

Multiscale Aspects of Generation of High-Gamma Activity during Seizures in Human Neocortex

eNeuro; March/April 2016

Eissa TL, Tryba AK, Marcuccilli CJ, Ben-Mabrouk F, Smith EH, Lew SM, Goodman RR, McKhann GM Jr, Frim DM, Pesce LL, Kohrman MH, Emerson RG, Schevon CA, van Drongelen W

Objective – A third of the population with epilepsy fails to achieve seizure freedom with anti-epileptic drugs. These patients have to resort to vagus nerve stimulation, deep brain stimulation or surgical removal of areas that initiate seizures. For surgical removal of brain tissue, finding out where the seizure onset zone (SOZ) is located is critical. In some patients this requires electrocorticography (ECoG), the placement of electrodes on the brain surface. But it is thought that ECoG sometimes overestimates the SOZ, thereby potentially making the neurosurgeons resect more brain tissue than just the SOZ. Hence, there is a need to find a better biomarker to identify the SOZ. The authors of a [recent paper](#) looked at high gamma (HG) activity as a potential biomarker. HG activity is observed at the network level; at the neuronal level, paroxysmal depolarizing shifts (PDSs) are also thought to be important for seizure generation. The hypothesis of this paper was that HG activity at the network level is linked to PDSs at the neuronal level. Experiments were done in tissue resected from patients with intractable epilepsy and by looking at seizure activity in the patients *in vivo*.

Results – On experiments done on resected tissue from patients with intractable epilepsy, the authors recorded electrical activity from outside neurons (extracellular) and inside neurons (intracellular). *In vivo* seizures were measured with microelectrodes placed with ECoG grids. By simulating seizure activity in resected tissue, the authors found an increase in HG activity. *In vivo* seizures exhibited a higher HG activity in parts of the seizure. This HG activity was correlated to PDSs.

Interpretation – These experiments show that HG and PDSs are indeed correlated, and that HG activity could be a more accurate determinant of the SOZ for resection surgery than what is currently done.

Short summary for scientists – High gamma (HG; 80 – 150 Hz) activity has been linked to seizures, but how seizure activity influences HG is not well understood. In a [recent study](#), the authors used tissue obtained from resection of people with intractable epilepsy, microelectrode recordings from *in vivo* seizures and modeling to see if HG activity could be a (better) indicator of the seizure onset zone (SOZ). Currently, low frequency local field potentials (LFPs) are used as a biomarker for the SOZ. The authors found that HG activity on a network level was correlated with paroxysmal depolarizing shifts (PDSs) that are seen on a neuronal level. Also, greater HG was found in the core as opposed to the penumbra, indicating that looking at HG may be a better way to demarcate the SOZ.

Link to the paper – Free access - [yes](#)