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Evaluating Whether EEG Could Predict Alzheimer's Disease Onset in Preclinical Patients with the ApoE4 Allele: An Update

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Introduction: Alzheimer's disease (AD) is a progressive neurodegenerative disease and the leading cause of dementia in the elderly. AD is diagnosed primarily through clinical examination, but mental status exams, supportive imaging, and/or laboratory tests are often used as well. Although no predictive biomarkers or tests are currently available for preclinical patients, the Apolipoprotein E (ApoE) polymorphic alleles are the strongest genetic risk factor for indicating if a patient is at high (e4 allele), neutral (e3 allele), or low risk (e2 allele) for developing AD. Previous studies have also shown that there may be electrical changes in the brains of mild cognitive impaired (MCI) patients as memory loss progresses. In this study, electroencephalogram (EEG) analysis was used in preclinical patients with high genetic risk for AD to determine if there are characteristic EEG changes and/or patterns that may predict progression to AD at the preclinical stage.

Methods: Participants ages 64 to 78 were selected from Hawaii Pacific Neuroscience's (HPN) patient database. Participants had a Mini-Mental Status Exam (MMSE) score no lower than 28 and were asymptomatic at the time of the study. A genotype study was performed to determine the ApoE genotype for each participant (1 e2e4; 3 e2e3; 26 e3e3; 7 e3e4; 3 e4e4). EEG was performed to determine any apparent trends via visual analysis for each participant.

Results: This study included EEG and genotype data from a previous study that examined 18 preclinical participants and introduced data for 22 additional participants from the same database. Of the combined 40 participants, 19 (47.5%) displayed evidence of abnormal temporal slowing of some kind. Of these 19 participants, 10 displayed focal left temporal slowing and 9 displayed bilateral temporal slowing of some kind. The remaining 21 participants showed no abnormalities in their EEG study. Of all participants, 2 e2e3 participants (67%) 1 e2e4 participant (100%), 10 e3e3 participants (38%) 5 e3e4 participants (71%), and 1 e4e4 participant (33%) displayed abnormal slowing. Of the participants with an ApoE4 allele present in their genotype, 7 (64%) displayed abnormal slowing. Of the participants without an ApoE4 allele present in their genotype, 12 (41%) displayed abnormal slowing.

Conclusion: This study suggests that EEG has potential to serve as a prognostic tool for the progression to AD in patients, particularly those with the presence of the ApoE4 allele. Our data showed that individuals with an ApoE4 allele present in their genotype had a higher percentage of abnormal temporal slowing being present on their EEG compared to individuals without an ApoE4 allele present. However, the small sample sizes for certain genotype groups are a limitation of this study and may have influenced our findings. Future studies may involve examining EEG data in this same patient population over time to determine if our EEG data correlates with the future onset of cognitive symptoms. If successful, EEG may be an additional, noninvasive, affordable tool that could aid in the early diagnosis and intervention of AD to delay the progression of permanent memory loss.