

Correlation between brain volume change and impairment of the inhibition control in patients with schizophrenia

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Synopsis

Despite recent studies in identifying the neural circuitry contributing to delayed-response working memory (WM), the correlation between brain volume change and impairment of the inhibition control in patients with schizophrenia have not yet been completely specified.

The purpose of this study was to discriminate the brain activation patterns associated with the effect of distraction during the working memory maintenance for the human faces in the healthy controls and patients with schizophrenia by using a function magnetic resonance imaging (fMRI), and further to assess the relationship between changes of the activation patterns due to impairment of the inhibition control and reduction of the volumes of the corresponding brain areas in patients with schizophrenia.

Subjects and Methods

A total of 18 patients with schizophrenia (mean age = 31.0±8.7 years) and 18 healthy controls (mean age = 33.5±7.3 years) who had no history of neurological or psychiatric illness underwent the functional MRI on a 3.0 Tesla Magnetom Verio MR Scanner (Siemens Medical Solutions, Germany). Patients with schizophrenia were assessed on the basis of an interview of the DSM-IV-TR by a psychiatrist.

The paradigm consisted of a string of "encoding - WM maintenance - distractor - retrieval". In the encoding task, three different human faces were presented once. During the delay time following the encoding, the subjects were asked to maintain the WM for the encoded faces. Then, a normal face and a scrambled face were presented as the distractors, and the subjects were instructed to look at the distractors while maintaining the WM. In the retrieval task, either of the face presented in the encoding task or a new face was presented. The brain activation maps and their resulting qualification were reconstructed and analyzed by using statistical parametric mapping (SPM8) program.

Results and Discussion

In the healthy controls, the normal face distractors showed significantly ($p < 0.0005$) stronger activities compared with the scrambled face distractors in the brain areas including the superior frontal gyrus (SFG), dorsolateral prefrontal cortex (DLPFC), ventrolateral prefrontal cortex (VLPFC), superior/inferior parietal gyri (SPG/IPG), anterior cingulate gyrus (ACG), and fusiform gyrus (FG) (Fig. 1). Similar to the healthy controls, the patients with schizophrenia showed significantly stronger activities with the normal face distractors over the scrambled face distractors in the same brain areas except the ACG ($p < 0.0005$) (Fig. 1). However, these brain areas showed decreased activities in patients with schizophrenia over healthy controls, which are supposed to be involved in a specific role for impairment of the inhibition control in the patients.

As compared with healthy controls, patients with schizophrenia showed decreases in the gray matter volumes of the superior frontal gyrus, DLPFC, VLPFC, ACG, and fusiform gyrus ($p < 0.005$) (Fig. 2a). Also, the white matter volumes of the superior/inferior frontal lobes showed a tendency to decrease in patients with schizophrenia over the healthy controls (Fig. 2b).

Conclusion

This study discriminated the differential brain activation patterns associated with the effect of distraction during the delay interval of the WM task the healthy controls and patients with schizophrenia, and furthermore, assessed the relationship between the brain activation changes and the brain volume reduction in patients with schizophrenia. This finding will be helpful not only to understand the neural mechanisms on the general

impairment of the inhibition control in schizophrenic diseases, but also to apply to differential diagnosis of pseudo psychiatric diseases.

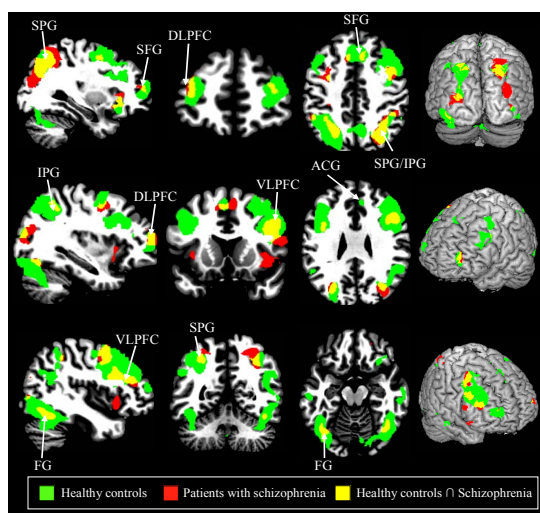


Figure 1. Regional activation maps demonstrating the activation patterns derived from the healthy controls (green) and patients with schizophrenia (red), in which yellow activation indicates the overlapping areas between two groups.

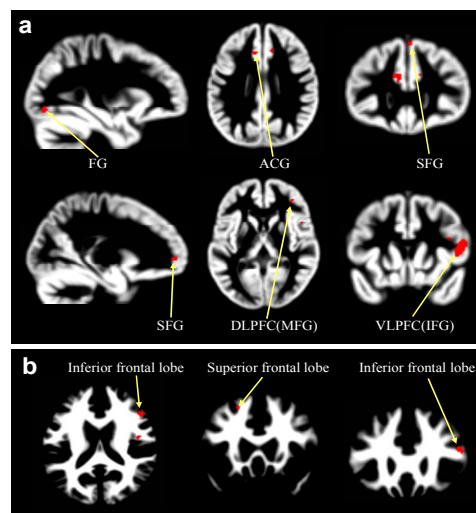


Figure 2. Brain areas with significant volume reduction of the gray matter (a) and white matter (b) in patients with schizophrenia as contrasted with the healthy controls.

References

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