

DELTA-BAND HYPERCONNECTIVITY AS A POTENTIAL MARKER OF MIGRAINE SEVERITY AND CHRONIFICATION: A RESTING-STATE HIGH-DENSITY EEG STUDY

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Background. Increasing evidence suggests that migraine is characterized by altered brain network dynamics and dysfunctional thalamo-cortical communication. Resting-state EEG studies have identified abnormal slow-frequency oscillatory patterns consistent with the Thalamo-Cortical Dysrhythmia (TCD) model (1). However, the relationship between these oscillatory abnormalities and alterations in functional connectivity across migraine phenotypes remains unclear. Notably, HD-EEG functional connectivity has recently proved sensitive to treatment-related cortical network modulation in migraine, with early changes in delta-band connectivity observed after both atogepant and onabotulinumtoxinA (2,3). We investigated resting-state high-density EEG (HD-EEG) functional connectivity in chronic migraine (CM), high-frequency episodic migraine (HFEM), and healthy controls (HCs) to characterize frequency-specific network alterations associated with migraine.

Methods. In this retrospective cross-sectional study, interictal resting-state HD-EEG recordings were obtained from patients with migraine (HFEM n=22; CM n=12) and healthy controls (HCs n=30). Clinical migraine burden and disability were assessed using validated questionnaires. Source-space functional connectivity was computed using the weighted phase-lag index (wPLI) across δ, θ, α, β, low-γ, and high-γ frequency bands after artifact removal and source reconstruction. Between-group differences were assessed using Network-Based Statistics (NBS), adjusting for age and sex. Correlations between connectivity measures and clinical variables were explored.

Results. Thirty-four patients with migraine (HFEM n=22; CM n=12) and 30 HCs were included. Source-space analyses revealed significant alterations in resting-state functional connectivity, predominantly within the δ band. δ-band hyperconnectivity involved temporo-parietal, orbitofrontal, insular, and limbic regions, showing a progressive increase across groups, with the highest mean network connectivity in CM, intermediate values in HFEM, and the lowest values in HCs (CM > HFEM > HC). Within the migraine cohort, δ-band mean network connectivity was positively correlated with MIDAS score.

Conclusions. Resting-state HD-EEG identified a progressive increase in δ-band functional connectivity across migraine phenotypes, with the greatest abnormalities observed in CM. The association between δ-band hyperconnectivity and clinical disability supports a relationship between slow-frequency network hypersynchronization and migraine severity. These findings suggest that δ-band connectivity may represent a potential neurophysiological marker of migraine chronification and warrant validation in larger longitudinal studies.