

## Brain activation induced by acupoint stimulation in the Yin meridian: fMRI study

G. Li<sup>1</sup>, A. M. Y Tang<sup>1</sup>, G. G. Jing<sup>1</sup>, E. S. Yang<sup>1</sup>

<sup>1</sup>The Jockey Club MRI Centre, The University of Hong Kong, HK, HKSAR, China, People's Republic of

### Introduction:

Interest in understanding the principles underpinning acupuncture using fMRI techniques has been growing rapidly. Recent advances in imaging technology enables us to observe the anatomy and physiological functions involved during acupuncture in humans. According to Chinese medical thinking, the pericardium meridian is a Yin meridian. The heart and pericardium are associated with the brain and its functions, so they constitute a functional unit.<sup>1</sup> Notice that Yang meridians pass through the brain while Yin meridians do not. Thus, it is believed that stimulation of Yin meridian acupoints would not lead to brain activation. We postulate that 1) acupoint stimulation of PE 6 in the pericardium meridian would induce brain activation, and further that 2) brain activation induced by manual acupuncture would be stronger. The latter conjecture arises from the general belief that “deqi” can be attained more readily and effectively through manual acupuncture. 14 normal right handed male subjects (age 18-25 year old) were studied using fMRI with manual acupuncture and electrical acupuncture, respectively. Brain activation was observed in the superior temporal gyrus and superior longitudinal fasciculus bilaterally as well as in the medial areas of the frontal gyrus. We successfully observed brain activation following acupoint stimulation in PE6 of the pericardium meridian. Moreover, brain activation induced by manual acupuncture is significantly stronger.

### Materials and methods:

MRI was performed on a Philips Achiva 3 T whole body MRI at the Jockey Club MRI Centre, Hong Kong with a 8 channel quadrature birdcage head coil. A sagittal spin echo localizer image was acquired initially. fMRI was performed in the transverse plane, parallel to the anterior-posterior commissura (AC-PC) line. A 34-slice set of fMRI images was acquired with the following scan parameters: TR = 3000 ms; TE = 30 ms; flip angle = 90°; matrix = 64 X 64; field of view = 23 cm X 23 cm; slice thickness = 4.0 mm, without inter-slice gap. Anatomical whole brain MRI was acquired using a T1-weighted turbo spin echo (TSE) sequence with TR 2000 ms and TE 10 ms with IR delay 800 ms.

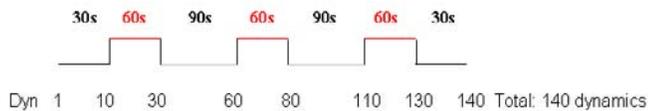


Figure 1 shows the sequence design in the fMRI experiment. 140 fMRI volume images were collected during each run. The first four fMRI volume images of each run were discarded to ensure steady state magnetization. Each fMRI examination consisted of two different stimulation paradigms, namely, manual acupuncture and

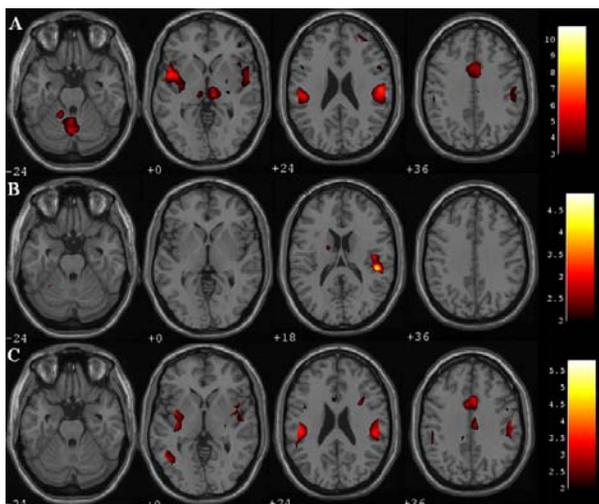
electrical acupuncture at PE 6. Stimulation was performed on the left PE 6, located between the tendons muscle palmaris longus and muscle flexor carpi radialis. Post-processing of fMRI data was done using Statistical Parametric Map (SPM2) software package, running on Matlab (Version 7.9). Each of the 140 fMRI image volumes was automatically realigned to the first images of the time series to correct for head movements during fMRI acquisition. The time series volumes were then registered to the brain template adopted by the International Consortium for Brain Mapping (ICBM); spatial normalization was mapped into Talairach space. The spatially normalized EPI volumes were smoothed by an 8 mm full-width-half-maximum Gaussian kernel. Physiological noise was filtered using a window function that corresponds to a hemodynamic impulse response function (HRF). Statistical analysis was conducted at two levels. First, individual task-related activation was evaluated. Second, to make inferences at a group level, individual data were summarized and incorporated into a random effects model.

### Results:

Figure 2 illustrates fMRI images of 14 normal subjects: A refers to manual acupuncture, B refers to electrical acupuncture, and C refers to comparison of manual acupuncture vs. electrical acupuncture stimulation. Brain activation was found in the superior temporal gyrus and superior longitudinal fasciculus bilaterally. Also, activation was observed in the medial areas of the frontal gyrus (BA 8 and 32). Moreover, activation induced by manual acupuncture was significantly stronger than those elicited by electrical acupuncture.

### Discussion:

The superior longitudinal fasciculus comprises numerous pathways among the frontal pole, the occipital lobe, and the posterior part of the temporal lobe. Activation of these regions following stimulation of PE 6 suggests that PE 6 may be related to mental disorder, psychiatric diseases, agitation and insomnia, and epilepsy. In particular, the observed activation of the medial frontal cortex corroborates the possible link between PE6 and mental disorder.



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**References:** 1. Stux G et al., Basics of acupuncture. 2003