

Volumetric changes of subcortical nuclei in Mild Cognitive Impairment Converter: A longitudinal MRI study

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Purpose

Previous studies have demonstrated volume shrinkage of subcortical nuclei in the brain of mild cognitive impairment (MCI) [1]. However, the evolution of the volumetric changes remains to be defined. In this study, we aimed to investigate the atrophy trajectory of subcortical structures from longitudinal data.

Materials and methods

Data of a total of 150 MCI converters (right-handed, age 75.74 ± 6.95 years, 88 males) was retrieved from the Alzheimer's Disease Neuroimaging Initiative (ADNI) database (<http://www.loni.usc.edu/>). All patients were followed up semiannually for 2 to 4 years with the time point of the diagnosis of MCI as the baseline. The time point when MCI converts to AD was calibrated to zero on the time axis. T1 weighted magnetic resonance imaging (T1WI) of each patient was acquired on 1.5T MRI scanners using a magnetization prepared rapid gradient echo (MP-RAGE) sequence with typical parameters of TR/TE 2400/3.5ms, TI 1000ms, flip angle 8°, acquisition matrix $256 \times 256 \times 170$, and resolution $1.25 \times 1.25 \times 1.2$ mm³ [2]. Images were preprocessed and segmented using FreeSurfer software (version 4.3, <http://surfer.nmr.mgh.harvard.edu/>). The average volume of the bilateral amygdala, caudate, hippocampus, pallidum, putamen, and thalamus was calculated and normalized for comparison.

Results

Volumetric shrinkage was detected in all the six subcortical nuclei, in which the volume of amygdala and hippocampus underwent the sharpest linear drop prior to and after the MCI conversion to AD (Figure 1). Volume of pallidum and thalamus decreased moderately relative to that of the rest of the six subcortical nuclei. Left caudate and putamen were almost invulnerable during the evolution from MCI to AD, whereas their contralateral counterparts experienced a reduction larger than 5% (Figure 2).

Conclusion

The remarkable volume changes of the subcortical nuclei were identified in amygdala and hippocampus during the conversion of MCI to AD, indicating that they may serve as a sensitive biomarker for the early diagnosis and monitoring of the disease. Structural atrophy of caudate and putamen was hemispheric asymmetric, which was in line with the previous finding from a cross sectional study [3].

References

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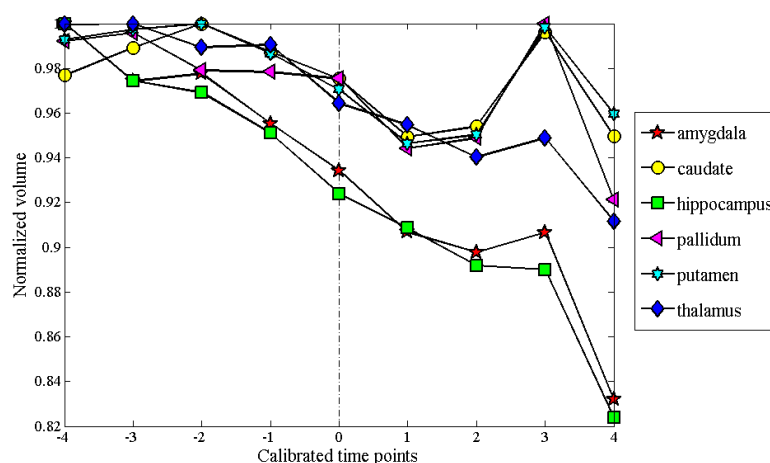


Figure 1. Normalized volume of six subcortical nuclei across time points. The volume of amygdala and hippocampus were remarkably reduced two time points before patients converted from MCI to AD.

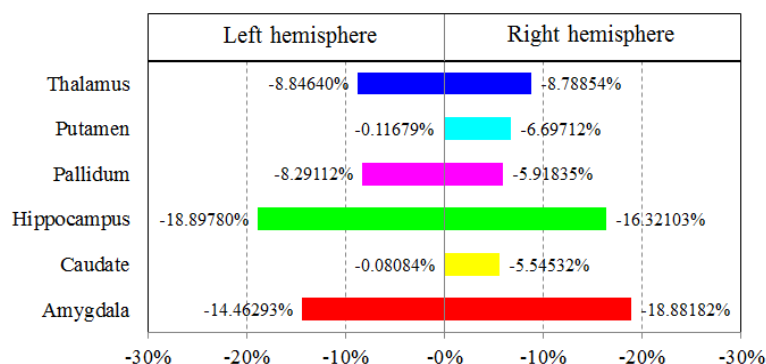


Figure 2. The total volume reduction of subcortical nuclei for each hemisphere.