Association between antidepressant treatment response and EEG alpha: current source density (CSD) spectral measures at rest and time-frequency (TF) measures during a novelty oddball

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EEG alpha rhythm has been used as a neurophysiological measure of activation, ranging from relaxation at rest to task-related cortical synchronization or desynchronization. Although the topographic capacity of high density EEG is limited by volume conduction, it is enhanced by CSD transformation, which provides reference-free measures that represent the neuronal generator pattern underlying alpha. CSD-based spectral analysis (CSD-PCA) of resting EEG has identified posterior condition-dependent (eyes closed-minus-open) alpha as a predictor of treatment response to serotonergic antidepressants. Serotonin and norepinephrine drugs (serotonin-norepinephrine reuptake inhibitors, SNRs; SSRIs) improve depression by elevating tonic activity in the alpha frequency range. Here, we report a CSD-based spectral analysis of resting EEG that identifies a prominent posterior alpha rhythm in non-depressed healthy adults and depressed patients. This prominent posterior alpha rhythm is associated with antidepressant-induced changes in alpha spectral density (ERS/ERD) during cognitive processing of tones presented in a pseudo-random sequence. Moreover, CSD analysis of a novel auditory oddball task revealed a unique topographic distribution of alpha ERD (alpha paradox) that is specific to novel sounds, termed novelty vertex source (NVS; Fig. 1), which was reduced in depressed patients. This a priori knowledge was exploited to delineate the relationship of the ERSP plots with functional properties. The factor identified as Alpha ERD unambiguously quantified alpha desynchronization at 7-12.5 Hz in the latency range of 350-700 ms, showing a posterior ERS corresponding to auditory N1 can be detected (yellow oval) . Differences in Eyes Closed-minus-Open Alpha ERD (minus ERS) are evident below 15 Hz, affecting both ERS and ERD, thereby supporting an event-related desynchronization (ERD) at and above alpha frequencies. Group differences are evident below 15 Hz, affecting both ERS and ERD, thereby supporting the hypothesized association between the NVS and a composite alpha/beta measure. CSD-PCA solutions across all conditions and subjects showed selective ERP responses to ERD, as well as the subsequent alpha ERD. When the alpha topography is provided, the prominence of the ERS increases, contrasting the broad distribution of alpha against the sharp localization of the NVS.

Mediafrontal and posterior mechanisms are differentially predictive of treatment response to pharmacologic antidepressants


t 1. Resting alpha is a positive outcome predictor to treatment with serotonergic or nonserotonergic (NVS) antidepressants.
2. Despite a comparable topography, task-related baseline alpha is selective for bupropion response.
3. Alpha ERD has a posterior topography for targets and novels, extending to central sensorimotor regions for targets, and is absent for nontargets, but is not related to treatment response.
4. Frontocentral midline synchronization following infrequent novels and targets at latencies corresponding to MMN and P3a factors was greater for serotonergic nonresponders than responders, but patients treated with bupropion showed the opposite difference (i.e., greater ERS in group in which psychomotor slowing has also been found).