Using EEG as a tool to better assess recovery following brain injury

VA | U.S. Department of Veterans Affairs

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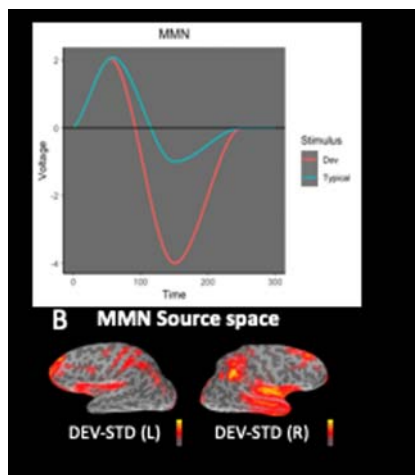**Sherri Livengood, PhD**
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SUMMARY STATEMENT

Combining electroencephalogram (EEG) with auditory stimuli to develop a repurposed diagnostic to evaluate treatment efficacy for 3-5 patients with severe traumatic brain injuries (TBIs) and in 15 healthy control patients

DISEASE/CONDITION

In 2013, 2.8 million individuals in the U.S. were reported to have sustained a traumatic brain injury (TBI), and the number of TBIs increased by 53% from 2006 to 2014.

TBIs can lead to disorders of consciousness (DoC), including coma, vegetative state, unresponsive wakefulness syndrome or minimally conscious state. DoC patients are solely dependent on caregivers, family members, and healthcare providers to advocate on their behalf.

CURRENT TREATMENT

TBIs can have long-term consequences that can alter the quality and course of a patient's life. Current treatments focus on stabilizing patients.

Individuals with severe TBIs are often in need of diagnostics that can provide insight into the nature of their impairments, the potential for recovery, and progression of their recovery. This particularly importance when patients are unable to communicate.

PROPOSED TREATMENT

Utilizing electroencephalogram (EEG) as a clinical diagnostic tool to identify cognitive impairment and recovery in individuals diagnosed with severe traumatic brain injury (TBI) and disorders of consciousness (DoC).

EEG is a non-invasive tool that can detect brain responses/activity, without requiring a conscious or volitional response, and is used to monitor patients with TBIs and DoC. EEGs also can be used to record evoked response potentials (ERPs), which are brainwaves produced in response to stimuli such as sounds and spoken words.

EEG-ERPs are an important element to understanding cognitive processing and can be beneficial to aiding understanding of DoC. Previous research has shown that EEG-ERPs can be sensitive to cognitive impairment and can predict recovery from injury. Therefore, EEG-ERPs may be structured as a routine assessment diagnostic to measure severe TBI/DoC patients' response to treatment.

PROJECT

The proposed study will leverage an ongoing clinical trial testing rTMS in patients with severe TBI resulting in DoC to develop a standard protocol for using EEG to assess cognitive function.
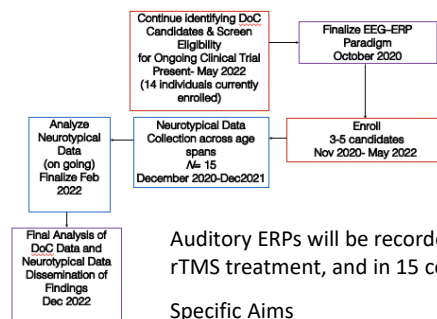
The research team is conducting a clinical trial testing repetitive transcranial magnetic stimulation (rTMS), a technique that delivers magnetic pulses to a targeted part of the brain, as a treatment for severe TBIs resulting in DoC. This adjunct study will pair EEG with auditory stimuli to assess the ability of EEG-ERPs to detect cognitive impairment and recovery in patients treated with rTMS.

Auditory ERPs will be recorded and analyzed in 3-5 patients, prior to and following rTMS treatment, and in 15 control volunteers with no history of head injury.

Specific Aims
- Compare EEG-ERPs between patients and healthy individuals
- Identify changes in EEG-ERPs after rTMS treatment
- Examine the relationship between EEG-ERPs and neuropsychological function

Results from the proposed study could be used to as a framework to develop a clinical protocol for EEG-ERPs as a diagnostic measure of cognitive recovery in severe TBI. Future success will provide families with more information regarding potential recovery, enabling them to better make long-term care decisions.

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