

Characteristic Increases in EEG Connectivity Correlate With Changes of Structural MRI in Amyotrophic Lateral Sclerosis.

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Abstract

Amyotrophic lateral sclerosis (ALS) is a terminal progressive adult-onset neurodegeneration of the motor system. Although originally considered a pure motor degeneration, there is increasing evidence of disease heterogeneity with varying degrees of extra-motor involvement. How the combined motor and nonmotor degeneration occurs in the context of broader disruption in neural communication across brain networks has not been well characterized. Here, we have performed high-density cross-sectional and longitudinal resting-state electroencephalography (EEG) recordings on 100 ALS patients and 34 matched controls, and have identified characteristic patterns of altered EEG connectivity that have persisted in longitudinal analyses. These include strongly increased EEG coherence between parietal-frontal scalp regions (in γ -band) and between bilateral regions over motor areas (in θ -band). Correlation with structural MRI from the same patients shows that disease-specific structural degeneration in motor areas and corticospinal tracts parallels a decrease in neural activity over scalp motor areas, while the EEG over the scalp regions associated with less extensively involved extra-motor regions on MRI exhibit significantly increased neural communication. Our findings demonstrate that EEG-based connectivity mapping can provide novel insights into progressive network decline in ALS. These data pave the way for development of validated cost-effective spectral EEG-based biomarkers that parallel changes in structural imaging.

KEYWORDS:

amyotrophic lateral sclerosis; coherence; electroencephalography; neural connectivity; structural MRI

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