Changes in thalamus connectivity in mild cognitive impairment: Evidence from resting state fMRI

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Background: A growing amount of evidence confirmed that mild cognitive impairment (MCI) presented a neuro-disconnection syndrome. The subcortical region such as thalamus was confirmed to have close relationship with many cerebral cortexes, which made it especially interesting in the study of functional connectivity. However, functional connectivity of thalamus remains unclear in MCI.

Objective: We aimed to use resting state functional MRI (fMRI) to examine changes in thalamus connectivity in MCI patients.

Materials and Methods: Twenty-eight right-handed subjects (14 MCI patients and 14 healthy elders) participated in this study. Clinical and neuropsychological examinations were performed on all the subjects. Resting state Functional MRI data was collected by using an echo-planar imaging (EPI) sequence on 3T MRI. All analyses were conducted using a statistical parametric mapping software package (SPM5, http://www.fil.ion.ucl.ac.uk/spm). The bilateral thalamus regions of interest (ROI) were generated using the free software of WFU_PickAtlas Tool Version 2.4 (http://www.ansir.wfubmc.edu). Thalamus connectivity was investigated by examination of the correlation between low frequency fMRI signal fluctuations in the thalamus and those in all other brain regions. We also investigate the relationship between the thalamus FC (functional connectivity) strength and cognitive performance.

Results: Functional connectivity between the left thalamus and a set of regions was decreased in MCI patients; these regions were cuneus, middle occipital gyrus (MOG), superior frontal gyrus (SFG), medial prefrontal cortex (MPFC), precuneus, inferior frontal gyrus (IFG) and precentral gyrus (PreCG). There were also some regions showed reduced connectivity to right thalamus; these regions were cuneus, MOG, fusiform gyrus (FG), MPFC, paracentral lobe (PCL), precuneus, superior parietal lobe (SPL) and IFG. We found increased functional connectivity between the left thalamus and the right thalamus in MCI patients. Left MPFC showed significant negative correlation with left thalamus ($r=-0.46$, $p=0.047$) and right thalamus ($r=-0.48$, $p=0.040$) in MCI patients.

Conclusion: The decreased connectivity between the thalamus and other brain regions might indicate reduced integrity of thalamus-related cortical networks in MCI. Additionally, the increased connectivity between the left and right thalamus suggest compensation for the loss of cognitive function. Briefly, impairment and compensation of thalamus connectivity coexist in the MCI patients.

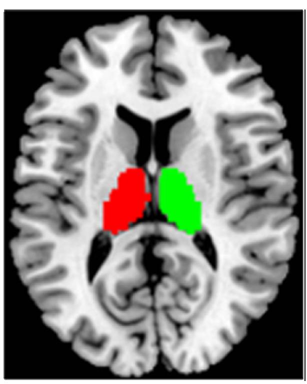

Fig 1

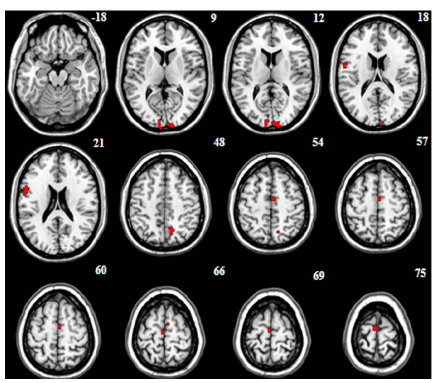

Fig 2a

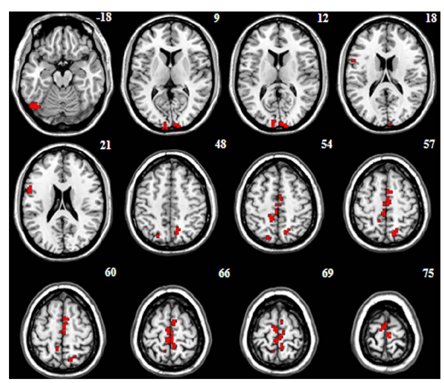

Fig 2b

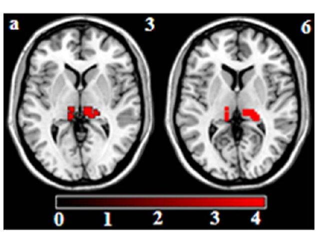

Fig. 3 a

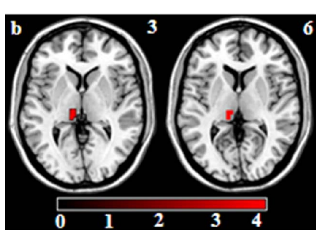

Fig. 3 b

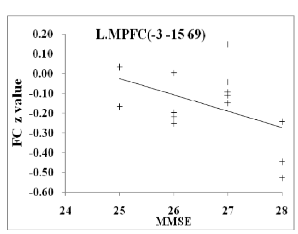

Fig. 4 a

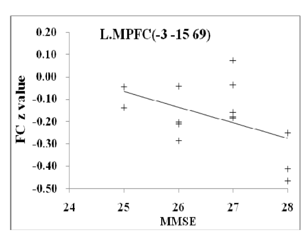

Fig. 4 b

Fig. 1 Regions of interest including left thalamus (red) and right thalamus (green). **Fig. 2** Brain regions showing decreased connectivity to bilateral thalamus in MCI patients. a) left thalamus; b) right thalamus. Left is left. **Fig. 3** Brain regions showing increased connectivity to bilateral thalamus in MCI patients. a) left thalamus; b) right thalamus. Left is left. **Fig. 4** Correlation analysis. a) FC strength (between left thalamus and left MPFC) and mini mental state examination (MMSE). b) FC strength (between right thalamus and left MPFC) and MMSE.