Effect on Autonomic Nervous Function of Shiatsu Stimulation to the Anterior Cervical Region

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I. Introduction

The Japan Shiatsu College has previously reported in issues 22–31 of the Journal of the Japan College Association of Oriental Medicine on the effects of shiatsu stimulation on the circulatory system (reduction in heart rate and blood pressure, peripheral increase in muscle blood volume, and rise in skin temperature)[1-3]; the musculoskeletal system (improvements in muscle pliability and spinal range of motion)[4-8]; and the digestive system (gastrointestinal motility)[9-10].

Sato et al[9] and Kurosawa et al[10] reported that shiatsu stimulation to the lower leg and to the abdominal region promote gastrointestinal motility. Based on those results, in this study we will investigate what effect shiatsu stimulation to the anterior cervical region has on gastrointestinal motility and on the circulatory system.

II. Methods

1. Subjects

Research was conducted on 21 healthy adult students from this college, including 12 males and 9 females (average age: 38.8 years old). Test procedures were fully explained to each test subject and their consent obtained. They were also asked to refrain from receiving shiatsu or other stimulation on the day of testing.

2. Test period

May 24 to August 20, 2008

3. Test location

Testing was conducted in the basic medicine research lab at the Japan Shiatsu College. Room temperature was 25.0 ± 2.0°C and humidity was 63.0 ± 12.0%.

4. Outcome measures

(1) Blood pressure

A continuous blood pressure manometer (Japan Colin Jentow-7700) was used to derive blood pressure from the right radial artery using tonometry.

(2) Heart rate

A pulse tachometer (Nihon Kohden Corp. model AT-601G) was used to calculate the momentary heart rate (hereafter, 'heart rate') as triggered by the ECG's R wave (the second deflection on the ECG).

(3) Dominant power (DP)

DP is an indicator of the size of electrical response activity (ERA) in gastric smooth muscle cells accompanying peristalsis. Raw data measured using the electrogastrograph (NIPRO) is subject to spectral analysis using MBFA and classified as slow-wave (0–2 cpm), normal-wave (2–4 cpm), and fast-wave (4–9 cpm), to express changes in the electric potentials of their respective frequency bands.

(4) Frequency

The frequency is the highest amplitude taken from the 0–9 cpm waveforms each minute.

The measurement electrodes for the electrogastrograph were applied to the following areas (Fig. 1).

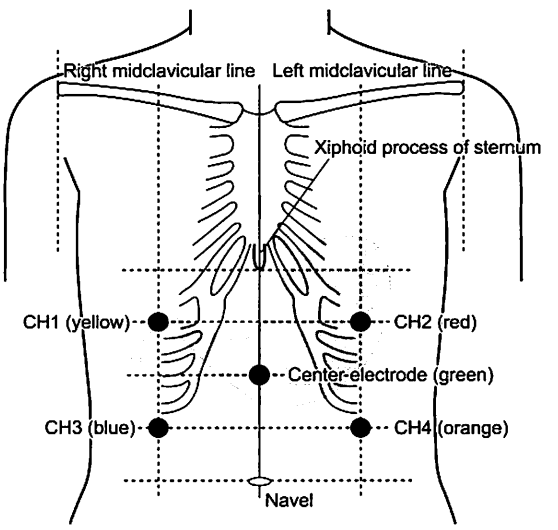

Fig. 1. Electrode positioning

CH1: at the intersection of a line running horizontally through the point midway between the xiphoid process of the sternum and the center electrode and the right midclavicular line

CH2: at the intersection of a line running horizontally through the point midway between the xiphoid process of the sternum and the center electrode and the left midclavicular line

CH3: at the intersection of a line running horizontally through the point midway between the center electrode and the navel and the right midclavicular line

CH4: at the intersection of a line running horizontally through the point midway between the center electrode and the navel and the left midclavicular line

Center electrode: midway between the xiphoid process of the sternum and the navel

5. Stimulation

With the therapist positioned behind the test subject's head, standard pressure was applied using the left thumb, 3 seconds per application for 5 minutes, to a single point on the medial border of the sternocleidomastoid muscle near the area over the carotid artery in the carotid triangle (Fig. 2).

Pressure was regulated so as to be pleasurable for the test subject (standard pressure).

6. Test procedure

The overall condition of the test subjects was determined by asking them to fill out a survey including questions on physical condition, meal times, and usual abdominal condition. After measurement was completed, test subjects completed a survey to determine their feelings on the experimental environment, amount of shiatsu pressure, and changes in abdominal condition due to treatment.

(1) Measurement procedure

Measurements were taken for the 35 minutes that elapsed while the following operations [1]–[3] were performed:

[1] 15 minutes rest (supine position)
[2] 5 minutes treatment
[3] 15 minutes rest (supine position)

(2) Test precautions

The following items were monitored and recorded during testing:

[1] that they remained alert
[2] that they remained motionless
[3] that the surroundings were quiet

(3) Other

Regarding test subjects' meals on the day of testing, no limitations on meal times were established.

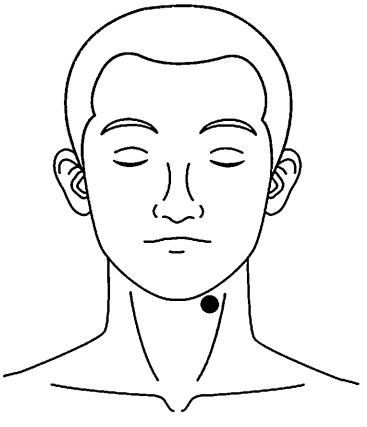

Fig. 2. Point 1, left anterior cervical region

7. Data analysis

(1) Chronological changes to blood pressure and heart rate

Taking the average value during 1 minute prior to stimulation as the control value (cont.), comparisons were made at 1 minute (St.1), 2 minutes (St.2), 3 minutes (St.3), 4 minutes (St.4), and 5 minutes (St.5) during stimulation, and for 1 minute (Af.1), 3 minutes (Af.3), 5 minutes (Af.5), 10 minutes (Af.10), and 15 minutes (Af.15), after stimulation.

(2) Chronological changes to DP and frequency

Taking the average value during 5 minutes prior to stimulation as the control value (cont.), comparisons were made with the average values during stimulation (St.0-5), immediately after stimulation (Af.0-5), 5 minutes after stimulation (Af.6-10), and 10 minutes after stimulation (Af.11-15).

8. Statistical processing

Chronological changes to blood pressure, heart rate, and electrogastrograph were analyzed using Bonferroni multiple comparison and one-way analysis of variance using a general linear model. Analytical software used was SPSS Ver.15, with a significance level of ≤5% taken as significant.

III. Results

During testing there were no instances requiring cessation of treatment due to pain or discomfort.

1. Changes to blood pressure

(1) Maximum blood pressure

Maximum blood pressure decreased significantly ($p=0.003$) 2 minutes after commencement of stimulation (Fig. 3).

(2) Minimum blood pressure

Minimum blood pressure decreased significantly 1 minute ($p=0.022$) and 2 minutes ($p=0.017$) after commencement of stimulation, with a trend toward lower blood pressure ($p=0.06$) indicated during the 5 minutes of stimulation (Fig. 4).

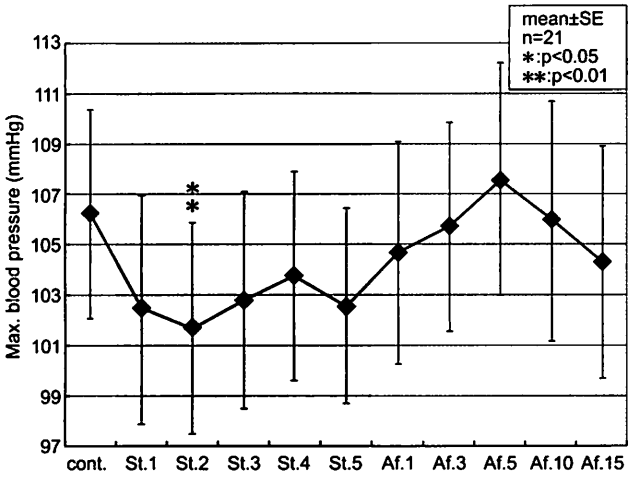

Fig. 3. Changes to maximum blood pressure

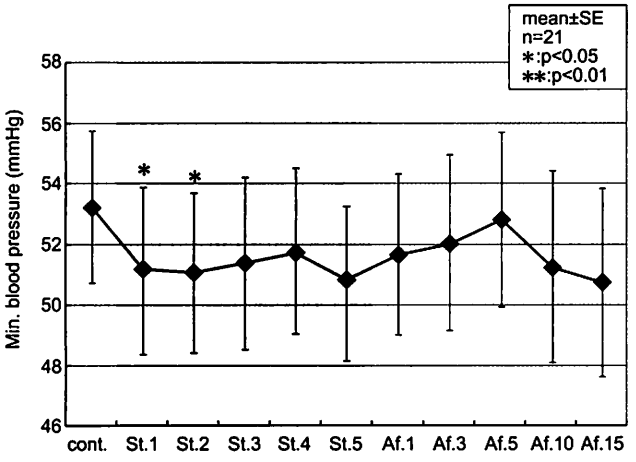

Fig. 4. Changes to minimum blood pressure

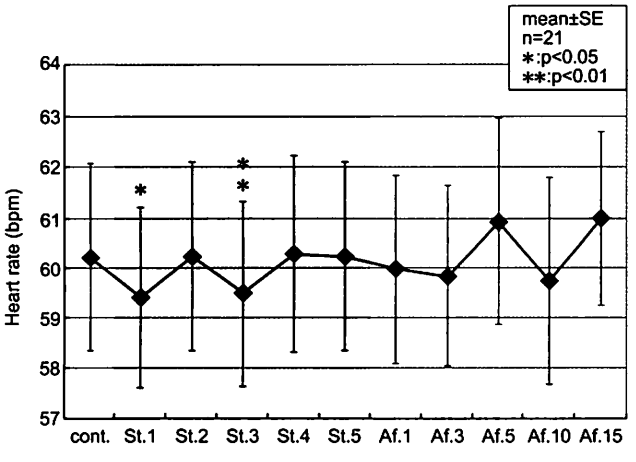

Fig. 5. Changes to heart rate

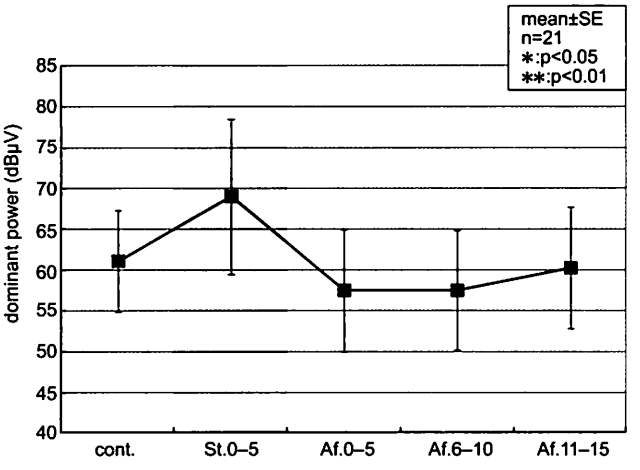

Fig. 6. Changes to DP

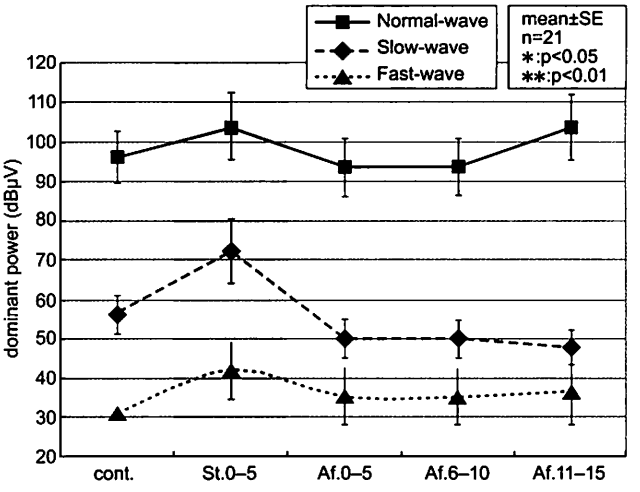

Fig. 7. Changes to DP for each frequency range

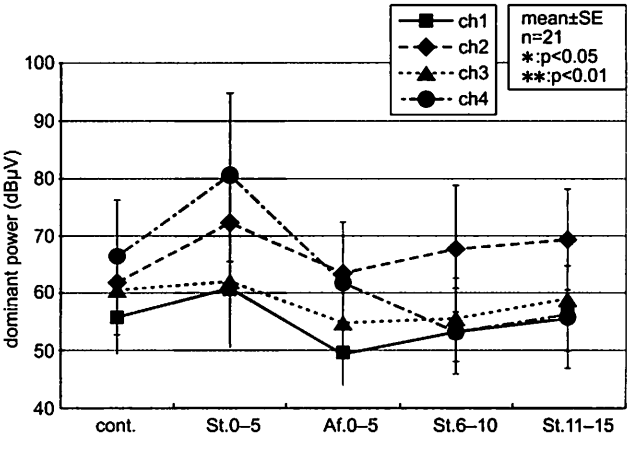

Fig. 8. Changes to DP for each channel

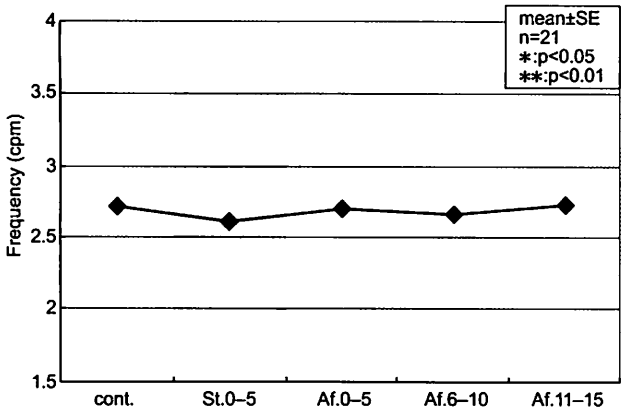

Fig. 9. Changes to frequency

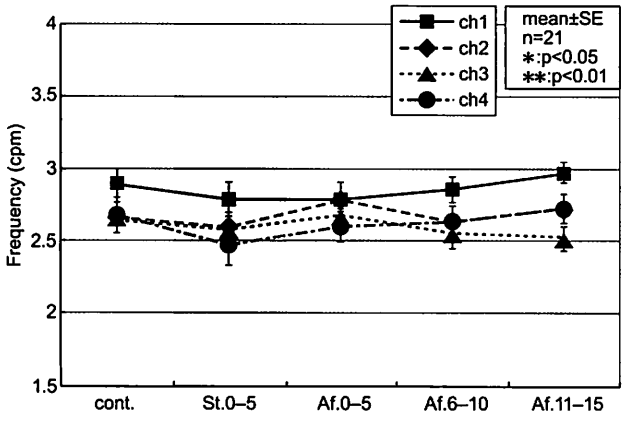

Fig. 10. Changes to frequency for each channel

2. Heart rate

Heart rate decreased significantly 1 minute (p=0.013) and 3 minutes (p=0.001) after commencement of stimulation, and showed a trend toward reduction (p=0.094) during 4 minutes of stimulation (Fig. 5).

3. Changes to DP

(1) DP

A significant chronological change to DP was not observed (Fig. 6).

(2) Changes to DP for each frequency range

A significant chronological change was not observed in any of the slow-wave, normal-wave, or fast-wave ranges.

There was no interaction between slow-wave, normal-wave, and fast-wave ranges on the electrogastrogram due to shiatsu stimulation (Fig. 7).

(3) Changes to DP for each channel

No significant chronological changes were observed in any of the channels (Fig. 8).

4. Changes to frequency

(1) Frequency

Frequency did not exhibit a significant, chronological change, varying within the normal frequency range (Fig. 9).

(2) Changes to frequency for each channel

No significant, chronological changes were observed for any of the channels (Fig. 10).

IV. Discussion

Significant reductions were observed in maximum blood pressure, minimum blood pressure, and heart rate due to shiatsu stimulation of the anterior cervical region. This may have been caused by a response to stimulation of the skin and muscles of the cervical region involving either suppression of sympathetic nervous function or excitation of parasympathetic nervous function regulating the heart, or involving suppression of sympathetic nervous function regulating vascular function. It may also have been caused by a depressor response involving a pressoreceptor reflex due to pressure applied to the carotid sinus. This result is the same as reported by Koyata et al[1] and Ide et al[2].

Sato et al[9] considered whether the rise in DP due to shiatsu stimulation of the lateral crural region occurred via a supraspinal reflex that excited activity in the vagus nerve, which regulates the stomach. Kurosawa et al[10] also reported a rise in DP due to shiatsu stimulation of the abdominal region. This may have been due to a viscero-visceral reflex mechanism via the visceral afferent nerves as a result of stimulation of the abdominal organs or the intramural plexus.

Both Koyata et al[1] and Ide et al[2] also reported decreases in blood pressure and heart rate due to shiatsu stimulation of the lower leg and the abdominal region.

In this study, shiatsu stimulation of the anterior cervical region resulted in decreases in blood pressure and heart rate, but an increase in DP was not confirmed, making it clear that the reaction to shiatsu stimulation with respect to DP differs between stimulation of the anterior cervical region and stimulation of the lower leg and abdominal regions.

Imai et al[11] suggested that the effect of acupuncture stimulation on the stomach, heart, and sweat glands in humans is based on autonomic regulatory mechanisms that are independent for each system. This may also be the case for the responses of the circulatory and digestive systems in this study.

Based on the above, it is clear that shiatsu stimulation of the anterior cervical region affects blood pressure and heart rate, but does not affect gastric motility.

V. Conclusions

From this study performed on healthy adults, the following is evident:

1. Shiatsu stimulation of the anterior cervical region resulted in significant reduction of blood pressure

during stimulation.
2. Heart rate decreased significantly during stimulation.
3. A significant change in dominant power (DP) was not observed. Frequency also varied within normal range, with little effect.

In closing, we would like to express our appreciation to the instructors and students of the Japan Shiatsu College who participated in this research.

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