MRI Morphometry of the Brain in a Longitudinal Study of Depression

J. Ahdidan[1], L. K. Hviid[2], K. Mouridsen[3], B. Ravnkilde[1], A. B. Rodell[4], R. Rosenberg[2], P. Videbech[1]

[1]Neuropsychiatric Unit, University Psychiatric Hospital in Aarhus, Risskov, Denmark, [2]Center for Basic Psychiatric Research, University Psychiatric Hospital in Aarhus, Risskov, Denmark, [3]Neuroradiology, CFIN, Aarhus, Denmark, [4]PET Center, General Hospital of Aarhus, Aarhus, Denmark

INTRODUCTION

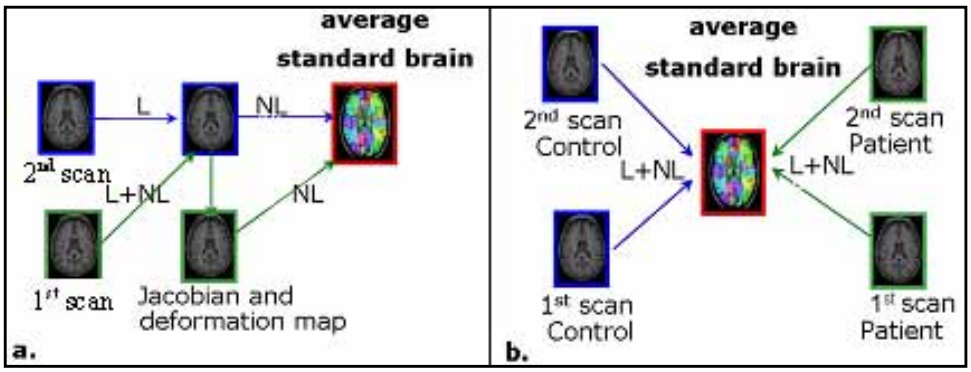
Several cross-sectional studies of patients with major depression have demonstrated volumetric and morphologic changes in specific brain structures such as the Hippocampus and the Amygdala (see [1] for a review). In the present study, we propose to use morphometric methods to automatically detect structural shape changes of the whole brain associated with depression. These methods can detect changes with a higher resolution and accuracy and without a priori hypothesis. We examine structural morphometric differences of the whole brain, between patients and controls over time [3].

MATERIAL

Twenty patients suffering from major depressive disorder (DSM-III-R criteria) at the time of the first scan, as well as 20 age matched controls [4] were examined. The patients were rated as moderately to severely depressed, scoring 17 or more on the 17-item Hamilton Depression Rating Scale. Structural T1-weighted 3D volume MRIs were acquired for all subjects using either a Phillips 1.5 Tesla Gyroscan or a GE Sigma Echospeed 1.5T. All subjects had one follow-up scan approximately five years after the first scan. The patients were not depressed at the time of the second scan. Results in this abstract are based on a preliminary analysis of five patients and seven controls.

IMAGE ANALYSIS

After non-uniformity correction, images were co-registered using [2]. Study design 1: The second scan is linearly and non-linearly (L+NL) registered to the average standard template. The first scan is L+NL registered to the second scan in linear space. We create a deformation rate field representing the deformation between the two scans in the linear space. Structural differences between groups are assessed by resampling the deformation and its Jacobian determinant. This is achieved by using the NL transformation from the linear second scan to the template. (see figure a.)



Study design 2: All the scans are co-registered L+NL to the standard template [3]. The deformation field and its Jacobian determinant are recovered reflecting the temporal changes. (see figure b.)

RESULTS

The table lists the structures showing a significant group difference in local translation between the two time points (Hotelling's T2 map, corrected p-values < 5% [5]).

Study Design 1 in linear space	Study Design 2 in non-linear space
- Right Prefrontal Cortex (several locations) - Temporal Pole - Pons - Right Hippocampus	- Prefrontal Cortex - Right Insula - Left Thalamus - Anterior Cingulate Gyrus - Cerebellum

DISCUSSION

Our results suggest that Prefrontal and Limbic areas are changed during the course of the disease. These areas have been identified as being important in the pathogenesis of major depression in several previous cross-sectional MR and PET studies [5]. Both study designs show different results. This can be explained by the study design 2 being more sensitive to co-registration errors, which may also be amplified by the small sample size. The results in the study design 1 are given in the linear space. We will have to put all the images in the non-linear space, i.e. NL resampling of all the subjects to the standard space, to increase both the sensitivity and the specificity of the analysis. We speculate that morphometric analyses will help understand how depression influences the brain structure over time. It will also be used to analyze the correlation of those differences with the cognitive deficits associated with depression.

Reference List: [1]Sheline YI. Biol Psychiatry 2003, [2]Collins L. Brain Warping 1999, [3]Chung M.K. Neuroimage 2003, [4] Videbech P. Acta Psychiatr. Scand 2001, [5] Videbech P. Acta Psychiatri. Scand. 1997 and 2000.