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Altered source-based EEG coherence of resting-state sensorimotor network in early-stage Alzheimer's disease compared to mild cognitive impairment

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HIGHLIGHTS

- The resting-state sensorimotor activities were examined in AD and MCI.
- Increased delta coherences within the sensorimotor network were found in AD.
- No significant difference of spectral powers was observed between AD and MCI.
- Enhanced cortical coupling at delta band characterizes the alterations in AD.

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ABSTRACT

Although the altered coherence between cortical areas in Alzheimer's disease (AD) has been widely studied, it remains unclear whether the source-based coherence measures within sensorimotor network show significant difference between mild cognitive impairment (MCI) and AD. In the present study, resting-state electroencephalographic signals were recorded from 21 MCI and 21 mild AD patients. The spectral power and coherence in the sensorimotor areas were analyzed using the minimum norm estimate (MNE) combined with fast Fourier transform and coherence analysis in delta (1–4 Hz), theta (4–8 Hz), alpha (8–13 Hz), beta (13–25 Hz), and gamma (25–40 Hz) bands. Our results indicated that source-based coherence in AD showed increased delta coherences between the bilateral precentral, left supplementary motor area (SMA) and right precentral, and left SMA and right postcentral areas. However, no significant difference of spectral powers was observed between AD and MCI. To conclude, the phenotype conversion from MCI to AD may be associated with an altered connectivity of the sensorimotor cortical network. This is a promising finding; however, further large-scale studies are needed.

1. Introduction

Alzheimer's disease (AD) is a neurodegenerative disorder that is characterized by cognitive deficits and behavioral disturbances, as well as pathological changes as shown by the senile plaques, neurofibrillary tangles, and neuronal loss in the frontal, temporal and parietal neocortical association areas [4]. Although, in the early stages of AD, motor cortex was found to be relatively spared of pathological change [36], deteriorated fine motor skill performance [24] and subclinical motor slowing of reaction and movement time [20] were found for the disease. Transcranial magnetic stimulation (TMS) studies also demonstrated that early-stage AD exhibited the motor hyperexcitability and subclinical motor cortical reorganization [21]. It is feasible that the early changes of motor cortex in AD reflect a functional, but not structural, alteration of the cortical motor network [33].

The sensorimotor network, which is crucial for the execution of voluntary movements and comprised of postcentral, precentral and supplementary motor areas, is one of the resting state networks

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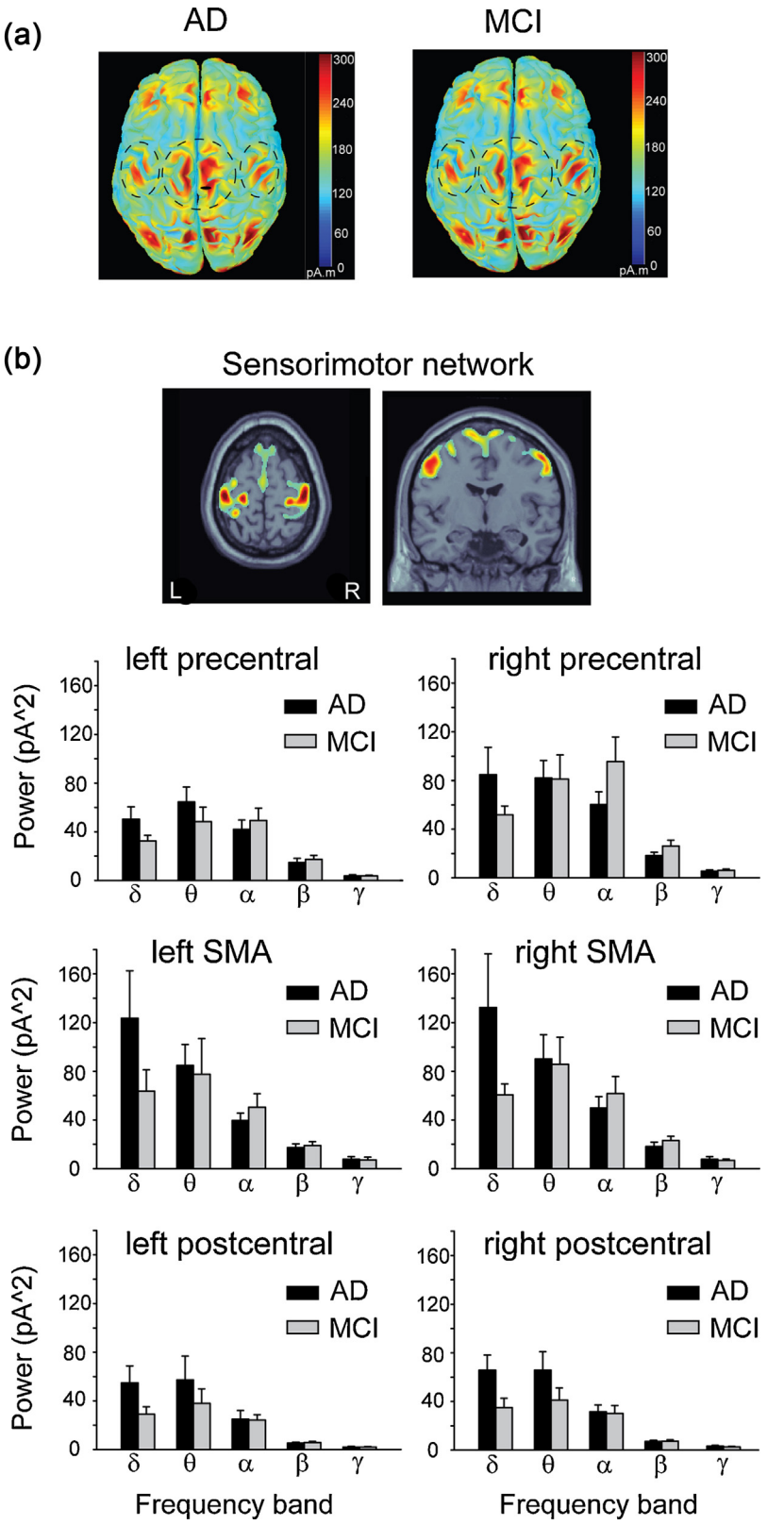

Fig. 1. (a) Distributions of averaged cortical activation during resting-state condition in 21 AD and 21 MCI patients, respectively. Cortical areas encircled by dashed circles indicate the sensorimotor areas. The strength of cortical sources is color coded; large values are represented in red, and small values are in blue. (b) Upper: Map of sensorimotor network on the axial and coronal MR images is shown. Lower: The bar plots show the power values in each frequency band in AD and MCI. δ, delta; θ, theta; α, alpha; β, beta; γ, gamma. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)