Functional imaging of fibromyalgia using empathy for pain

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Introduction

Fibromyalgia(FM) is disorder of unknown etiology [1], characterized by chronic widespread pain and are often accompanied by functional disturbance (dizziness, palpitations) in different organ systems and symptoms of sleep disturbance, anxiety, memory problems, fatigue, and exhaustion. Previous functional imaging studies of FM mainly focused on pain by applying pressure to specific FM tender point. However, there is no emotional and cognitive functional imaging study with FM. Therefore, the aim of this study investigates difference of pain perception between fibromyalgia patient and healthy controls using empathy for pain task.

Subject and Methods

Subjects: Sixteen right-handed, healthy female participants were recruited from the general population and twenty-three right-handed, fibromyalgia female participants were recruited from the fibromyalgia population in this study. The mean age of fibromyalgia group were 39.4 years and the healthy group were 37.9 years. After detailed explanation of the study design and potential risks, all subjects gave written informed consent. All study protocols were approved by the local Internal Review Board (IRB).

Functional MRI: The fMRI task paradigm was used emotional pain task with block design. Functional magnetic resonance images were acquired using a 3.0T GE HD scanner(EPI, TR=4000ms, TE=40ms, matrix=64x64, Thickness=3.0mm, FOV=192mm, no gap). Anatomical images were acquired using 3D-FSPGR sequence(TR=7.8ms, TE=3ms, matrix=256x256, no gap).

Empathy for pain paradigm: The empathy for pain stimuli had been previously developed and were used with their permission. The picture stimuli consisted of a series of color pictures that showed right hands and right feet in painful and non-painful situations (Fig 1). The 96 painful pictures used in this paradigm and the session consisted of 26 blocks. The participants were asked to watch and evaluate the pictures describing right hands or feet in painful situations as a task condition(12 blocks). The baseline trials showed a 2 fixed cross blocks at the middle and end of the session. Each task or control block consisted of eight 4-s trials of the same condition. Each picture was shown for 2s, followed for 2s by a faces pain rating scale.

Data Analysis: Statistical parametric map software (SPM5, Wellcome Department of Cognitive Neurology, London, UK) was used to generate activation map. One-sample for within group analysis and two-sample t-test for between group analysis were performed with voxel-wise intensity threshold of P<0.05 (FDR, corrected).

Result and Discussion

Our within group analysis, consistent with previous functional imaging studies on empathy for pain [2], demonstrated that the control group showed the significant activation in the insula, thalamus, temporal parietal junction(TPJ), anterior cingulate cortex(ACC), dorsolateral prefrontal cortex(DLPFC), somatosensory cortex, and SMA(Fig 2.(a),FDR corrected, P<0.05). Compared to control group, the FM group showed superior parietal, TPJ, inferior prefrontal cortex, superior prefrontal cortex, putamen, and SMA(Fig 1.(b),FDR corrected, P<0.05). Between group analysis (two sample t-test) revealed that the control subjects showed more activations in the left insula, thalamus, TPJ, ACC, DLPFC, somatosensory cortex, ACC, and SMA(Fig 3.), FDR corrected, P<0.05) compared to the FM group. Among the brain areas, which were strongly activated in control group, DLPFC was associated with cognitive processing and representation regarding the internal states of others. In addition, ACC is also known to be involved in general emotional processing and the affective processing of pain under conditions of 'first hand' experience of the emotion or sensation.

Therefore, the reduced ACC activity in FM subjects suggests that FM patients has experienced a difficulty to associate with estimation of the intensity off observed pain and to activate the neural network underlying this specific emotion or sensation in the empathizer [3]. Based on our finding that the FM group did not show activation in the several pain empathy related areas during the empathy for pain task, the current study suggest that DLPFC and ACC hypoactivity in FM group is associated with a deficit in cognitive function in empathizing and evaluating other's pain.

References

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[3] Saarela, M.V., Hlushchuk, Y., Williams, A.C. de C., Schurmann, M., Kalso, E., Hari, R. The compassionate brain: human detect intensity of pain from another's face. Cereb. Cortex 17, 230–237.

Result data

Fig 1. Sample pictures of hands and feet in painful and non-painful conditions and faces pain rating scale.

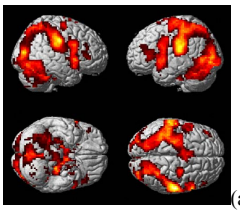
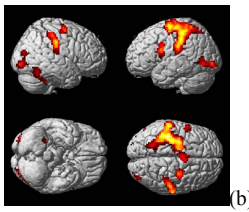

(a)

(b)

Fig 2. The control group(a) show more activation ACC, DLPFC, insula, thalamus ,TPJ than the FM group(b)(p<0.05, FDR corrected)

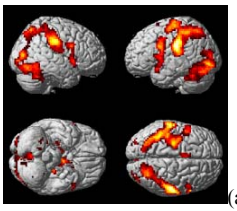
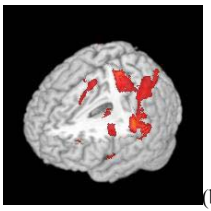

(a)

(b)

Fig 3. Between group analysis map(a) and 3D overlay(b).(p<0.05, FDR corrected, 2sample t-test)