Brain Structure and Function Associations in Stroke

Introduction: Electroencephalography (EEG) is a non-invasive method of directly capturing neural activity (electrical potentials) from the underlying brain. The frequency of neural oscillations measured by EEG subserves behavioral processes. For instance, neural activity in the beta frequency range (20-30 Hz), generated from underlying thalamocortical connections, influences motor function. The purpose of this study was to examine potential associations between brain structure (motor cortex (M1) and thalamus volumes and M1 thickness) and brain function as measured with EEG in individuals with stroke. Methods: This study involved 19 participants (4 females, 57.5 ¬± 12.4 years, 12.4 ¬± 6.8 days post-stroke) with ischemic and hemorrhagic stroke from a previous study that completed a three-minute resting-state EEG recording and a structural MRI. Anatomical scans were pre-processed using FreeSurfer to obtain measures of ipsi- and contralesional M1 thickness and volume and thalamic volume using the Desikan Killiany atlas. Preprocessed EEG data underwent source localization to the Desikan-Killiany atlas prior to extracting measures of relative EEG power at ipsi- and contralesional M1 regions in the high beta (20-30 Hz) frequency band. Statistical Analyses: All statistics were performed in JMP, Version 14 (SAS Institute, Cary, NC). We computed associations between structural (Freesurfer measures) and functional (EEG power) brain measurements using Pearson correlation coefficients. Subjects were removed from the analyses if they sustained stroke-related damage to M1 and thalamus regions of interest. Due to the exploratory nature of this study, we did not correct for multiple comparisons. Results:1 We did not observe associations between ipsilesional M1 power and ipsilesional M1 thickness ($r=-0.25$, $p=0.36$, $n=15$) or volume ($r=-0.17$, $p=0.54$, $n=15$). EEG power at contralesional M1 did not relate to contralesional M1 thickness ($r=0.16$, $p=0.51$, $n=19$) or volume ($r=0.24$, $p=0.31$, $n=19$). Lastly, associations between ipsilesional M1 power and ipsilesional thalamus volume ($r=-0.30$, $p=0.25$, $n=16$) and contralesional M1 power and contralesional thalamus volume ($r=-0.17$, $p=0.48$, $n=18$) were not significant. Conclusions: Findings from our heterogeneous sample of individuals with stroke do not support associations between cortical brain thickness and volume with high-frequency neural activity from that region nor do they support associations between subcortical volume (thalamus) and upstream EEG activity.