

Correlation of Regional Homogeneity and Cognitive Decline in Alzheimer's Disease: a Preliminary Study

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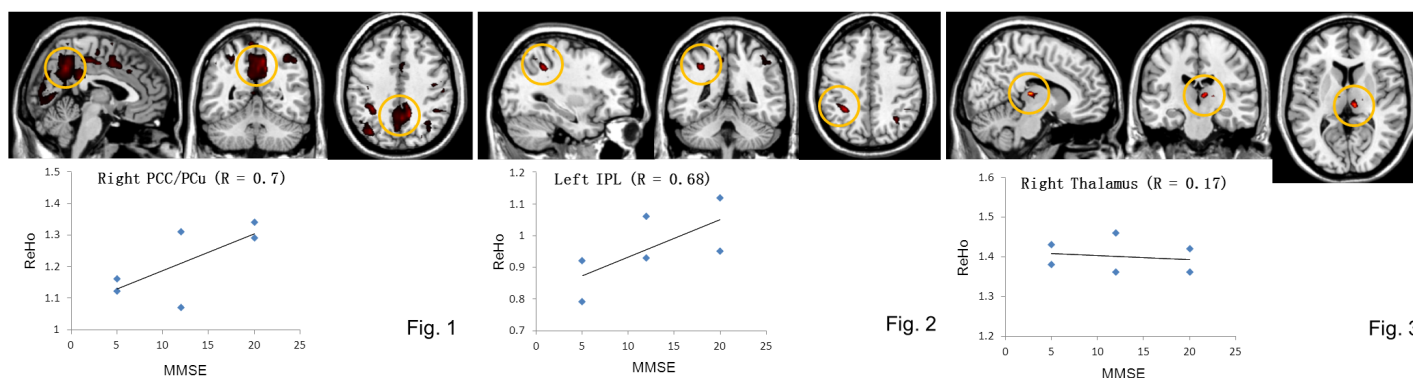
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Introduction: Alzheimer's disease (AD) is a neurodegenerative disorder characterized by an insidious onset and progressive deterioration, commonly leading to dementia in later life [1]. Many studies indicated changes of spontaneous brain activity in Alzheimer's disease during the resting-state [2]. Regional homogeneity (ReHo), a novel resting-state fMRI parameter has been raised to reflect spontaneous brain activities and the background neurophysiological process across the brain [3]. In this preliminary study, we investigated the potential to use ReHo as an indicator for AD progression.

Materials and Methods: The study was approved by the local ethical committee and written informed consent was obtained from all the participants. Six AD patients (aged 59.0 ± 4.32 years, range 51-64 years) were recruited according to the criteria of NINCDS-ADRDA [4] and Mini-Mental State Examination (MMSE) scores. Nine gender- and age-matched healthy controls (aged 55.1 ± 10.9 years, range 46-82 years) were selected for group comparison. All subjects were right-handed. Thirty-three axial slices covering the whole brain were acquired using a 3.0T GE Signa MR scanner (GE Healthcare, Milwaukee, WI) with an 8-channel phase array head coil (TR/TE 2000/30 ms, flip angle 90° , matrix 64×64 , FOV 22 cm, thickness/gap 3.4/1mm, total 210 volumes). Data preprocessing included slice timing and realignment for temporal and spatial adjustment using SPM5, followed by spatial normalization to warp all the images into the same stereotactic space for group comparison. An in-house software DPARSF was used for ReHo analysis (<http://www.restfmri.net>). All the time series were de-trended and band-pass filtered (0.01-0.08Hz). ReHo was calculated based on a cluster size of 27 voxels and standardized by the global mean within the whole brain. The statistical analysis contained both of one-sample T test within the AD and control groups respectively and two-sample T test to reveal the group difference between each other. For the regions of significant difference detected, ReHo values were averaged across these regions and correlated with corresponding MMSE scores.

Results: For one-sample T test, the control group showed increased ReHo in the bilateral posterior cingulate/precuneus cortex (PCC/PCu, $p=0.009$, FDR corrected) and bilateral inferior parietal lobe (IPL, $p=0.009$, FDR corrected) as compared to the global mean across the brain (Fig. 1-2). In contrast, AD group only showed increased ReHo in the right thalamus ($p=0.016$, FDR corrected, Fig. 3). For two-sample T test, AD group showed decreased ReHo in bilateral IPL and PCC/PCu ($p<0.001$, uncorrected) as compared to the control group. For AD patients, average ReHo within the regions of significant difference were positively correlated with MMSE scores in right PCC/PCu and left IPL ($R=0.7$ and $R=0.68$ respectively, Fig 1-2). No obvious correlation was observed between ReHo and MMSE scores in the right thalamus ($R=0.17$, Fig. 3).

Conclusion: In this preliminary study, we found that (1) in AD group, the core structure of default mode network (DMN) including bilateral PCC/PCu and bilateral IPL had decreased spontaneous neural activity, which is consistent with previous studies; (2) decreased ReHo in right PCC/PCu and left IPL might correlate with cognitive decline; (3) ReHo of right thalamus might indicate a compensatory mechanism of cognitive decline in AD group. ReHo shows the promise to reflect the cognitive decline in AD patients but more subjects are required for further study.



References:

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