QEEG, The Tentative Biomarker for Early Screening of Preclinical Alzheimer's Disease in Subjective Cognitive Decline

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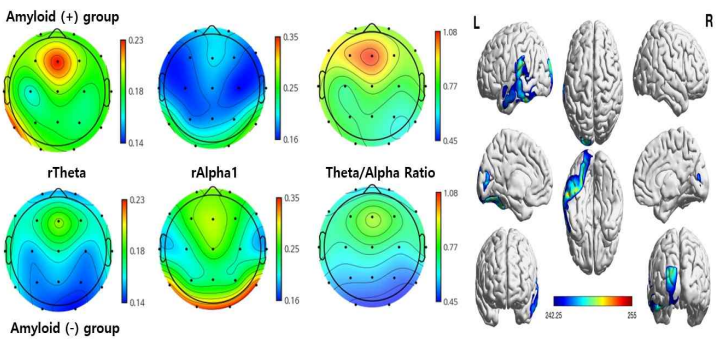
Background and objective

- Early screening biomarker has been required to discriminate a higher risk of progressive subgroup in subjective cognitive decline (SCD) at preclinical stage.
- Synaptic dysfunction is known to be associated with early cognitive impairment in AD. Electroencephalography (EEG) directly reflects brain electrical activity at the level of synapses.
- Study purpose was to identify unique quantitative EEG (QEEG) patterns among different conditions of amnestic SCD.

Methods

- This is a part of the CoSCo study, which is a prospective observational study aimed to enroll 120 people aged 60 years or older presenting with a complaint of persistent cognitive decline in six different dementia centers.
- Subjects who are in the range from 7% to 50% of the verbal memory test and over 7% of the other tests were included based on comprehensive neuropsychological tests. These groups were named as "amnestic SCD" who were expected to have a higher risk of progression to MCI or dementia.
- All participants underwent F^{18}-florbetaben positron emission tomography (PET) and apolipoprotein E (APOE) genotype.
- QEEG was measured at 19 channels of international 10-20 system under resting state, and spectrum power and power ratio were calculated. Source cortical activity was mathematically estimated by standardized low resolution brain electromagnetic tomography (sLORETA).

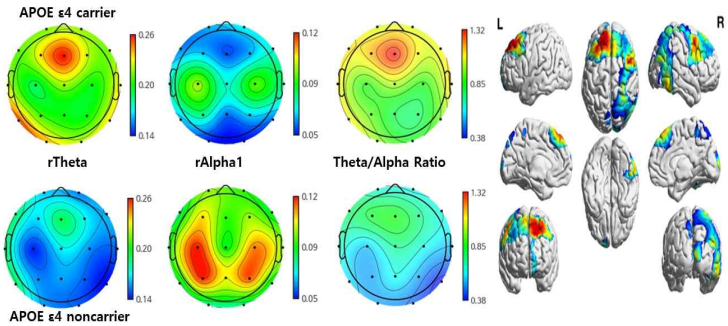
Figure 1. Amyloid PET (+) vs. Amyloid PET (-)



Results

- 120 SCD subjects (male 53, female 67) were included. Florbetaben PET positive group were 25 (20.8%) and APOE ε4 carriers were 26 (21.6%), respectively. People who showed amyloid PET positive had a higher frequency of APOE ε4 (48%) compared to those who showed amyloid PET negative (14%).
- We selected 67 out of 95 in amyloid PET negative SCD group to reduce the age differences with 25 amyloid PET positive SCD group. The mean age and education level was 74.24±5.58 and 12.3±4.08 in amyloid PET positive group 72.89±5.11 and 10.66±4.13 in amyloid PET negative group, respectively. Amyloid PET positive SCD patients showed a significant increase of relative theta power at left frontotemporal (Fp1, F5, F7), both occipital (O1,O2) and right parietal (P4) channels. Similarly, a significant increase of theta was observed at left superior and transverse temporal, fusiform and cuneus at sLORETA in amyloid PET positive group.
- Among 25 SCD people with amyloid PET positive, 12 APOE ε4 carriers showed significant increase of theta/beta ratio at both superior frontal and anterior cingulate, right parietal and occipital area. At sLORETA, both superior frontal, right superior parietal, right pericalcarine, right cuneus, both caudal anterior cingulate area showed a significant increase in APOE ε4 carriers group.

Figure 2. APOE ε4 carrier vs. APOE ε4 non-carrier in amyloid PET(+) SCD



Discussion and Conclusion

- Amnestic SCD with Florbetaben PET positive showed a relative increase of slow wave in resting EEG, which have been similarly reported about amnestic mild cognitive impairment (MCI) or Alzheimer's dementia. QEEG could be a tentative biomarker to screen SCD due to Alzheimer's disease at preclinical stage. Longitudinal study and development of quantitative index of QEEG to evaluate individual subject will be needed to confirm its clinical significance.

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