Figure 2. Fluoro-Jade B stained hippocampi from control, KA and KA+MB rats. There is negligible staining in the control. The hilus, CA3 and CA1 are prominently stained in the KA treated rat, which is milder in the KA+MB rat.

3.073
AUTOMATED HIGH-FREQUENCY OSCILLATION DETECTION FROM TRIPOLAR CONCENTRIC RING ELECTRODE SCALP RECORDINGS

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Rationale: Tripolar concentric ring electrode (TCRE) electroencephalography (tEEG) was first introduced by Besio [1]. The novelty of the TCRE and instrumentation is that two bipolar differential signals from three closely spaced electrode elements are recorded. Then the tripolar Laplacian derivation first described in [1] as a weighted sum {16*(M-D)-(O-D)} where O, M, and D are the potentials on the outer ring, middle ring, and central disc of the TCRE, respectively, is performed. We have shown that compared with conventional EEG signals, tEEG has nearly 4-fold (374%) the signal to noise ratio and less than one-tenth (8.27%) the mutual information [1, 2].
The goal of this work was to demonstrate that TCREs provide a unique opportunity to record high-frequency oscillations (HFOs) from scalp and develop a procedure to detect them that may be automated. We expect these techniques to improve diagnosis of epilepsy.
Methods: The recording protocol was approved by the IRB committees and did not interfere with the clinical EEG recording and evaluation. The tEEG recordings were performed concurrently with the clinical EEG. The TCREs were placed just behind the disc electrodes in locations close to the 10-10 sites.
After acquiring the t/EEG we used a modified version of the time course algorithm reported by Gardner et al. for detection of HFOs [3]. The algorithm performs a continuous short-time Fourier transform to calculate the power within a particular frequency band over consecutive half-overlapping one second epochs using a Hamming tapering window. As a result, the time course of power modulations was obtained. We found that HFOs were visually evident in the tEEG but were not present in the EEG.
However, with a threshold set at the mean plus one standard deviation the time course was only able to automatically detect the HFOs in one of our five patient's data. Various thresholds were tested with no improvement. Therefore, instead of calculating the power within a particular frequency band over time, we calculated the power spectrum within a short period of time using the same mean plus one standard deviation threshold.
Results: For each of the five patients we were able to visually observe where the peaks in the high gamma-band burst HFOs were with both methods. The automated threshold correctly detected the high gamma-band burst HFOs in four of the five patient's data using the power spectrum.
Conclusions: The power spectrum method more consistently lead to automatic HFO detection than the time course on our tEEG data for these five patients.
[1] WG. Besio et al."Tri-polar Concentric Ring Electrode Development for Laplacian"
[2] K. Koka, WG. Besio, "Improvement of Spatial Selectivity and Decrease of Mutual Information of TCRE"
[3] AB Gardner et al. "Human and automated detection of HFOs"
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3.074
MODULATING EPILEPTOGENESIS IN THE GLUTAMINE-SYNTHETASE DEFICIENT MODEL OF MTLE

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Rationale: Glutamine synthetase (GS) has been found to be deficient in the hippocampus of patients with MTLE. Recreating a state of GS deficiency by infusing methionine sulfoximine (MSO), a competitive inhibitor of GS, into the entorhinal cortex-hippocampus has been shown to result in spontanenous, recurrent seizures in rats. In this project we study two periods of MSO exposure in the rat brain, namely 72 hrs and 28 days, and analyze the effects on seizure outcome and long-term EEG perturbations. The main question we are asking is if epileptogenesis can be stopped or delayed, and if there are EEG measurements that are markers of this epileptogenic process.
Methods: Under Isoflurane anesthesia, a drug delivery cannula was introduced into the right entorhinal cortex and connected to a subcutaneously implanted Alzet osmotic minipump filled with MSO. Two depth electrodes and two screw electrodes were introduced in the dentate gyrus and cerebral hemispheres bilaterally to record EEG activity. A depth electrode and a screw electrode were introduced in the cerebellum to serve as reference and ground respectively.
After 72 hours of continuous video-EEG recordings, the pump was removed from a group of the animals via a minimally invasive procedure under anesthesia. The other subset of animals underwent a sham procedure involving a similar incision with comparable anesthesia exposure, while leaving the pump intact.
The rats were monitored via video-EEG continuously for a goal of 90 days or until when the implantation fell. Seizures were first identified by visual inspection of the EEG record using Ceegraph Vision Analysis and EEG was subsequently analyzed to quantify changes using Teager energy and spectral band power measurements. EEG was analyzed in three periods: 1) the first 72 hours, 2) day-3 to day-28, and 3) >28.
Results: All of the chronically infused rats had seizures. The majority of them continued to have seizures after the 28-day period of infusion. The rats infused with MSO for 72 hours had seizures during infusion, and in a subset seizures were still observed following a latent period but were significantly less frequent.
Seizure frequency was not significantly different during the first 72 hours between the 72-hr infusion and 28-day infusion groups, $t(18)=0.31$, $p=0.62$.
There was a significance difference in the period from day-3 to day-28, $t(18)=-7.67$, $p<0.001$. There was a trend toward significance between the groups after day 28, $t(18)=-1.50$, $p=0.07$.
Teager energy and spectral band measurements pending.
Conclusions: One of the key questions is if epileptogenesis can be stopped. Our data suggests that epileptogenesis is an ongoing process that can at least be slowed. Rats who had an acute MSO infusion underwent a long latent period, and though they developed seizures they were less frequent. We will next correlate seizure outcome with Teager energy and spectral band analysis to identify measurements that might be markers of an ongoing epileptogenic process. A better understanding of this epileptogenic process will be critical for patient management and the creation of better targeted pharmacotherapy.