

RESEARCH ARTICLE

Effects of three needling manipulations of the right-side Zusanli (ST 36) on brain using functional magnetic resonance imaging

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Abstract

OBJECTIVE: To investigate the effects on the brain using three needling manipulations (twirling, lifting-thrusting, and twirling plus lifting-thrusting) when the right-side Zusanli (ST 36) acupoint was stimulated with needles.

METHODS: Seventeen healthy subjects accepted three needling manipulations stimulating the right Zusanli (ST 36) over separate days. Functional magnetic resonance imaging was used to detect changes in the brain during the manipulations, and then the needling sensations were recorded using the MGH acupuncture sensation scale (MASS) after each scan. fMRI data were processed using Statistical Parametric Mapping 8 to analyze the positive

and negative activation in the brain induced by different acupuncture manipulations.

RESULTS: The individual needling sensations showed no statistically significant differences among the three manipulations. However, the MASS index showed that lifting-thrusting > twirling plus lifting-thrusting > twirling. Lifting-thrusting activated left premotor cortex, left postcentral, right middle frontal gyrus, left inferior frontal gyrus, right lingual gyrus, left insula, right putamen, bilateral cingulate gyrus and right cerebellum; and deactivated bilateral hippocampus and left caudate. Twirling activated bilateral orbital middle frontal gyrus, left opercular and triangular inferior frontal gyrus, and right middle occipital gyrus; and deactivated bilateral precuneus, right amygdala, left anterior cingulate gyrus, right inferior temporal gyrus, right middle frontal gyrus, right supplementary motor gyrus, and left postcentral. Twirling plus lifting-thrusting activated bilateral postcentral, left inferior occipital gyrus, left insula, left thalamus, left cingulate gyrus, and right putamen; and deactivated right superior frontal gyrus, right superior parietal gyrus, right temporal gyrus, right middle occipital gyrus, right insula, and left lingual gyrus. Pairwise comparisons of the three manipulations showed that signals induced by lifting-thrusting were the strongest, especially in the limbic system, followed by twirling plus lifting-thrusting; twirling alone was the weakest.

CONCLUSION: Three methods of needling manipulations similarly activated areas associated with the somatosensory system, vision, cognition, and emotional regulation. This may have significant implications for acupuncture in clinical practice.

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Keywords: Needling methods; Point ST 36 (Zusanli); Magnetic resonance imaging; Limbic system; Neocortex

INTRODUCTION

Acupuncture manipulation is an important part of acupuncture technique for producing treatment effects. Clinical evidence suggests that the effects of acupuncture are better when using needling manipulation. Furthermore, different manipulations may induce different effects in the same acupoint.¹⁻³ Over the past 20 years, functional magnetic resonance imaging (fMRI) has been widely used to image the brain in acupuncture studies. Many fMRI studies⁴⁻⁸ have examined acupuncture specificity by comparing different acupoints, real and sham acupoints, or true and sham acupuncture. The technique with twirling manipulation was commonly used. Results showed negative activation (deactivation) of regions mainly located in the limbic system and activation of areas in the somatosensory cortices. However, it is not clear whether different manipulations induce different effects on the brain as evidenced by fMRI.

Our present study aimed to investigate the effects caused by different acupuncture manipulations when stimulating the right-side Zusanli (ST 36) acupoint on healthy subjects and detect the changes in the brain using fMRI.

MATERIALS AND METHODS

Seventeen healthy, right-handed, male university students participated in the study with informed consent [(24.0 ± 1.2) years old, (64.0 ± 2.8) kg, (174.0 ± 4.1) cm] in Beijing. Subjects were screened and excluded for mental or medical disorders, history of head trauma, use of medications within 4 weeks before the trial, and contraindications for exposure to a high magnetic field. The study was approved by the Ethics Committee of the China Academy of Chinese Medical Sciences.

The different manipulations

All subjects accepted three acupuncture manipulations on the right Zusanli (ST 36) with sterile disposable stainless steel needles, one manipulation each week: twirling, lifting-thrusting, and twirling plus lifting-thrusting. Zusanli (ST 36) is located on the tibia anterior muscle, 3 cun below the kneecap and 1 cun lateral from the anterior crest of the tibia. The needle was inserted vertically to a depth of 3 cm. Twirling was manipulated with the needle rotating approximately 180°. Lifting-thrusting was to keep the needle up and down about 1 cm in the same frequency. Twirling plus lifting-thrusting is the combination of the two manipulations.

All manipulations were at the rate of 2 Hz for 2 min. An experienced licensed acupuncturist administered the acupuncture for the whole study.

fMRI

The study was performed in the Department of Radiology, Guang An Men Hospital, China Academy of Chinese Medical Sciences. Brain imaging was conducted using a 3.0 T MRI scanner (MAGNETOM Skyra, Siemens, Erlangen, Germany) equipped with a standard 20-channel head coil. The subjects lay supine with earplugs to suppress the noise and cushions to immobilize the head. They were instructed to stay awake and relax, keep their eyes closed, breathe steadily, and not think of anything in particular. Acupuncture was performed at the acupoint while lying in the supine position in the scanner, so the subjects could not see which manipulation the acupuncturist was working on. After 2 min of the needle being in the right Zusanli (ST 36), MRI scanning began. At the same time, the needle was manipulated continuously for 2 min, and kept in place for 4 min. A total of 180 volumes were acquired for a total imaging time of 6 min. Each volume consisted of 30 slices, with a thickness of 4 mm and a 0-mm gap to cover the entire brain. The time interval between each successive acquisition of the same slice (repetition time, TR) was 2000 ms, with an echo time (TE) of 30 ms and a flip angle (FA) of 80°. The field of view (FOV) was 200 mm × 200 mm, and the matrix size was 64 × 64, yielding volume dimensions of 3 mm × 3 mm × 4 mm. After the functional scans, a set of high-resolution sagittal images with a T1-weighted 3D-MPRAGE sequence were acquired (TR 2.5 s, TE 4.4 ms, thickness 1 mm, FA 8°, FOV 280 mm × 245 mm).

Psychophysical sensation

After scanning, the subject was asked to report the sensations of acupuncture needling. The MGH Acupuncture Sensation Scale (MASS)⁹ questionnaire was used for the investigation of sensation, including soreness, dull pain, pressure, heaviness, fullness, numbness, sharp pain, warmth, coolness, throbbing or other sensations, and then each sensation on the scale was rated from 0 to 10 (0 = no sensation, 1-3 = mild, 4-6 = moderate, 7-8 = strong, 9 = severe, and 10 = unbearable sensation). The De Qi response was defined as a total score ≥ 3 for the recorded sensations except for sharp pain. Sharp pain was considered as an inadvertent noxious stimulation.^{5,10}

Psychophysical data analysis

SPSS 20.0 (IBM Corp. Released 2011. IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY, USA) software was used for analysis of the sensation data. The measurement data was indicated as mean ± standard deviation ($\bar{x} \pm s$). The Kruskal-Wallis test was performed for comparing the intensity of every needling

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