Does acupuncture produce a BOLD-signal?
New findings with fMRI on stimulation of acupoint GB 37

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INTRODUCTION

The acceptance of acupuncture as a therapy of organic diseases has increased rapidly even though the exact mechanisms of acupuncture are still unknown. Most studies, however, suggest that the effect of acupuncture is transmitted through the neuronal system (1). By means of fMRI, we aim to scrutinize whether or not focal cerebral activity is elicited by acupuncture. Recent studies investigating the BOLD-signal changes in the visual cortex correlated to acupuncture reported diverse results (2, 3). In our former study the BOLD-response of the visual cortex to optical stimulation was not significantly modulated by acupuncture nor was a BOLD-response detected correlating with acupuncture (3). In our present study the acupuncture of the acupoint Guangming (GB 37), documented to influence vision related disorders (4), was intensified. Acupuncture was performed bilaterally and a manual twisting manipulation of the needles was added. This manipulation intensified the so-called ‘‘De-Qi’’-Phenomenon, a local tingling sensation which according to classic literature is essential for the effectiveness of acupuncture. Being aware that the visual stimulation might interfere with the cortical effects of acupuncture, in a part of the subjects only the acupuncture protocol was applied omitting the visual stimulation.

METHODS

This study was performed on a 2 T whole body system (BRUKER S200 Avance) equipped with a head gradient insert (30 mT/m, 150 T/m/s). Acquisition parameters were: single-shot GE-EPI, matrix size: 64 x 64, square FOV: 25 cm, 12 slices, slice thickness: 4 mm, interslice distance: 6 mm, TE_{eff}: 35 ms, T_R: 3 s. Altogether 17 healthy volunteers were investigated using identical acupuncture protocols, 11 of them with additional visual stimulation, 6 of them without. The needles were inserted bilaterally during the 200th and removed during the 540th timeframe. The needles were twisted in intervals of one minute during acupuncture. 2 different kinds of functional maps were obtained by cross-correlation analysis relating to: **needle insertion (**before vs. after) and **needle twisting** (12 s before vs. 12 s after).

Visual stimulation: red goggles flickering at 8 Hz, 7 visual stimulation-cycles alternated with 7 non-stimulation-cycles; visual stimulation-cycle: 2 activation periods, 2 rest periods, 30 s each. 40 images were acquired per cycle, except during needle insertion. Then, 120 images were acquired in order to distinguish between effects related to needle application and the visual stimulus. Functional maps of visual activation for each individual cycle were calculated by cross-correlation analysis. Fig.1 displays the timing of acupuncture and visual stimulation.

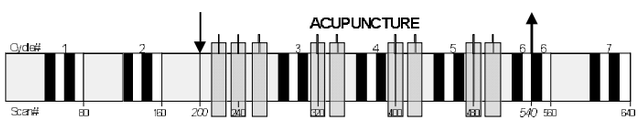

Fig.1: The bilateral needle insertion and removal is symbolized by arrows. Non-stimulation-cycles are coloured grey. Visual stimulation-cycles with goggles on and off are shown in black and white, respectively. Timeframes before and after needle twisting used for cc-analysis are shown as overlaid boxes.

RESULTS

Needle insertion: no statistically significant brain activation due to needle insertion could be observed.

Needle twisting: slight but significant BOLD-signal changes were detected in response to needle twisting (time course: Fig. 2). For the group of subjects examined with acupuncture only, the functional maps were transformed into the stereotactic coordinate system based on (5). The Talairach coordinates of the clusters of activated voxels with significant activation in at least 5 out of 6 subjects are:

cluster	x	y	z	anatomical name
1	49	-59	18	left Gyrus temp. med.
2	-52	-57	13	right Gyrus temp. med.
3	51	-32	23	left parietal operculum, BA 40, S2
4	-54	-28	30	right parietal operculum, BA 40, S2
5	-38	-5	7	right insula

Four clusters are shown overlaid onto a high-resolution MRI of an individual brain (Fig. 3).

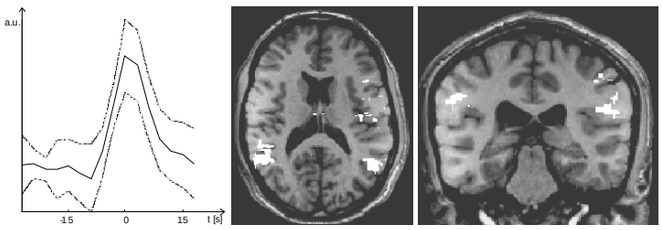

Fig.2 (left): Time course, averaged over the significantly activated voxels, all twisting periods and subjects with voxels in clusters 1&2. The dotted lines represent the standard deviation. Fig.3: BOLD-response of clusters 1&2 (center) and 3&4 (right).

Visual stimulation: successful activation of the visual cortex was demonstrated in each of the activation cycles. The proportional signal changes in the visual stimulation-cycles did not significantly differ before acupuncture vs. during acupuncture.

DISCUSSION AND CONCLUSION

Even with an intensified acupuncture stimulus a significant BOLD-response was observed only for needle twisting in 5 different cortical areas. The symmetric location of clusters 1&2 and 3&4 probably reflects the bilateral acupuncture. Clusters 3&4 seem to correspond to the activation of the secondary somatosensory cortex. The primary somatosensory cortex was not imaged since the focus of the study was on the visual cortex. The activation of the clusters 1&2 may reflect attention-related processes. Whether these clusters represent a response specific to acupuncture or correlate to the inevitable somatosensory stimulation accompanying acupuncture can not be deduced from our data. Currently we perform further studies with an appropriate somatosensory stimulation as a baseline condition in order to resolve this issue.

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