Lower GPC compounds in the hippocamps and higher GPE in the putamen/thalamus region in depressed patients detected by 3D ^{31}P RINEPT MRSI

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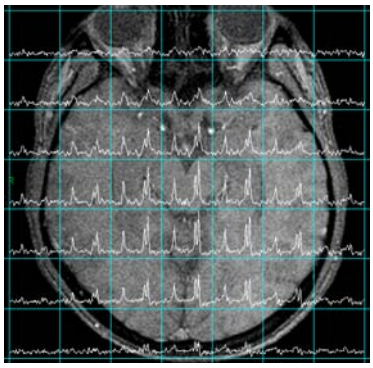
Introduction

We conducted a 3D ^{31}P RINEPT MRSI study in patients with major depression (MDD) compared to healthy controls. Our previous ^{1}H MRSI findings of reduced hippocampal choline-containing compounds (Cho) and increased Cho in the putamen in MDD (1, 2) let us to the hypothesis that phosphomono- and/or –diester (PME and PDE) resonances measured via ^{31}P RINEPT would be decreased in the hippocampal region and increased in the putamen. This study was supported by the German Research Foundation (SFB 636, project D1).

Figure 1



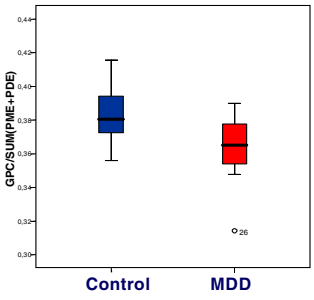
Methods

Twelve patients (6 males, age 46.9 +/- 12.8 years) with MDD (HAMD 29 +/- 6) and 15 healthy controls (10 males, age 37.7 +/- 7.2 years) participated in this study. All measurements were performed on a 1.5 T Siemens Vision system with a double resonant ^{31}P-^{1}H volume head coil (RAPID Biomedical, Würzburg, Germany). For localization, 2D FLASH images in sagittal and transverse orientation were acquired. The measurement parameters for the 3D ^{31}P MRSI included TR = 0.5 s, $TE_{1/2}$ = 40 / 32 ms and FOV = 400 mm. 3D spatial localization (8 ×8 ×8 encoding) is obtained by phase encoding gradient pulses which are free from chemical shift displacement errors. In all MRSI measurements proton decoupling during acquisition was employed using a WALTZ-4 pulse train on a second independent transmit channel. The MRSI data were fitted in the time domain with jMRUI using the AMARES algorithm. Voxel selection was done using home developed software and SID from SITools (3, 4). The metabolite values are expressed as ratios with the total phosphorous RINEPT signal intensity (sum(PME+PDE)).

Results

In concordance with previous results of decreased Cho signals in the hippocampus of patients with MDD (1) we see a significant below-normal GPC ratio in this brain region (Fig. 2a & b). Furthermore we found a significantly above normal GPE ratio in the putamen/thalamus region of depressed patients (Fig. 3). The Hamilton Depression scale (HAMD) did not correlate significantly with the observed PDE changes, nevertheless a trend towards lower GPC with higher HAMD can be observed.

Figure 2a: left hip. region



b: right hip. region

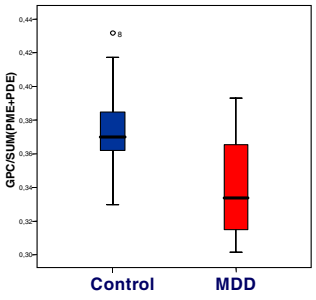
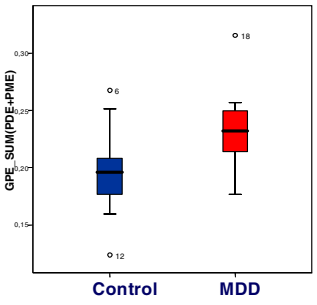


Figure 3: putamen



Discussion

The hippocampus is the focus for hypotheses related to stress and its effects. Below-normal hippocampal Cho and GPC signals in MDD patients are in good accordance to reduced serotonergic neurotransmission and impaired neurogenesis/synaptogenesis, respectively in this brain region (5). We previously observed a (transient) increase in hippocampal Cho under ECT treatment and in recently remitted patients treated with amitriptyline (1). An fMRI study by Lawrence et al. (6) 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 (7). Smaller caudate and putamen volumes have been reported in several MRI studies of major depression.

A previous ^{1}H MRSI study of the basal ganglia in major depression reported increased Cho/tCr in the putamen (8) in concordance with our ^{1}H and ^{31}P MRSI data.

References

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