Hyperexcitability of the motion-sensitive area MST in migraineurs with aura

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Introduction

Migraine is a common disorder in which abnormal visual cortical excitability has been suggested to play an important part as a possible factor predisposing to the cortical spreading depression that has been suggested to represent the pathological basis of the aura during the migraine attack [1]. In the last twenty years an altered interictal cortical excitability has been claimed in migraine, however sometimes similar methodological approaches led to contradictory results, and even similar results led to opposing explanations.

As specific fMRI data regarding the motion processing areas is lacking, the present experiment was designed to address the responsiveness of the extrastriate, motion-responsive middle temporal area (MT) and medial superior temporal area (MST) of the migraineurs brain to moving visual patterns. We hypothesized that these areas show increased responsiveness in migraine patients compared to controls. Furthermore, we evaluated the differences between migraine patients with aura and without aura.

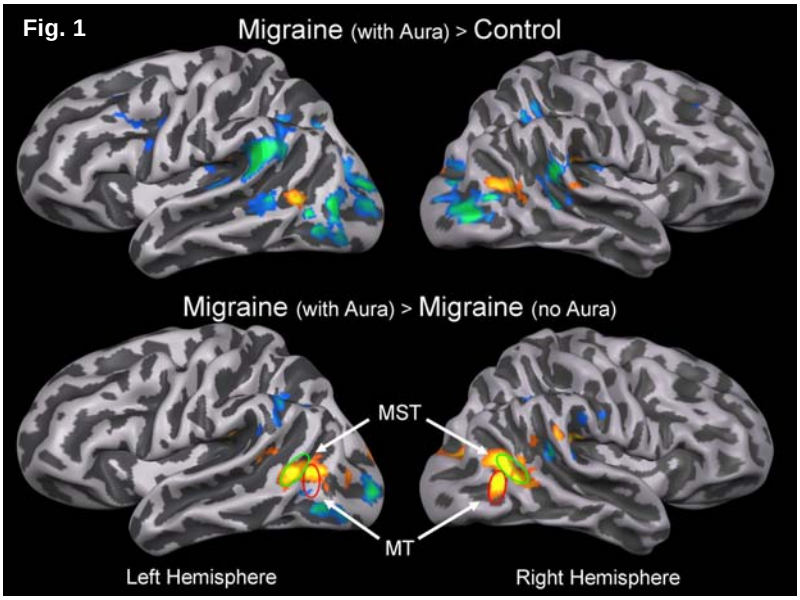
Methods

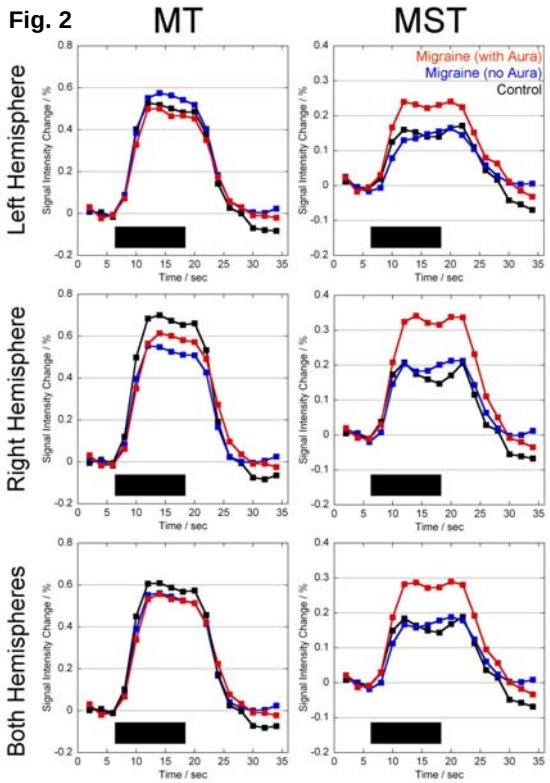
Subjects. 27 adults including nine migraine patients without visual aura (MwoA; mean age: 28.3 years, 1 male) and nine patients with visual aura (MwA; mean age: 33.3 years, 4 males), as well as nine healthy control subjects (mean age: 29.8 years, 3 males) participated in the study. Migraineurs were studied between attacks (>72 h after the last and before the next migraine attack).

Visual motion paradigms. Five different types of simple and complex coherent as well as incoherent visual moving dot stimuli were used as described previously [2]. The motion stimulation phases (12s) were interleaved with control phases (18s) consisting of a static version of the dot pattern. Stimuli were presented with the use of "Presentation" (Neurobehavioral Systems, USA) and a set of MR-suited LCD glasses (Resonance Technology, USA).

MRI. MRI was performed at 3 Tesla (Siemens Magnetom Trio, Germany) using the standard eight-channel phased-array head coil. Initially, an anatomical T1-weighted MR dataset covering the whole head at 1 mm^3 isotropic resolution was acquired (3D Turbo FLASH). For blood oxygenation level dependent (BOLD) fMRI a T2*-sensitive EPI technique with an in-plane resolution of 2 x 2 mm^2 was used (TR: 2000 ms, TE: 36 ms, flip angle: 70, acquisition matrix: 96 x 128, 16 sections of 4 mm thickness parallel to the calcarine fissure).

Data analysis. Group analysis and visualization were achieved using BrainVoyager QX (Brain Innovation, The Netherlands). To improve the spatial correspondence mapping between subjects' brains, the individual cortical folding pattern was accounted for by using a cortical matching approach [3]. In a GLM analysis, group differences in response to all movement types pooled together were assessed by contrasting MwA vs. MwoA, MwA vs. Controls as well as MwoA vs. Controls. Areas MT and MST were defined on the group-aligned inflated representation of the left and right hemisphere using gross anatomical landmarks (red/green ellipse in **Fig. 1**) [4], and signal intensity time-courses were extracted from these areas (**Fig. 2**).





Results and Discussion

Group analysis revealed bilateral activation in areas MT and MST in response to visual motion paradigms in the three subject groups. The assessment of differences between subject groups (**Fig. 1**) revealed stronger bilateral activation of MST in MwA compared to controls as well as to MwoA. In MT, control subjects showed stronger bilateral activation compared to MwA, while the comparison between MwA and MwoA revealed stronger right-sided activation for MwA, but no clear picture in the left hemisphere.

Generally, signal changes in MT were about 2-3 times higher as in MST (**Fig. 2**). In MT signal changes in response to the visual motion stimuli were comparable for all subject groups. In MST however, a substantially lower signal increase compared to MwA in both hemispheres was seen in MwoA (-35%) as well as controls (-35%).

In summary, we have observed that MwA patients demonstrate increased responsiveness to moving visual stimuli in MST in the interictal period compared to control subjects as well as MwoA patients. These results strengthen the notion that not only the primary visual cortex but also higher order visual areas are affected in the interictal phase of the disease.

References: **1**. Welch et al. Neurol Clin 1990; 8: 817–28. **2**. Antal et al. Vis Neurosci 2008; 25: 17-26. **3**. Goebel et al. Hum Brain Mapp 2006; 27: 392–401. **4**. Huk et al. J Neurosci 2002; 22: 7195-205.