**Early detection of focal seizures in thalamus using a novel seizure detection paradigm: Progress towards a closed-loop thalamic stimulation**

[1]Sandipan Pati MD, [1]Diana Pizarro EE, [2]Rosana Esteller PhD, [3]Kaushik Majumdar PhD, [1]Jerzy P. Szaflarski MD PhD

[1]University of Alabama at Birmingham, Birmingham, AL, USA

[2]NeuroPace, Inc. Mountain View, CA, USA

[3]Indian Statistical Institute, Bangalore, India

**Rationale:** Despite therapeutic advances, many persons with epilepsy may not be candidates for resective surgery or RNS implantation if seizure onset is non-localizable. One potential approach to treating epilepsy in this cohort is to provide stimulation to thalamus. One of the pre-requisites for developing an effective closed loop therapy is early detection of seizures. We report our experience in mapping the temporal dynamics of thalamic activity during transition from interictal to ictal state and compare a novel seizure detection method called "P-operator" to “curve-length”.

**Methods:** Data were recorded from five adults with history of difficult-to-localize epilepsies using stereo-depth electrodes implanted in thalamus. Matlab was used to analyze power spectrum, power spectral density, comparison between P-operator against curve-length for substantiating functional connectivity between the seizure onset zone(s) and thalamus.

**Results:** 22 seizures were recorded and analyzed. Matlab analysis with P-operator and curve-length confirmed involvement of thalamus in 4 out of 5 patients. Curve-length detected seizures earlier than P-operator, however P-operator showed more efficacy for detection and count of interictal discharges. Spectral analysis confirmed cortico-thalamic involvement between 100-400 Hz and the seizures were detected in thalamus within -10 to +5 seconds from cortical onset (T=0 sec). Thalamic signatures at seizure onset differed from offset. Curve-length had an average percentage of error of 5% compared to 9.6% for P-operator.

**Conclusions:** Thalamus was involved early in focal onset seizures. Seizures and interictal discharges can be quantified using curve-length and P-operator.