MedicalXpress

Using network science to help pinpoint source of seizures

December 17 2015

The ability to reliably pinpoint the anatomical source of epileptic seizures, different for each patient, remains elusive. One third of patients do not respond to medication and an alternative can be surgery to locate and remove the small cluster of neurons that act as the seed of an epileptic seizure, unfortunately such surgeries often fail to bring any relief.

New research published in *PLOS Computational Biology* is seeking a way to refine this process by looking at networks of electrical activity in the brain just prior to the onset of a seizure by studying the recordings of 88 seizures from 22 patients.

Using brain data crowdsourced from 22 epilepsy patients with implanted electrodes, researchers from the University of Pennsylvania led by Danielle Bassett have developed a series of algorithms that can predict where in the brain a seizure will originate and which groups of neurons it will likely spread to as it grows.

Such algorithms could provide a more objective way of identifying surgical targets, improving the success rate of interventions and possibly lead to less invasive forms of treatment. An implant device, for example, could monitor warning signs and automatically deliver precise electrical impulses that would neutralize the seizure before it manifests.

"By mapping the network of activity in the brain and how it changes over time," Bassett said, "we aim to quantify the reconfiguration of this

network that leads to different stages of a seizure."

At the core of the research team's findings is the International Epilepsy Electrophysiology Portal, which was designed to collect direct brain recordings from epilepsy patients the world over.

Each patient in the study has between 80 and 100 electrodes implanted in regions of the brain that preliminary tests suggested were the source of seizures. The electrodes indirectly record the voltage of brain activity in the neurons they sit above.

The researchers believe algorithms based on these network relationships could immediately aid in pinpointing surgical targets in patients' brains and eventually inform implant devices that can neutralize seizures before they spread.

More information: Khambhati AN, Davis KA, Oommen BS, Chen SH, Lucas TH, Litt B, et al. (2015) Dynamic Network Drivers of Seizure Generation, Propagation and Termination in Human Neocortical Epilepsy. *PLoS Comput Biol* 11(12): e1004608. DOI: 10.1371/journal.pcbi.1004608