

Final Report

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Title of Project:

Use of Continuous EEG in Australia, and evaluation of Posttraumatic Epilepsy

Summary:

Continuous EEG monitoring (cEEG) is a new clinical technique in Australia with extensive use and experience in the United States which is growing worldwide. Essentially, cEEG is the comprehensive assessment of critically unwell inpatients with electroencephalography (EEG) which may be hours or days of monitoring. Various patients may benefit from cEEG in hospital as cEEG has been shown to reduce mortality when compared with routine EEG (20mins) or no EEG, for critically unwell inpatients. Across patient groups, around 20-30% of critically unwell patients in the intensive care unit with an altered conscious state may have seizures recorded within 24-48hrs of cEEG. The majority of these are non-convulsive, and many patients may be in non-convulsive status epilepticus (NCSE). One of the most studied patient groups is traumatic brain injury (TBI). Whilst cEEG has been used predominantly in the United States, these studies have not been replicated in Australia.

This *Brain Foundation* grant allows assessment of patients using cEEG, in the detection and subsequent management of those with primarily non-convulsive seizures and non-convulsive status epilepticus.

Hypothesis vs Findings

Critically unwell patients, typically with an altered conscious state, may have seizures detected on cEEG. The project utilised by retrospective and prospective patients whom underwent cEEG for detection of seizures, to evaluate the frequency of seizure detection as well as risk factors predicting seizures in this group.

A subgroup of patients, part of the multinational Epibios4rx study investigating biomarkers for epileptogenesis in patients with traumatic brain injury, evaluated patients with moderate to severe traumatic brain injury for the occurrence of seizures via cEEG within the first 7 days since injury.

This *Brain Foundation* grant has complemented work as part of a NHMRC funded PhD Scholarship in this area, to explore and establish the role and use of cEEG for critically unwell patients in Australia with traumatic brain injury as a model. Interim results from 18 months of patients from both the Alfred and Royal Melbourne Hospitals have assessed 181 studies of cEEG as part of the first Australian case series of patients undergoing cEEG. A further 13 patients have been evaluated with cEEG as a screening tool for seizures in patients with severe traumatic brain injury.

Of the 181 cEEG studies, 60% were conducted on the ward and 40% in the ICU. The average age was 51.7 years old. 66% of the studies were performed for investigations of unexplained altered conscious state and the other 34% for diagnosis of paroxysmal events. Seizures were detected in 51% of studies, with 72% of that reflecting status epilepticus. Most seizures recorded were non-convulsive. Factors predicting seizures were prior clinical seizure, location in ICU, focal slowing and interictal discharges seen on EEG, as well as unexplained altered conscious state. Following cEEG, recorded management changes were high with 87% having a documented management change at the conclusion of the study, most of which were increases in antiepileptic drugs. Mortality was not common in this group but represented 15%, which likely reflects the critical illness severity of the patient group. Location in ICU, seizures, and increases in antiepileptic drugs were all associated with increased mortality. The study will continue to recruit patients prospectively and using an updated database that the Brain Foundation grant contributed to funding.

As mentioned, 13 patients were recruited prospectively following moderate to severe traumatic brain injury to undergo continuous EEG for the first 7 days from injury in the ICU. So far, the numbers are low, however 1 patient was found to be in refractory non-convulsive status epilepticus and has subsequently developed epilepsy some months later. Although this only represents 1 of 13 patients so far, further recruitment continues and subsequent evaluation of seizure frequency in this prospective patient group will unfold.

Unanswered Questions

To date, using cEEG for highly selected patients has revealed a high number of those with seizures and additional studies will provide information of other risk factors in order to further expand cEEG to those that may benefit. A morbidity and mortality assessment would be ideal to assess the efficacy of cEEG in our patient group, as well as a cost benefit analysis on a larger patient group level. It remains to be seen if prospective recruitment of high risk patients, such as those with traumatic brain injury, is beneficial and feasible in the Australia population.

What these research outcomes mean

With the support of this *Brain Foundation* grant, we have been able to explore the use of continuous EEG in Australia and demonstrate that it is feasible and able to detect a high percentage of critically unwell patients having seizures in the inpatient hospital setting.

This work was recently presented during a platform presentation at the Epilepsy Society of Australia (ESA) annual scientific meeting in Sydney on the 8th of November 2019.

Follow up studies with a prospective database designed to maximise outcome measures and allow a cost benefit analysis will be employed to further expand the cEEG service and understanding of unanswered questions.

A sincerest thank you to the *Brain Foundation* and its donors to allow this work to happen, for the furthering of knowledge in this area and of patient care.

Dr Joshua Laing