Neuroanatomical and neuropsychological correlates of resting-state EEG diagnostic features in patients with Alzheimer's disease

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Background: In the search for accurate, low cost biomarkers for Alzheimer's disease (AD) and other dementias, quantitative electroencephalography (EEG) may offer a solution. In a recent multisite study by Cognision, patients with AD were assessed using the Alzheimer Disease Neuroimaging Initiative protocol, plus EEG assessment. The primary objective of the current analysis, was to examine the relationships between a resting-state (rs)EEG feature set (that best discriminated AD patients from controls) and neuroanatomical measures. The second objective was to identify the rsEEG measures that reflected disease staging.

Methods: Eighty-nine patients with mild AD (MMSE 21-26) were evaluated using a comprehensive neuropsychological assessment battery, 5 minute eyes-open rsEEG, and structural MRI. Correlations (Spearman's) were assessed between the 35 rsEEG features (that most accurately discriminated the AD patients), neuroanatomical measures (derived using Freesurfer), and neuropsychological test results.

Results: Cortical Thickness (CT) measures within the left posterior cingulate and right precuneus were related to alpha features. Beta features were associated with regions including the right entorhinal cortex, middle temporal, supramarginal, lingual, and paracentral cortex, in addition to the anterior cingulate cortex (ACC) and precuneus, bilaterally. Gamma features correlated with regions that included the right ACC and fronto-parietal cortex. Delta features were linked to the left fronto-parietal and right entorhinal cortex. Theta features were associated with the left ACC and visual cortex. In relation to disease staging – Clinical Dementia Rating scores were correlated with gamma features at frontal electrode sites, and with power over frequency bands, delta to beta, at Fz. Alpha features were associated with hippocampal volume (bilaterally), whereas some delta features and a beta feature were linked to left hippocampal volume.

Conclusions: These preliminary correlation analyses highlight multiple brain regions that appear to underpin the rsEEG abnormalities that occur due to AD. Given the rich data offered by both rsEEG and by structural MRI, future studies could investigate the combined potential for these techniques to classify the dementias.

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