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PROCEEDINGS

CORRELATIONS OF BRAIN STRUCTURES AND BEHAVIOUR IN ALZHEIMER'S DISEASE USING MR IMAGE SEGMENTATION

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Alzheimer's disease (AD) is a heterogeneous disorder which may affect multiple diverse cognitive domains in different individuals. In spite of this heterogeneity, the memory loss associated with the disease remains a hallmark of the condition and is a critical criterion for differential diagnosis.

This study investigated the relationship between regional neuropathology and specific psychological deficits in AD. Subjects (10 normal and 10 AD) were evaluated using a battery of neuropsychological tests and these data were correlated with magnetic resonance (MR) measurements of the volume of gray matter, white matter, cerebro-spinal fluid (CSF) in the whole brain and specific regions (frontal, temporal/parietal lobes and hippocampus in left and right hemispheres).

METHODS

Imaging was conducted with a 1.5 T MR imager (SIGNA, General Electric Medical Systems, Milwaukee). The images obtained were transferred to and processed on a SUN workstation. Axial images (TE = 30/80 ms, TR = 3000 ms, slice thickness 3 mm, half NEX) referred to as proton density and T2-weighted were used for calculation of the volume of gray matter, white matter and CSF in the whole brain and in the left and right parietal/temporal lobes. Bifeature segmentation was used with a trained operator identifying different tissue categories in one central slice [1]. Rules were developed for selecting this slice and for the number of points and their positions for each tissue type. Tools for removing the eyes and the muscle, fatty tissue and skin of the scalp from the segmented images and for dividing the images into regions and calculating volumes were also developed. The effects of (1) choosing different slices for choosing points, (2) using different operators for selecting points, (3) using different methods for segmentation and (4) the non uniformity of the B1 field on the segmentation were studied.

For hippocampal volume determination, sagittal, T1-weighted 3D volume images (TR = 35 ms, TE = 5 ms, flip angle = 35°, thickness 1.3 mm, NEX = 1) were reformatted in coronal slices (thickness 5 mm) perpendicular to the hippocampal structure and the hippocampal volume was outlined in the left and right hemispheres by a neuroradiologist. Fifteen different neuropsychological tests were performed in the battery of behavioral tests, requiring about four hours per subject.

RESULTS

Preliminary results indicate significant differences between the brain tissue volumes of the two groups (normal and AD). There are also correlations between the regional volumes and the results of the neuropsychological tests. For example, the CSF volumes

in the left temporal/parietal lobe and left hippocampus correlate negatively with deficits on the language tests. In this study we used two observers to identify tissue categories and two more observers to remove the elements not belonging to the brain in the segmented images. The reproducibility between observers was good with a reliability coefficient between 92 and 97% for differentiating different tissue categories.

DISCUSSION

Further analysis of the data is expected to reveal more detailed correlations between the regional tissue volumes and the results of the neuropsychological tests. Such relationships could contribute to the understanding of AD, the memory loss associated with it, and possibly provide a new tool for differential diagnosis of AD.

References:

[1] Harvey Cline, William Lorensen, Ron Kikinis, Ferenc Jolesz, "Three-Dimensional Segmentation of MR images of the Head Using Probability and Connectivity", Journal of Computer Assisted Tomography, 1990; 14:1037-1045

(61.) Stanchev P., Foster J., Bronskill M., Black D., Cheung G., "Correlations of Brain Structures and Behaviour in Alzheimer's Disease using MR Image Segmentation", ***GE Research Workstation SUN Users' Meeting***, Palo Alto, California, Sep. 14, 15, 1992.