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Specific Effects of Laserpuncture on the Cerebral Circulation

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Abstract. Acupuncture is a form of traditional Chinese medicine that has developed over thousands of years. We studied the effects of laser puncture, needle acupuncture, and light stimulation on cerebral blood flow in 15 healthy volunteers (mean age 25.0 ± 1.9 years, 5 female, 10 male) with non-invasive transcranial Doppler sonography. In addition 40-Hz stimulus-induced brain oscillations, heart rate, blood pressure, peripheral and cerebral oxygen saturation, and the bispectral index of the EEG were recorded. Stimulation with light significantly increased blood flow velocity in the posterior cerebral artery ($p<0.01$, ANOVA). Similar but less pronounced effects were seen after needle acupuncture ($p<0.05$, ANOVA) and laserpuncture (n.s.) of vision-related acupuncture points. Furthermore both, laserpuncture and needle acupuncture, led to a significant increase in the amplitudes of 40-Hz cerebral oscillations. Stimulation of vision-related acupuncture points with laser light or needle acupuncture elicits specific effects in specific areas of the brain. The results indicate that the brain plays a key intermediate role in acupuncture. However, brain activity of itself does not explain anything about the healing power of acupuncture.

Keywords: Acupuncture; Brain; 40 Hz brain oscillations; Cerebral blood flow velocity; Laserpuncture; Light stimulation; Middle cerebral artery (MCA); Posterior cerebral artery (PCA); Transcranial Doppler sonography (TCD)

INTRODUCTION

Acupuncture has been used as a therapeutic medical technique in China for thousands of years and is indicated for a wide variety of conditions. However, evidence of quantitative measurable effects of acupuncture is still rare in scientific literature.

Laser has been used to stimulate acupuncture points since the 1970s, primarily in children or adults with fear of needles. To date there are few objective data on the effects of laserpuncture [1]. Using a variety of sophisticated measurement systems, we [2–12] and other investigators [13] have shown that acupuncture has specific regional and generalised effects on the brain.

In this study we present multiparametric experimental data concerning alterations in cerebral blood flow velocity as measured non-invasively in healthy volunteers who underwent either laser puncture or conventional needle acupuncture.

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MATERIALS AND METHODS

Multiparametric brain function monitoring during visual stimulation with light, needle acupuncture and laserpuncture was performed on 15 healthy volunteers (five females, ten males; mean age 25.0 ± 1.9 years). All had normal neurologic and psychologic findings and none were taking medications. The study protocol was approved by the institutional ethics committee and all subjects gave informed consent.

During the experiments the subjects were in a relaxed and comfortable position on a bed in our laboratory. The monitoring apparatus was positioned. After a 10-minute resting period light, laserpuncture and needle stimuli were applied in a randomised order. Visual light stimuli were applied with goggles that blocked out all environmental stimuli. The goggles contained five red high-intensity lamps

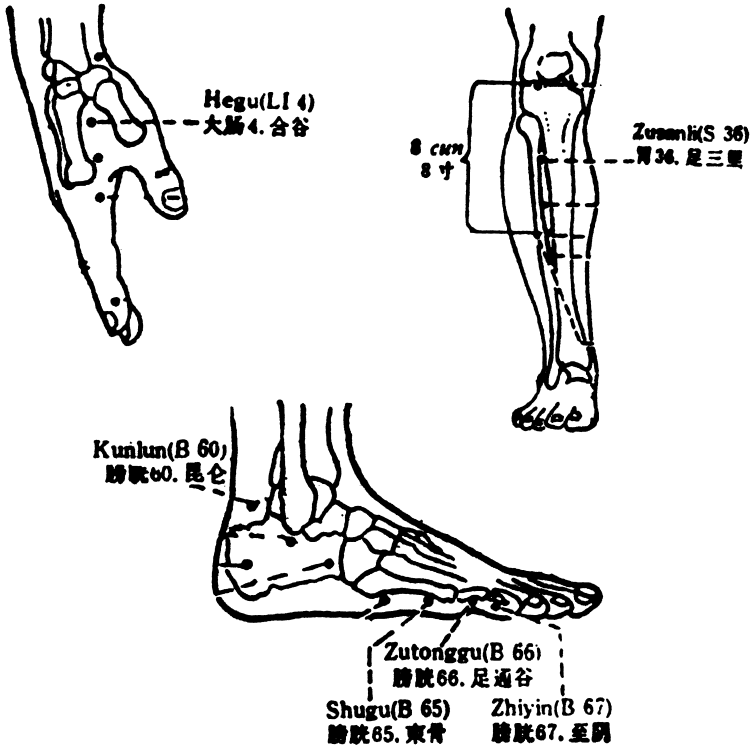

Fig. 1. Acupoints used in this study (modified from Engin [14]).

(HP; HLMP-3316) on each side. The dominant wavelength of the emitted light was 626 nm with a light density of 30 mcd/mm^2. A total of ten 1-s stimuli were applied at intervals of 3 s for a total duration of 40 s. Laserpuncture was performed with a low-level diode laser (Minilaser 2020F, Helbo-Medizintechnik, Gallspach, Austria; continuous beam; power, 19 mW; wavelength, 685 nm). Each acupoint was stimulated for 30 s by the same investigator. Needle acupuncture was performed with sterile, disposable, 0.30 × 0.30 mm needles (Huan Qiu, Suzhou, China) after local disinfection of the skin. A tonifying method was used. This method is characterised by painfree needling, gentle manipulation, and long retention of the needles. The needles were removed after 20 min. Acupunture points are shown in Fig. 1. The acupuncture points (Hegu, Zusanli, Kunlun, Shugu, Zutonggu, and Zhiyin) were chosen to increase the Qi-energy according to traditional Chinese medicine and to stimulate the optical system.

Cerebral Function Monitoring

We measured mean blood flow velocity (v_m, cm/s) simultaneously in the posterior cerebral artery (PCA) and middle cerebral artery (MCA) with a new construction [6,9–11] and a Multi-Dop T device (DWL Electronic Systems GmbH, Sipplingen, Germany). Stimulus-induced 40-Hz oscillations were recorded from C_z-C_{b1} with a Viking System IV (Nicolet, EMS, Korneuburg, Austria). Heart rate and blood pressure (systolic, diastolic and mean arterial pressure) were recorded. Peripheral oxygen saturation was recorded at the second finger of the left hand and regional oxygen saturation from the right frontal region. The bispectral index of the EEG was recorded.

Measurements were obtained before (A) and immediately after (B) stimulation with light, before (C) and immediately after (D) laserpuncture, before needle acupuncture (E), and immediately after needle placement and stimulation (F).

Acupoints

Hegu (LI 4): On the dorsum of the hand, between the 1st and 2nd metacarpal bones, in the middle of the 2nd metacarpal bone on the radial side (see Fig. 1). Puncture perpendicularly 0.5–0.8 cun [14].

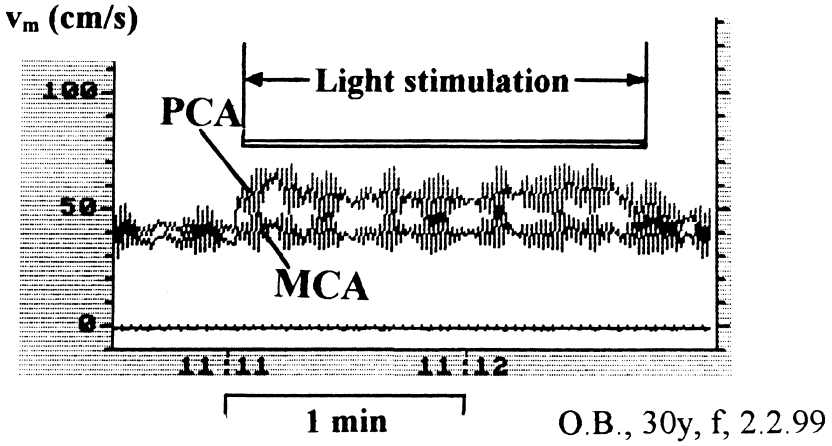

Fig. 2. Blood flow velocity in the posterior cerebral artery (PCA) and middle cerebral artery (MCA) before, during, and after stimulation with light.

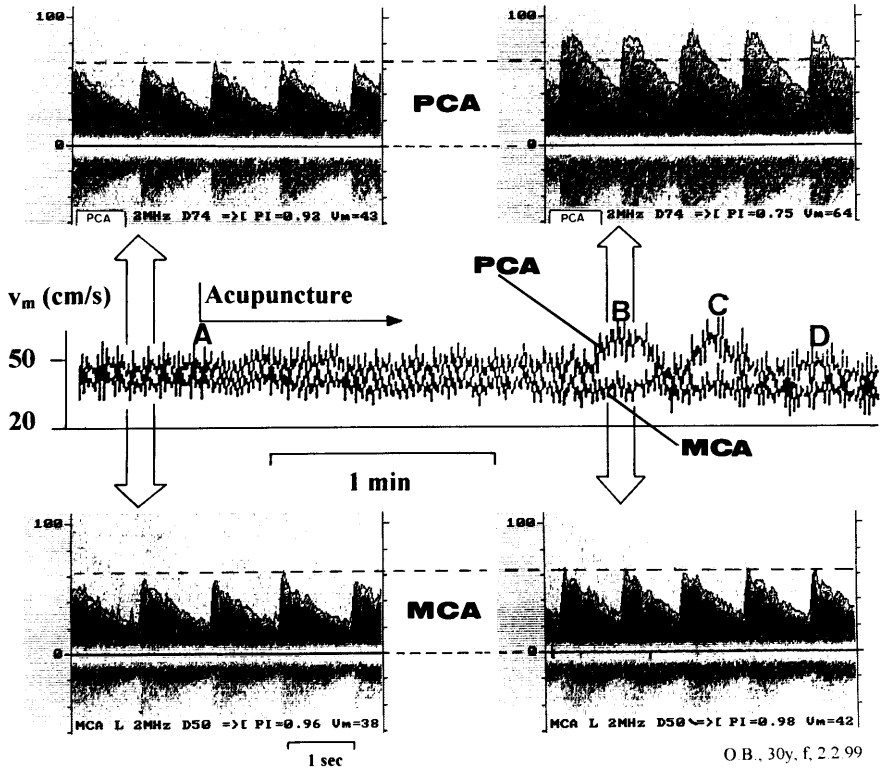

Fig. 3. Quantitative separation of specific acupuncture effects. Note the increase of the mean blood flow velocity in the posterior cerebral artery (PCA) immediately after needle placement (A). This effect is enhanced during stimulation of the acupuncture points (UB 65, UB 66 and UB 67; B–D). The blood flow velocity in the middle cerebral artery (MCA) is unchanged.

Zusanli (S 36): 3 cun below Dubi (S 35), one finger-breadth from the anterior crest of the tibia (see Fig. 1). Puncture perpendicularly 1–1.5 cun [14].

Kunlun (B 60): In the depression between the tip of the external malleolus and tendo calcaneus (see Fig. 1). Puncture perpendicularly 0.5–1 cun [14].

Shugu (B 65): Posterior to the small head of the fifth metatarsal bone, at the junction of the red and white skin (see Fig. 1). Puncture perpendicularly 0.3–0.5 cun [14].

Zutonggu (B 66): Anterior to the fifth metatarsophalangeal joint, at the junction of the red and white skin (see Fig. 1). Puncture perpendicularly 0.2–0.3 cun [14].

Zhiyin (B 67): On the lateral side of the small toe, about 0.1 cun lateral to the corner of the nail. Puncture superficially 0.1 cun [14].

Statistical analysis

The data were tested with analysis of variance (one-way repeated-measure ANOVA) with SigmaStat software (Jandel Scientific Corp., Erkrath, Germany). The results were given as means ± standard error ($\bar{x} \pm SE$). The criterion for significance was $p<0.05$.

RESULTS

Figures 2–6 summarise the results. Stimulation with light induced a significant increase of the flow velocity in the posterior cerebral artery [15]. Figure 2 shows a typical increase of the mean blood flow velocity in the posterior cerebral artery after stimulation with light in a 30-year-old woman. Similar but not as pronounced effects were seen after needle acupuncture and laserpuncture (see Fig. 3). Stimulation with light also slightly increased the flow velocity in the middle cerebral artery whereas acupuncuture led to a decreased blood flow velocity in the middle cerebral artery. The amplitude of the acoustically induced 40-Hz oscillations increased significantly with both laserpuncture and needle acupuncture. All other cardiocirculatory and brain specific parameters like blood pressure or frontal cerebral regional oxygen saturation were insignificantly affected either by laser puncture or by needle acupuncture or light stimulation.

DISCUSSION

This pilot series in 15 adult subjects showed specific changes in blood flow velocity in cerebral arteries both during stimulation with light as well as during acupuncture. These changes were more pronounced with needle acupuncture than with laserpuncture. The findings are consistent with the concept that an external stimulus will likely evoke a neurological response, regardless of its source.

In previous studies we have found that the brain is the key to understanding the effects of acupuncture [2–12]. New experimental constructions to measure ultrasound, light and bioelectrical processes can reproducibly demonstrate effects of acupuncture in the brain. We have shown that acupuncture with needles can increase overall cerebral blood flow. Studies with biosensors and probes in a specially designed helmet showed that

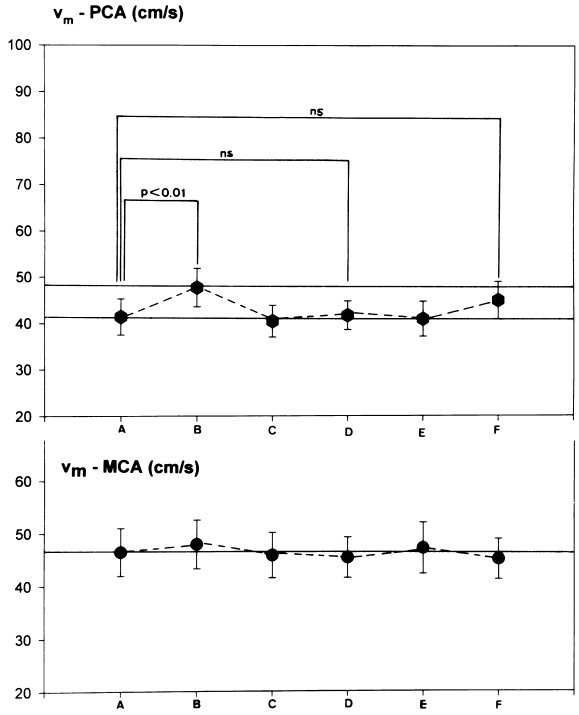

Fig. 4. Mean blood flow velocity in the posterior cerebral artery (PCA) and the middle cerebral artery (MCA). A, C and E, control periods; B, stimulation with light; D, laserpuncture; F, needle acupuncture.

acupuncture can increase the blood flow velocity in the middle cerebral artery and increase the oxygen supply to the brain.

The present study is a further step to objectify the effects of acupuncture. In 15 healthy volunteers we found that needle acupuncture and laser puncture of specific acupoints increases blood flow in specific regions of the brain. Cho et al. [13] have described similar effects in the brain by stimulating vision-related acupuncture points with functional magnetic resonance imaging and after light stimulation. Control studies with stimulation of other acupuncture points on the foot did not produce specific activation in the visual cortex.

Acoustic stimulation techniques and sensitive measurement techniques [16] developed for critical care monitoring have shown significant changes in bioelectric oscillations in the brain during acupuncture. The present study shows also that laserpuncture can elicit reproducible and measurable bioelectrical effects in the brain. These changes may have their origin in the thalamus or hypothalamus. Nonetheless, the changes elicited with laserpuncture are much less pronounced than those elicited with conventional needle acupuncture.

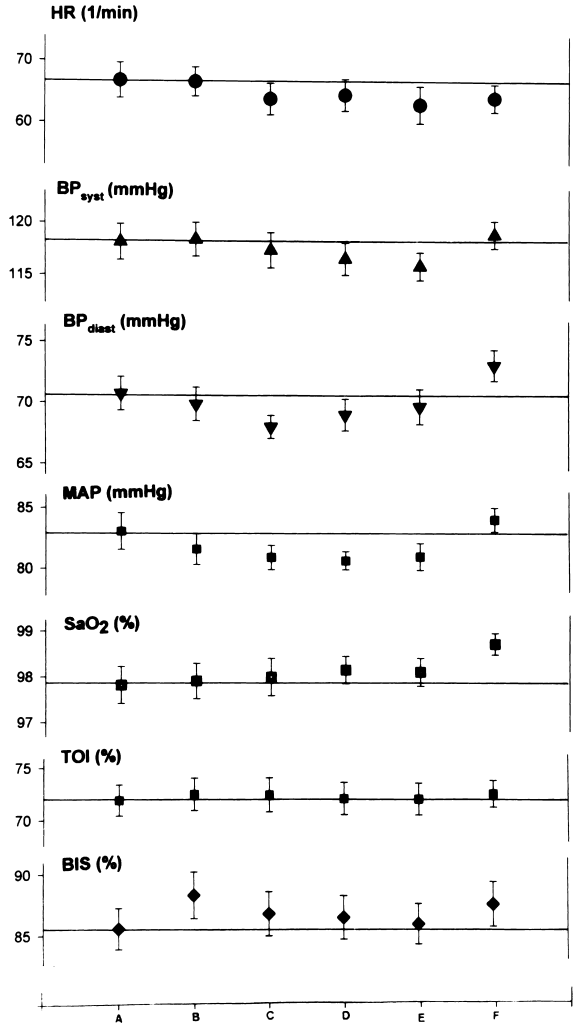

Fig. 5. Multiparametric data analysis. HR, heart rate; BP, blood pressure; MAP, mean arterial pressure; SaO_2, peripheral oxygen saturation; TOI, tissue oxygenation index (regional cerebral oxygen saturation); BIS, bispectral index (index of the EEG). See also Fig. 4.

Our multiparametric brain function monitoring techniques and study design can demonstrate that acupuncture produces specific and reproducible effects on the brain but cannot explain the underlying mechanisms.

CONCLUSION

In conclusion, these results demonstrate activiation of specific regions in the brain in healthy volunteers when vision-related acupoints with laser light or needle acupuncture were stimulated. Further studies are warranted using biomedical techniques to evaluate a possible therapeutic effect of acupuncture techniques in subjects with medical conditions treated with acupuncture.

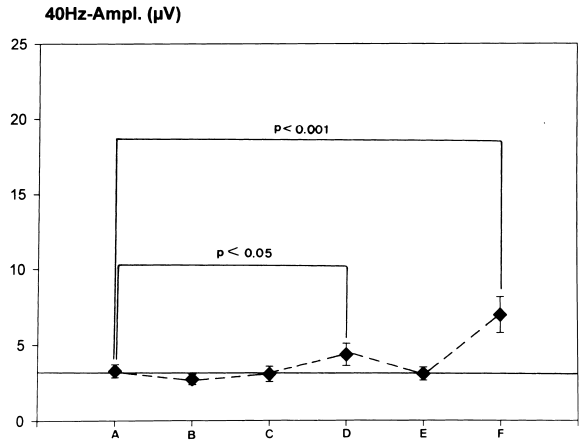

Fig. 6. Stimulation-induced 40-Hz oscillations. Note the significant increase of the amplitudes during laserpuncture (D) and during needle acupuncture (F). For further explanations see Fig. 4.

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