UV LED therapy shows promising results in preventing focal seizures

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Researchers from the University of Minnesota Medical School discovered that light from an ultraviolet diode (UV LED) reduced "seizure-like" activity in a rat epilepsy model. During the study, UV light released gamma aminobutyric acid (GABA) from the "caged" compound carbonyl amino butanoic acid (BC204). GABA then decreased the abnormal electrical activity in the CA1 area of the brain. Results of this study have considerable potential in treating focal epilepsy in humans. Details of this study are available in the January 2010 issue of *Epilepsia*, a journal published by Wiley-Blackwell on behalf of the International League Against Epilepsy.

Focal (or partial) epilepsy is very common in both adults and can occur in children. It is caused by an abnormality in a localized area of the brain resulting from such conditions as stroke, trauma, or infections. Up to one-third of epileptic patients fail to respond to conventional medical therapies and are subject to toxic effects from antiepileptic drugs (AEDs). While surgery has benefited some patients with focal epilepsy, a substantial number of patients do not experience a complete remission after operation, prompting researchers to investigate alternative treatments.

Steven Rothman, M.D., and colleagues conducted experiments with UV LEDs to control seizure-like activity in rodent brain slices. Population spikes in CA1 (which reflect the discharge of a population of neurons) were elicited by delivering constant current pulses through a microelectrode placed in the CA3 brain area. Researchers induced

seizure-like activity by adding the convulsant, 4-aminopyridine (4-AP; 100 µM) and removing magnesium from the fluid solution outside the cells. Caged GABA, BC204, was perfused into the preparation for at least 30 minutes prior to the first illumination.

When population spikes were measured (as a reflection of tissue excitability), the research team found that illumination of control slices with up to 200 mA LED current had no effect on peak amplitudes. Addition of BC204 (30 µM) and illumination using as little as 50 mA LED current produced a statistically significant reduction of the peak of the population spike. More important, BC204 (10 µM) significantly reduced the slice spikes and bursting induced by the 4-AP and low magnesium.

"Our strongly positive results, in an epilepsy model far more severe than the naturally occurring disease, suggest that this technique could translate to human epilepsy," said Dr. Rothman. Researchers believe that a programmable pump could deliver the caged GABA into the subarachnoid space over the epileptic area of the brain. UV LEDs could then be responsively activated to release GABA, using techniques similar to those used for cortical stimulation units that are currently in clinical trials.

The researchers are optimistic that an LED-based implantable device is feasible. "Optical stimulation would be a far more rapid delivery method than any mechanical device for direct administration of drug into the brain and would not subject patients to toxic doses of medication or irreversible brain damage from epilepsy resections," concluded Dr. Rothman.

More information: "Optical suppression of experimental seizures in rat brain slices." Xiao-Feng Yang, Brigitte F. Schmidt, Daniel L. Rode, and Steven M. Rothman. Epilepsia; Published Online: August 2009

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