

Quantitative electroencephalography (EEG) measures for prediction of neurological outcome of aneurysmal subarachnoid hemorrhage (aSAH)

Authors:

Fizra Khan, Heikki Kiiski, Narayan Puthanmadam Subramaniam

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Abstract

Delayed Cerebral Ischemia (DCI) is a secondary condition that occurs as a frequent complication of aSAH, affects ~30% of aSAH patients and results in long-term disability, cerebral infarction or death. Early and reliable predictions of DCI and its outcome remain challenging due to its evolving nature. Traditional tools for predicting DCI such as Modified Fisher Scale and Transcranial Doppler Ultrasound offer periodic assessment and limited sensitivity. In contrast, EEG allows continuous neuromonitoring, which can be useful for dynamic prediction. We investigated EEG-derived time domain, non-linear, and spectral, corrected for aperiodic component, measures as prognostic markers of poor neurological outcome. Continuous EEG data of 48 hours was obtained from Tampere University Hospital, recorded from 60 patients who had undergone treatment for aSAH. Standardized verbal, light, tactile and pain stimulations were performed to evaluate their level of consciousness. Ten-minute EEG segments were extracted post stimulation to capture their best possible cognitive state and preprocessed for confounded factors, eye and muscle artifacts. Patients were grouped based on Glasgow Outcome Scale – Extended (GOSE) scores into poor ($GOSE < 5$; $n=28$) and good ($GOSE \geq 5$; $n=32$) outcome of aSAH. Statistically significant decrease in corrected and uncorrected alpha band power and alpha delta ratio (corrected; $p=0.0035$, $p=0.018$, uncorrected; $p=0.02$, $p=0.0003$), relative alpha variability ($p=0.003$), beta band power ($p=0.004$), $1/f$ spectral slope ($p=0.006$), Hurst exponent ($p=0.0009$), approximate entropy ($p=0.011$), mobility ($p=0.009$) and complexity ($p=0.002$), was observed in poor outcome group. These findings suggest EEG based measures can be potential predictors of poor outcome, highlighting their clinical utility.