Assessment of Acute Mild Traumatic Brain Injury by Quantitative EEG Analysis

Mission Connect: Mild Traumatic Brain Injury Translational Research Consortium

The Integrated Clinical Protocol: Neurophysiology Core

Eli M. Mizrahi, MD 1,2; James D. Frost, Jr, MD 1,3; David E. Friedman, MD 1; Richard A. Hrachovy, MD 1,4; Jeremy D. Slater, MD 5

1 Peter Kellaway Section of Neurophysiology, Department of Neurology; 2 Section of Pediatric Neurology, Department of Neurology; 3 Department of Neuroscience, Baylor College of Medicine, Houston, TX; 4 Medical E. Debakey Veterans Administration Medical Center, Houston, TX; 5 Department of Neurology, University of Texas Medical School, Houston, TX

BACKGROUND

There are four related clinical research projects in the Mission Connect Mild TBI Translational Research Consortium. The Neurophysiology Core will provide electroencephalographic (EEG) data for one of its projects which will investigate the early (<24 hr.) diagnosis of mild traumatic brain injury (MTBI) and early differentiation of MTBI from post-traumatic stress disorder (PTSD).

STUDY OBJECTIVES

SPECIFIC AIM 8.2.1.1 — To investigate differential of patients sustaining MTBI from a group of patients with orthopedic injury (OI) based on cognitive performance, diffusion tensor imaging (DTI), and EPI findings within 24hr after injury and at follow-up over a six month interval.

SPECIFIC AIM 8.2.1.2 — To investigate reporting of acute stress disorder (ASD) symptoms, acute post-concussion symptoms (PCS) in relation to DTI and EEG by groups of patients with MTBI or OI.

METHODOLOGY

A 30 to 60 minute EEG will be recorded within 24hr of injury and then 3 months later utilizing a standard clinical protocol.

VISUAL ANALYSIS — The following parameters will be described: frequencies of the occipital alpha/delta-rhythm and the background activity in the frontal, temporal, and central regions and the presence of any asymmetries in the background rhythms, focal slow wave activity or epileptiform activity.

COMPUTER-BASED QUANTITATIVE ANALYSIS — Eight reference channels will be used for the quantitative analysis (Fpz, Fp1, F3, F7, C3, T3, T4, F8). Extensive EEG analysis software/hardware has been developed within the Section of Neurophysiology, Department of Neurology, Baylor College of Medicine, using the Matlab programming language, and will be available for this project. The background characterization of each 30-second EEG sample will be determined through the application of a battery of procedures that will permit the characterization of frequency components, amplitude distribution, rhythmicity, continuity and lateral symmetry. Measured parameters for each EEG sample include: Power spectra will be based on the fast fourier transform (FFT) to provide information concerning the average amplitude of specific frequency components in the 8 anatomical regions studied. Period/amplitude analysis will be used to determine the coherence value of each channel on a wave-by-wave basis and provide estimates of average frequency, average amplitude, and maximal amplitude for each of the 8 EEG channels. Coherence analysis will provide a frequency-specific measure of correlation, or similarity, between two channels as a measure of interhemispheric symmetry.

DATA ANALYSIS — Using multivariate statistical techniques, analyses will be performed to discover patterns of recovery in behavioral, cognitive, and EEG function, beginning within 24hr of injury and progressing through the six month post-injury period.

RESULTS AND DISCUSSION

This initial phase of the project has been directed towards the establishment of protocols and logistic of EEG recordings, and the pilot testing of computer-based quantitative EEG analysis.

CONCLUSIONS

Visual and computer-based analysis of EEG are potentially useful tools in diagnosis of MTBI and its early differentiation from PTSD. The Integrated Clinical Protocol of Mission Connect is designed to define that role.

POSSIBLE IMPACT

The contributions of the Neurophysiology Core to the Integrated Clinical Protocol of Mission Connect may establish the clinical utility of EEG in the early diagnosis of MTBI and its differentiation from other disorders.

ACKNOWLEDGMENTS

This work was supported by Grant Number W81XWH-08-2-0133, Department of Defense, USA.