Resting-State EEG in Early Stroke Rehabilitation

Background: Stroke is a heterogenous condition, which makes the prediction of motor recovery challenging. Electroencephalography (EEG) is an accessible neuroimaging tool that can be used to measure brain activity and identify markers of brain function. Resting-state EEG has been applied to stroke to determine changes in brain function after neural injury. Several biomarkers have been developed to aid understanding of injury and recovery after stroke that can inform clinical decision-making to optimize rehabilitation. In particular, low frequency delta (1-3 Hz) power has been shown to be positively related to motor impairment and stroke severity, while delta coherence is negatively associated with motor recovery.[1,2]

Purpose: To determine (1) how resting-state EEG measures change over time from inpatient admission to discharge in individuals after stroke, (2) how brain activity measures compare to healthy controls, and (3) whether there is a relationship between brain activity measures and behavioral measures. Of special interest was if EEG measures at inpatient admission can predict future outcomes in behavior to determine motor recovery.

Methods: Patients with stroke (n = 29) admitted to an inpatient rehabilitation facility completed resting-state EEG recordings and clinical testing in 3 visits (admission, discharge, and 90 days post-stroke). Healthy subjects (n = 16) also completed resting-state EEG and clinical testing within one visit. This data was cleaned and analyzed to determine relationships based on relative power and coherence.

Results: As a result of previous findings in the literature, our statistical analysis focused on delta coherence between bilateral primary motor cortices. In 29 participants, delta coherence at admission was able to predict 16% variance in Quality Indicators (QI) change at discharge. There was a negative relationship between delta coherence and QI change. The Upper Extremity Fugl-Meyer (UEFM) score at admission was negatively associated with delta coherence, while corticospinal tract (CST) injury was positively associated with delta coherence. This indicates that delta coherence reflects CST injury and motor impairment at admission. While there was a significant difference in delta coherence between subjects and controls at admission, delta coherence decreased to the level of controls at discharge and 90 days post-stroke, no longer indicating a significant difference.

Conclusions: Delta coherence between bilateral primary motor cortices appears to be a valuable biomarker for stroke recovery in early rehabilitation. These findings add to existing evidence that EEG can identify biomarkers which can contribute to clinical decision-making. EEG biomarkers such as delta coherence have the potential to complement clinical measures, guide prognosis, and match patients to personalized treatment and goals to support stroke recovery.

References:

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2. Cassidy JM, Wodeyar A, Wu J, et al. Low-Frequency Oscillations Are a Biomarker of Injury and Recovery After Stroke. *Stroke*. 2020;51(5):1442-1450. doi:10.1161/STROKEAHA.120.028932