Voxel Based Morphometry shows Hippocampal White Matter Reductions and a Correlation with Glycerophosphocholine levels in Patients with Major Depression

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Introduction

Efforts to examine the structural neuroanatomical differences between patients with major depression (MDD) and healthy controls by traditional methods of image analysis have led to variable findings especially concerning hippocampal volumes. These discordant findings are possibly due to methodological differences in image acquisition and analysis and heterogeneity of the studied patient groups. There also is growing evidence that cell loss due to apoptosis is rather low in MDD [1]. Morphometric alterations might be rather associated with abnormalities of membrane phospholipid metabolism, which may reflect a dysregulation in brain-signal transduction systems of relevance in MDD [2]. Voxel-based morphometry (VBM) of whole-brain anatomy allows examination of small patterns of WM and GM tissue differences between groups [3]. This study was aimed to determine whether structural alterations in MDD detected by VBM correlate with ^{31}P MR spectroscopic measures of glycerophosphocholine (GPC) detected with a 3D MRSI ^{31}P RINEPT sequence [4]. This study is supported by the German Research Foundation (SFB 636, project D1) and the Heidelberg Academy of Science.

Methods

Voxel based morphometry of the 3D mprage data sets of seventeen patients (5 male, 12 female) with major depression and seventeen healthy controls was conducted with SPM2. Patients and controls were matched for sex and age (mean age 49 y, range: 28 to 77 years). The mprages were acquired on a 1.5 T Siemens Vision system with 1.05 mm^3 isotropic voxel size. A subgroup of eleven patients participated in a RINEPT ^{31}P MRS study (sample spectrum see Fig. 3). We found decreased levels of GPC in the hippocampus of MDD patients compared to healthy controls [5]. Gray matter (GM) and white matter (WM) differences between patients and controls were analyzed with a two sample t-test, differences were regarded as significant when the p – value was less than 0.005 (uncorrected). In a second analysis the GPC scores of the subgroup of patients were correlated with WM and GM deviations from the template.

Results

The most prominent results were WM differences. Healthy controls showed more WM bilateral in the hippocampal-parahippocampal formation (Fig. 1), bilateral in the inferior parts of the postcentral gyrus, in the medial paracentral lobe and in the middle and anterior cingulate gyrus in the right hemisphere (Fig. 1 lower right). The temporal lobe/hippocampal GPC values of the subgroup of 11 patients correlated positive with the WM value bilateral in the hippocampal–parahippocampal formation (Fig. 2). No significant correlation was found for the corresponding GPE and PE values.

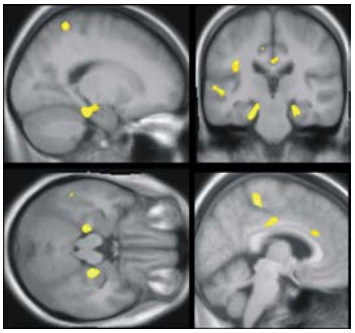

Figure 1: WM
Healthy controls > MDD

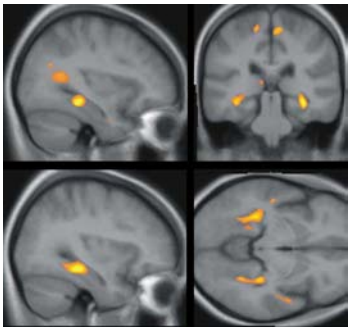

Figure 2: hippocampal GPC- correlation with white matter in MDD

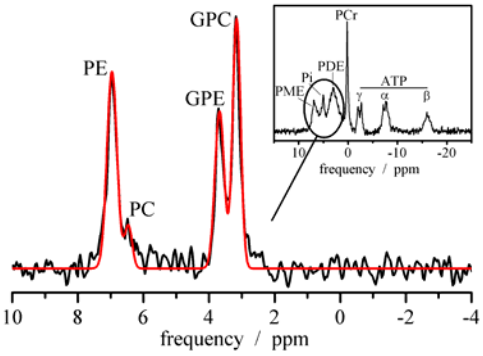

Figure 3: ^{31}P RINEPT spectrum

Discussion

The findings of a reduction in hippocampal WM and a positive correlation of the GPC level detected with ^{31}P MRS and WM volume in the hippocampus of MDD patients support the hypothesis, that membrane phospholipid metabolism is altered in MDD, which may reflect a dysregulation in brain-signal transduction systems of relevance.

References

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