Do Complexity Measures of Frontal EEG Distinguish Loss of Consciousness in Geriatric Patients Under Anesthesia?

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Background / Introduction: While geriatric patients have a high likelihood of requiring anesthesia, they carry an increased risk for adverse cognitive outcomes from its use. Previous work suggests this could be mitigated by better intraoperative monitoring using indexes defined by several processed electroencephalogram (EEG) measures. Unfortunately, inconsistencies between patients and anesthetic agents in current analysis techniques have limited the adoption of EEG as standard of care. In attempts to identify new analyses that discriminate clinically-relevant anesthesia timepoints, we tested $1/f$ frequency scaling as well as measures of complexity from nonlinear dynamics.

Methods: We tested whether analyses that characterize time-delayed embeddings, correlation dimension, phase-space geometric analysis, and multiscale entropy capture loss-of-consciousness changes in EEG activity. We performed these analyses retrospectively on EEG activity collected from a traditionally hard-to-monitor patient population: geriatric patients on beta-adrenergic blockade who were anesthetized using a combination of fentanyl and propofol. We compared these analyses to traditional frequency-derived measures to test how well they discriminated EEG states before and after loss of response to verbal stimuli.

Results: We found spectral changes similar to those reported previously during loss of response. We also found significant changes in 1/*f* frequency scaling. Additionally, we found that our phase-space geometric characterization of time-delayed embeddings showed significant differences before and after loss of response, as did multiscale entropy.

Conclusions: Our results suggest that subtle transitions in EEG activity around loss of consciousness transitions in geriatric patient monitoring can be distinguished with the application of new spectral analyses and complexity analyses from nonlinear dynamics.