Altered choline-containing compounds in the hippocampus and putamen in depressed patients detected by multislice ^{1}H MRSI

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Introduction

Mood-congruent processing biases are amongst the most robust research findings in neuropsychological studies of depression. It has been shown that depressed patients exhibit preferential processing of stimuli with a negative emotional tone.

Among the key brain regions for these variations in depression are the cingulate gyrus, the orbital, medial and dorsolateral prefrontal regions, the cingulate gyrus, temporal lobe, including hippocampus and amygdala, and basal ganglia. We conducted a multislice proton MRSI study with the aim to determine whether there are measurable alterations in depressed patients compared to healthy controls or significant correlations with neuropsychological measures of the metabolite concentrations in these key brain regions.

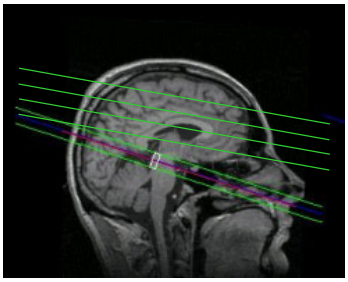


Figure1: position of the 3 MSSI slices

Methods

Thirteen patients with major depression and 13 matched healthy controls participated in this study. All MRSI studies were performed on a 1.5 T Siemens Vision system. For localization, 2D FLASH images in coronal, sagittal, and oblique transverse orientation were acquired. A spin-echo multislice sequence (TE 135/TR 1500 ms) was used acquiring three slices: one slice was positioned through the frontal lobe above the corpus callosum, the second slice parallel to the first slice through the basal ganglia region and the third slice slightly tilted towards the other two slices through the temporal lobe including the hippocampus (Fig. 1). Voxels for statistical analysis were selected from regions supposed to play key roles in emotion processing or in the pathogenesis of major depression. These were the following subregions: dorsolateral prefrontal GM, medial frontal GM, anterior cingulate gyrus, putamen, thalamus, insula, posterior cingulate, cuneus, hippocampus, ventral tegmental area, and raphe nuclei.

Postprocessing of the MRSI data was done with an automated spectral fitting program (1). With use of an automated image co-registration and segmentation program (2) all MRSI voxels were corrected for the CSF content as well as for the individual point spread function.

Results

In concordance with previous results of decreased signals from choline containing compounds in the hippocampus of patients with major depression (3) we see the most prominent signal alteration (Fig. 2) and a correlation of left hippocampal Ch with depression scales (BDI) for hippocampal measures. Furthermore we found a significantly increased Ch signal in the putamen of depressed patients (Fig. 3). Patients showed neuropsychological deficits especially in memory functions but no correlations with metabolite measures could be detected.

Figure 2: hippocampal Ch

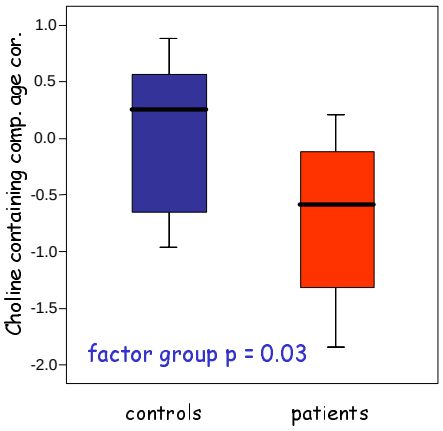
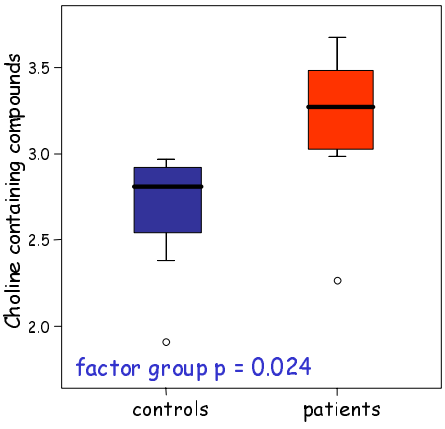


Figure 3: putamen Ch



Discussion

The hippocampus is the focus for hypotheses related to stress and its effects. A reduced hippocampal choline signal is in good accordance to reduced serotonergic neurotransmission and impaired neurogenesis/synaptogenesis in this brain region, respectively (4). We previously observed a (transient) increase in hippocampal Ch under ECT treatment and in recently remitted patients treated with amitriptyline (3). An fMRI study by Lawrence et al. (5) showed a significant correlation of left hippocampal activation to mild sadness and severity of depression.

Structural or functional abnormalities of the limbic-cortical-striatal-pallidal-thalamic (LCSPT) circuit have been reported and are associated with an increased risk for major depression (6). Smaller caudate and putamen volumes have been reported in several MRI studies of major depression.

A previous MRSI study of the basal ganglia in major depression reported increased Ch/Cr in the putamen (7) which is in concordance with an increased Ch signal.

References

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