An fMRI study of memory performance in Type 2 Diabetes Mellitus: a twin study

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Aim

To compare fMRI memory task activation between older twin pairs discordant for Type 2 Diabetes Mellitus (DM).

Introduction

Type 2 DM is associated with a greater risk of Alzheimer's dementia. The mechanisms underlying this association are poorly understood. It is unknown whether people with Type 2 DM have differences in fMRI activation compared with those without DM. We compared fMRI activation during a memory task between twin pairs discordant for Type 2 DM.

Method

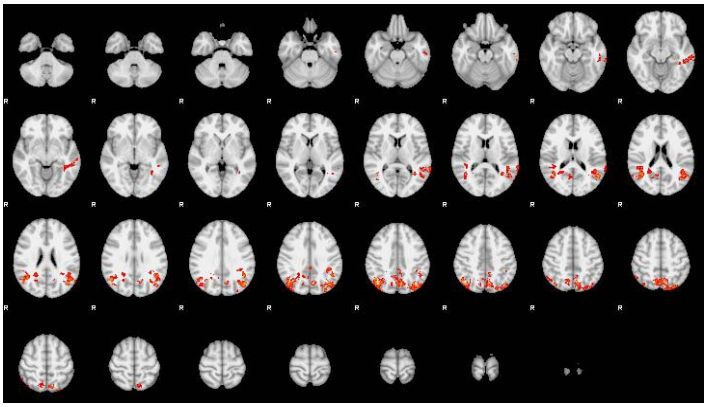
MRI was performed on a 3.0 T SIEMENS scanner. An EPI sequence (TR = 3000ms, TE = 40ms) was used with whole brain coverage. An incidental memory task was presented visually in a mixed-design, allowing for blocked and event-related analyses. Cycles of words, drawings and rest were presented and participants responded to each stimulus with a button press. Following fMRI scanning participants were presented with a recognition memory task on a laptop computer, in which fMRI task stimuli (targets) were presented together with new stimuli (foils) of the same category. Items correctly recognised in this test were assumed to reflect accurate encoding and used in subsequent analyses.

Images were analysed using FSL 4.1.4 (FMRIB Software Library, The University of Oxford). EPI scans of each subject were motion corrected, and normalised to the standard MNI152 brain using 12 DOF. Data were smoothed using a 5-mm isotropic Gaussian kernel. After high-pass filtering (cut-off 100s), data were convolved with Gamma function with temporal derivative and analysed using a general linear model with event-related analysis. For each participant, the contrasts "drawings recognised vs baseline", "words recognised vs baseline" and "all items correctly recognised vs baseline" were computed. Functional MRI contrast estimates for "task vs. baseline" of each subject were entered to second-level analysis. The main effects between twins were obtained by paired-T test.

Results

Nineteen twin pairs at age = 61.8 ± 7.7 were studied. We found significant BOLD signal difference between DM and non-DM twin pairs. For the average of both drawing recognition and word recognition vs. baseline, non DM twins showed significant greater activation DM in left parietal lobe, left temporal lobe and left occipital lobe ($Z>2.3$ and corrected cluster significance at $P < 0.05$) (Figure 1). Non DM twins also had significantly greater activation in the right parietal lobe and right temporal lobe for word recognised vs. baseline ($Z>2.3$ and corrected cluster significance at $P < 0.05$).

Figure 1



Conclusion

Type 2 DM is associated with reduced brain activation during a memory task. It would be important to study the structural and physiological basis for these differences in activation to provide a greater understanding of the mechanisms of dementia in Type2 DM.