Preliminary cognitive functional imaging study of patients with early diabetes

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Purpose: To evaluate cognitive dysfunction in early diabetes patients with psychological tests and fMRI. To analyze MR spectroscopy change in prefrontal cortex (PFC).

Method and materials: Twenty patients with early type 2 diabetes mellitus and 15 demographically similar, healthy subjects were enrolled. All subjects with microalbuminuria, hypoglycemia and ketonic acidosis, visible cerebral lesions on MR were ruled out. Wechs1er memory scale-revised(WMS-R)，trail making test A and the personality and affective states were assessed in both groups. Then nback task fMRI and single-voxel MRS with TE 30 on bilateral PFC were performed. The statistic differences of neuropsychological tests and MRS result between the two groups were evaluated. The fMRI data were analyzed by SPM99.

Results: (1) psychological tests showed that the scores of cognitive tests in diabetes group were significantly lower than those in control group. Diabetic patients were more depressive and anxious than controls. (2) fMRI examinations revealed that the activation pattern in diabetes group was similar with the control group, but less activation in frontal, parietal lobe and cerebellar was demonstrated. There was additional activation in right temporal lobe(including inferier temporal gyrus and parahippocampus gyrus) and anterior cingulate cortex in diabetes group. (3) MRS data showed that comparing with control group, the value of Glx/(Cho +Cr) was elevated in bilateral PFC, that the value of Cho/Cr were decreased in the right side, and that the value of NAA/Cho、Glx/Cho、Glx/Cr were elevated in the right side. Transit memory was negatively correlated with Glx/Cho (F=-0.546, P value =0.013) and Glx/(Cr+Cho) (F=-0.471, P value = 0.036). The number of errors in trail making test A was positively related to NAA/Cr.

Conclusions: Early type 2 diabetic patients have cognitive dysfunction, especially decreased memory at verbal working memory. fMRI using nback test shows the hypofunction in PFC, which plays an important role in cognitive dysfunction and the emotional abnormality in diabetic patients. The value of NAA in PFC is not significantly decreased. However Glx elevation may represent the disregulation of Glx metabolism and/or the neuron apoptosis caused by Glx accumulation. Increase of Glx and the degeneration of choline neuron system, which may be part of the pathophysiological basis of PFC hypofunction.

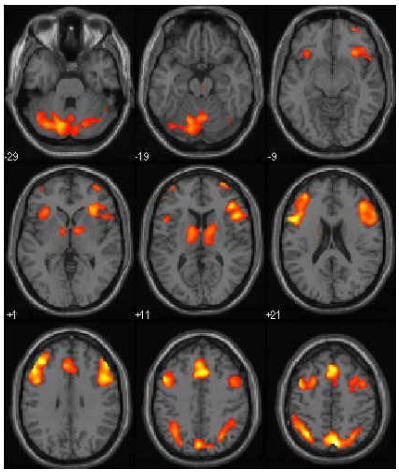

Figure 1

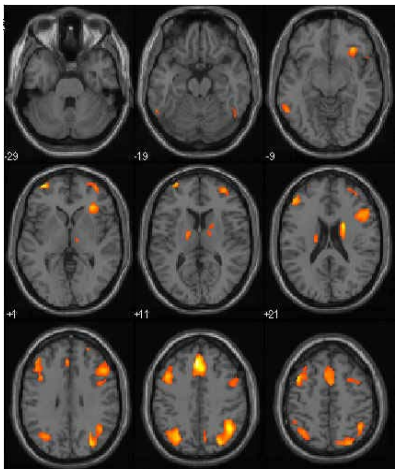

Figure 2

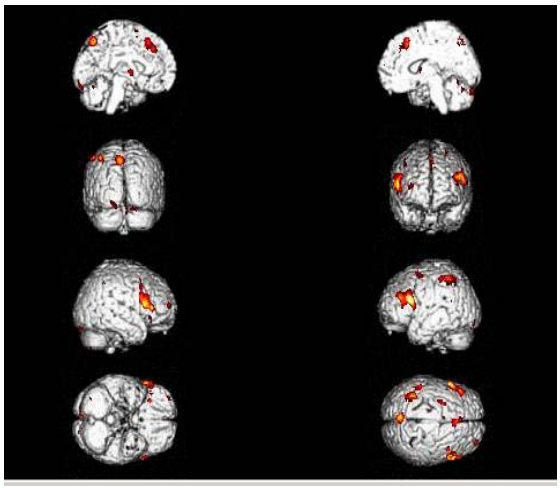

Figure 3

Figure 1: 2-0 back task fMRI of control volunteer group. Figure2: 2-0 back task fMRI of patient group; decreased activation especially on PFC. Figure 3: Localized brain area with decreased activation.