Transorbital Doppler Assessment Of Blood Flow Velocity During Stimulation Of Acupoints Yuyao And Zanzhu

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Citation

Abstract
We studied the effects of acupuncture on cerebral blood flow in 14 healthy volunteers (mean age 52.3 ± 15.7 years, 11 females and 3 males) and 22 patients (mean age 70.6 ± 7.3 years, 12 females and 10 males) with macular degeneration using continuous transorbital Doppler sonography. Acupuncture consisted of manual manipulation of the acupoints Yuyao and Zanzhu for periods of 20 seconds. Mean blood flow velocity in the supratrochlear artery increased significantly (p = 0.03 and 0.05, respectively) in both groups. Mean blood flow velocity in the ophthalmic artery increased also markedly during and after acupuncture. These results indicate once again that the brain plays a key intermediate role in acupuncture.

INTRODUCTION
Transcranial (transorbital) Doppler ultrasonography (TCD) is a noninvasive modality to assess blood flow velocity of cerebral arteries. Using new probe holder constructions, blood flow patterns in various extracerebral and intracerebral arteries can be recorded simultaneously and continuously (1,2,3,4,5,6,7,8,9,10,11,12,13).

Acupuncture, a method based on Traditional Chinese Medicine (TCM), has been used for more than thousands of years. Many empirical data have been collected on acupuncture, but few effects have been measured objectively (15). Early, intriguing results obtained by us (1-13) and other groups (13) indicate that effects of acupuncture can be measured in specific regions in the brain.

The goal of the present study was to investigate specific effects of manual stimulation of two acupoints (Yuyao and Zanzhu) on mean blood flow velocity (vm) in the supratrochlear (STA) and ophthalmic (OA) arteries simultaneously.

SUBJECTS AND METHODS
PARTICIPANTS
The normal volunteers comprised 11 females and 3 males, 29 - 79 (mean 52.3 ± 15.7 SD years) years of age. None of the volunteers had active medical problems or were taking medications. The studies were performed in a dark, quiet biomedical engineering laboratory with the subjects’ eyes kept closed. The patient group comprised 12 females and 10 males 55 - 83 (mean 70.6 ± 7.3 SD) years of age with age-related macular degeneration (14,16,17). Thirteen patients had atrophic or dry macular degeneration and nine patients had the exudative form of the disease.

Figure 1
Fig. 1 a: Wet form of age-related macular degeneration (AMD) with pigment epithelial detachment (PED).
**Figure 2**
Fig. 1 b: Wet form of AMD with fibrovascular scar.

**Figure 3**
Fig. 1 c: Dry form of AMD with Drusen and areas of pigment epithelial hypopigmentation

**Figure 4**
Fig. 1 d: Wet form of AMD with PED

**TRANSCRANIAL (TRANSORBITAL) DOPPLER SONOGRAPHY (TCD)**

TCD signals were recorded simultaneously in the left supratrochlear artery (STA) and the left ophthalmic artery (OA) with a Multi-Dop T and a Smart-Dop system (DWL Electronic Systems GmbH, Sipplingen, Germany). Two 4-MHz probes were used in a new multidirectional ultrasound probe holder construction (Fig. 2) (8,10,13). The Doppler signal was optimized for each artery by adjusting the insonation angle.
The STA was assessed at depths of 7 to 21 mm (mean 13.8 ± 3.7 SD mm) and the OA at depths of 24 to 41 mm (mean 35.4 ± 4.9 SD mm). Both Doppler systems allow online calculation of mean blood flow velocity (vm) derived from averaging the peak systolic and peak diastolic components of the Doppler waveform envelope. Approximately 40 vm values were averaged in each patient in three phases (a: 5 minutes before acupuncture; b: starting 2 minutes after inserting and immediately after stimulating the needles; and c: starting 2 minutes after removal of the needles). The averaged values of the three measured phases were compared for each subject and each group.

Blood pressure reading and pulse rate were obtained at the beginning and the end of the study to ensure that significant variations in these parameters did not occur.

**ACUPUNCTURE**

Two acupoints were tested in the healthy volunteers and the patients.

Yuyao (Ex.3)

Location: In the middle of the eyebrow, directly above the pupil.

Indications: Frontal sinusitis, eye disorders, headache, migraine.

Needling method: Oblique, 0.5 cm, in a medial direction for frontal sinusitis, in a ventral direction for eye disorders (15).

Zanzhu (UB.2)

Location: On the medial end of the eyebrow, directly above the inner canthus of the eye.

Indications: Eye disorders, frontal sinusitis, rhinitis, frontal headache, migraine.

Needling method: Perpendicular, 0.5 – 0.8 cm (15).

After desinfection of the skin the acupoints were punctured manually with 0.30 x 30 mm sterile single-use needles (Huan Qiu; Suzhou, China). Stimulation consisted of a combination of rotating and thrusting movements. A tonifying method, characterized by careful, painfree needling with thin needles, gentle manipulation, and long retention of the needles, was used. The needles were removed after 20 minutes and the subjects allowed to rest for 10 minutes.

**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 expressed as means ± standard error (\(x ± SE\)). The criterion for significance was \(p < 0.05\).

**RESULTS**

All 36 subjects were physiologically stable throughout the acupuncture session. There were no significant differences between the beginning and the end of the study in pulse rate or blood pressure. Figure 3 summarizes the results for all 14 volunteers and 22 patients. On average, vm increased in both arteries in both the healthy volunteers and the patients with macular degeneration. The increase in the vm in the left STA in normals (mean increase + 8.7 cm/s) was greater than that in the left STA in patients (mean increase + 6.6 cm/s). The baseline value of vm for the OA was lower in patients (mean – 2.4 cm/s) than in volunteers, whereas baseline of STA was slightly higher (mean + 0.4 cm/s) in patients.
**Figure 3**
Fig. 3: Participants, acupuncture schema, and graphical and numerical results (a) before, (b) during, and (c) after acupuncture.

![Figure 3](image)

Figure 4 shows the results in a 30-year-old female. Note the increase of \( v_m \) of the STA and OA after inserting the needles at the acupoints 1 – 4.

**Figure 4**
Fig. 4: Blood flow profiles of the supratrochlear artery (STA) and the ophthalmic artery (OA) and mean blood flow velocity (\( v_m \)) before and during inserting and stimulation needles at the acupoints Yuyao (1,4) and Zanzhu (2,3). Note that the increase of \( v_m \) in the OA is greater when Yuyao is stimulated than when Zanzhu is stimulated.

![Figure 4](image)

**DISCUSSION**

Acupuncture, which has its origins in Traditional Chinese Medicine, is one of the most frequently used treatment approaches worldwide today. The hundreds of acupuncture points on the human body are points at which according to TCM the flow of the vital force Qi can be stimulated. The most widely used way to stimulate these points is with needles. By moving the needle in the skin the therapist can induce further stimuli.

We have found in numerous studies that the key to understanding acupuncture’s secrets lies in the brain. New experimental constructions to measure light, ultrasound, and bioelectrical processes can reproducibly demonstrate effects of acupuncture in the brain. In 1997/98 we showed that acupuncture with needles can increase cerebral blood flow. Studies with biosensors and probes in a specially designed helmet (see editorial to this issue) in healthy probands showed that acupuncture can increase the blood flow velocity in cerebral vessels and increase the oxygen supply to the brain. In 1999 our group took a further step to demystify and objectify the effects of acupuncture. In healthy probands we found that acupuncture with needles increases blood flow in specific regions of the brain. For example, acupuncture of points on the hand and the lateral side of the foot (e.g. UB 67), which TCM places in
connection with the optical system, increased blood flow velocity in the specific artery that supplies the brain center for visual awareness. At the same time, blood flow in other brain vessels stayed unchanged. These kinds of effects had previously been found only after stimulation with light. Control studies with stimulation of the inner edge of the foot did not produce these specific changes. These results were obtained by using an adaptation of a complex multiparametric measurement system used mainly in critical care medicine.

The present study demonstrates once again the potential ability to correlate the physiological information provided by TCD with specific manual acupuncture stimulation.

We are convinced that the sophisticated tools of Western Medicine can be used to objectify the effects of Traditional Chinese Medicine. Conceivably this could improve the applications of acupuncture and would have wide implications for the quality of life of patients treated with acupuncture.

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References
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