electrical stimulation of acupuncture points reduced systolic blood pressure but not the diastolic blood pressure in subjects with normal and elevated blood pressure.

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