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Research paper

Differences in cognitive ability and hippocampal volume between Alzheimer's disease, amnestic mild cognitive impairment, and healthy control groups, and their correlation

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HIGHLIGHTS

- Alzheimer disease(AD), amnestic mild cognitive impairment(MCI),and healthy control(HC).
- We investigated the difference in cognitive abilities and hippocampus volume (HV).
- Hippocampus volume of AD and MCI subjects was relatively smaller than HC.
- There were positive correlations between Boston naming test (BNT) and HV.
- The BNT accurately differentiated the three groups by having the highest level of discrimination.

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ABSTRACT

The study investigated differences in cognitive ability and hippocampal volume between groups of patients with Alzheimer's disease (AD) and amnestic mild cognitive impairment (aMCI), and healthy control (HC) subjects, and explored the relationship between cognitive ability and hippocampal volume. Among the sub-tests of Korean version of the Consortium to Establish a Registry for Alzheimer's Disease (CERAD-K), the Boston naming test score decreased in the order HC, aMCI, and AD. The hippocampal volumes of subjects with AD and aMCI were relatively smaller than those of HC individuals. There were strongly positive correlations between hippocampal volume and the scores for the Boston naming test. Discriminant analysis identified the Boston naming test as having the highest level of discrimination among the variables used to differentiate the three groups (89.9%). In conclusion, the Boston naming test accurately differentiated the three groups and was correlated with hippocampal volume. These results will be helpful for choosing an accurate and economically feasible test method that efficiently differentiates the three groups.

1. Introduction

Alzheimer's disease (AD) is a degenerative brain disease that mainly manifests as memory loss of recent incidents in the early stages, but progresses to include abnormalities in several aspects of cognitive function [9]. In structural brain images obtained using magnetic resonance imaging (MRI), the typical findings are overall brain atrophy due to the loss of nerve cells [4]. Although brain atrophy in the early stages is limited to the hippocampus and entorhinal cortex, which are mainly responsible for memory, it gradually spreads to the entire brain via the parietal and frontal lobes [8].

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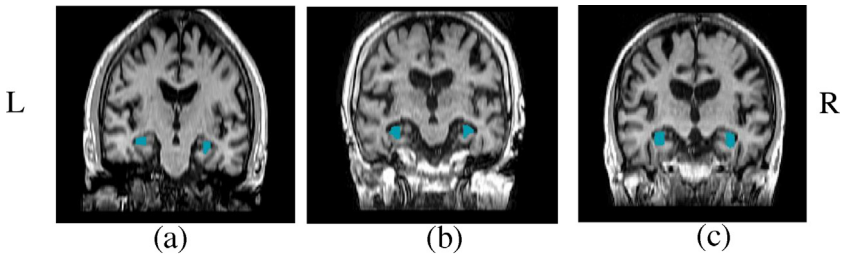

Fig. 1. Segmentation of the hippocampus in the coronal plane using BrainVoyager QX 2.3.0 software. (a) AD, (b) aMCI, (c) HC.

Mild cognitive impairment (MCI) is known as a pre-symptom of AD with affected individuals having poorer cognitive status than normal people, but with the ability to perform daily activities still being preserved, and MCI subsequently progresses to become dementia [6]. Mild cognitive impairment (MCI) is divided into amnestic MCI and non-amnestic MCI. Amnestic Mild cognitive impairment (aMCI) mostly develops into AD whereas non-amnestic MCI is highly likely to develop into frontotemporal dementia or vascular dementia [3]. Therefore, for an early AD diagnosis, the presence of aMCI should be essential for understanding precedence. Early diagnosis of aMCI may offer a way to impede the development of AD.

Numerous studies have sought to identify AD patients, MCI patients, and healthy persons through the analysis of neuropsychological tests and brain structural changes on the basis of MRI [12,13,18,19]. Typically, these studies have focused on MRI-based biomarkers, with neuropsychological test results tending to be used as reference criteria.

The results of widely used neuropsychological tests may be more accurate for identifying MCI and AD than MRI structural measures [5]. If so, the trend toward biomarker identification can be questioned, and it may be more prudent to increase the diagnostic efficiency by reflecting on and evaluating the importance of neuropsychological test results in combination with MRI structural measures than to consider these diagnostic aspects independently.

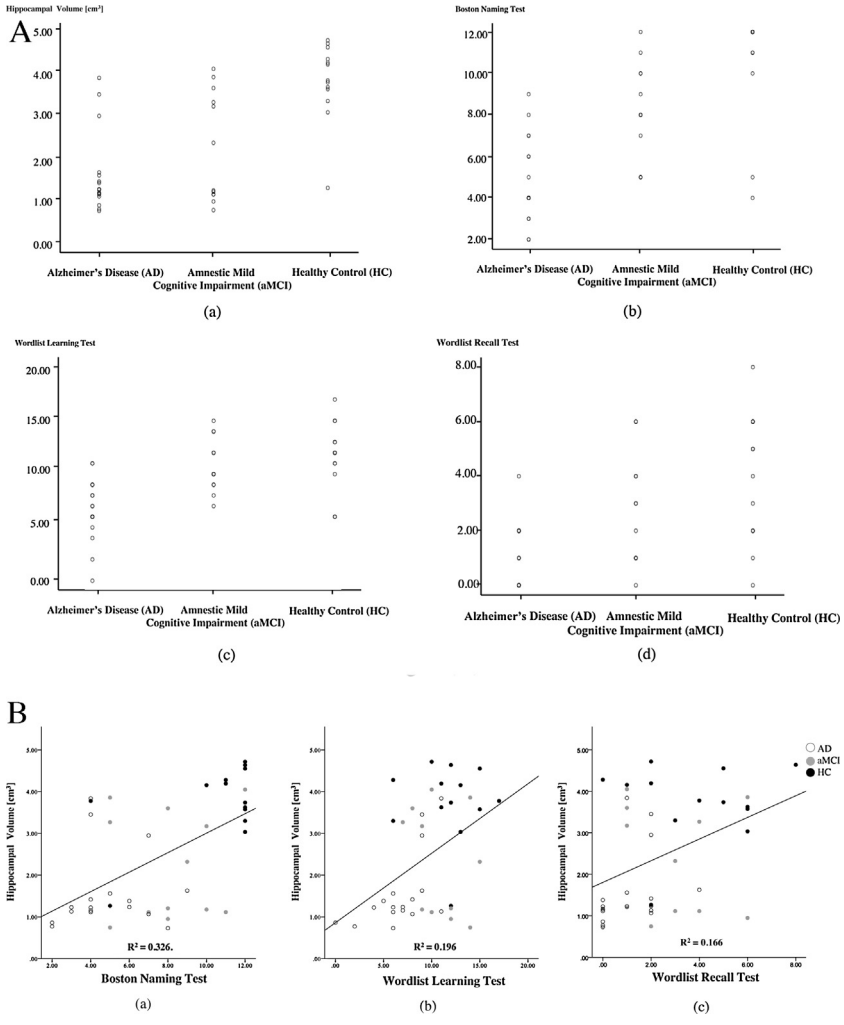

Fig. 2. (A). Scatter plots of hippocampal volume and scores from neuropsychological tests for the three groups (AD, aMCI, HC). (a) hippocampal volume, (a) Boston naming test, (b) wordlist learning test, and (c) wordlist recall test. (B). Correlations between hippocampal volume and scores for neuropsychological tests. (a) Boston naming test, (b) wordlist learning test, and (c) wordlist recall test.