

Research offers new hope for people living with seizures

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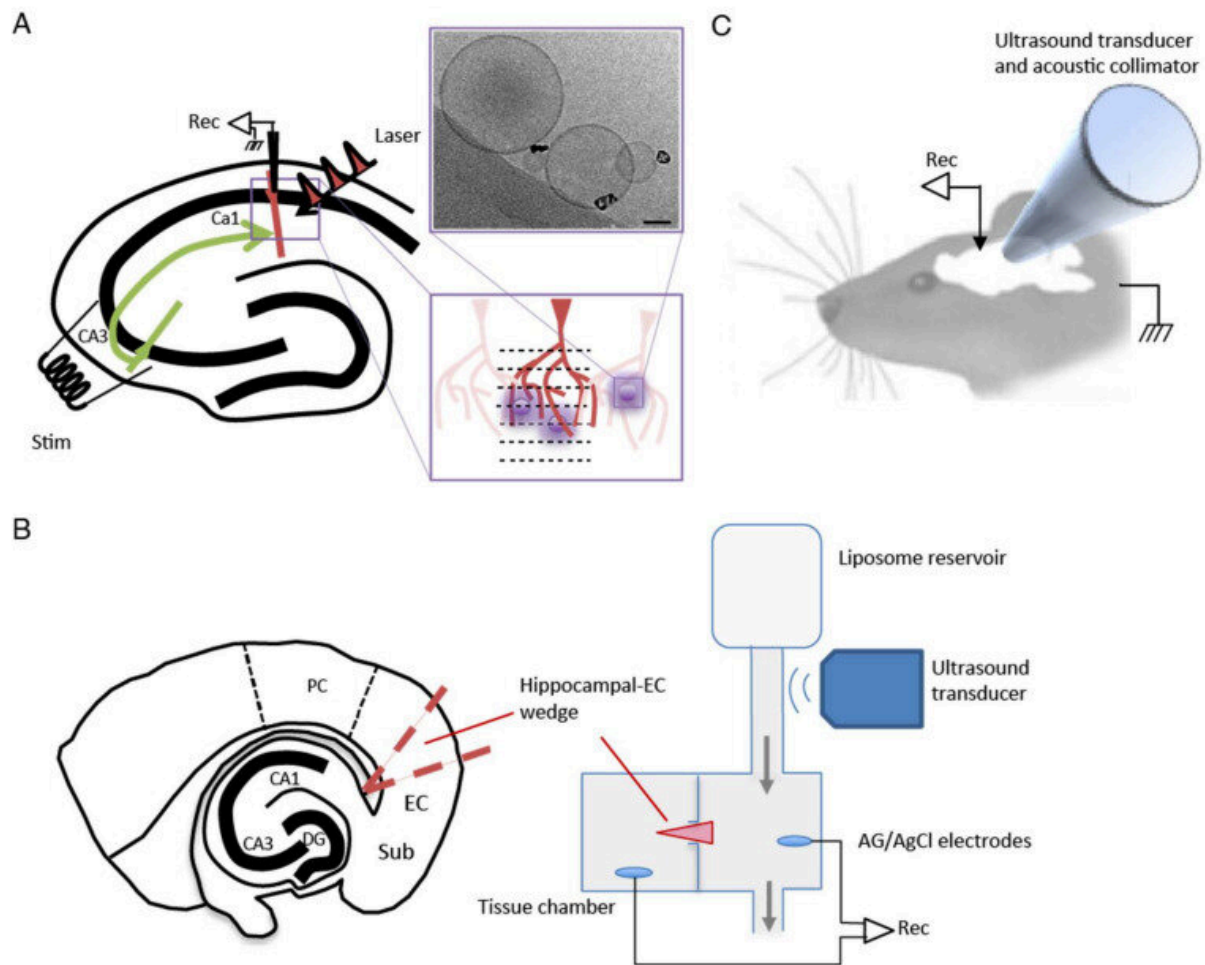


Figure 1. Experimental setups for three different models. (A) Hippocampal slice experiments. Schematic of hippocampal slice shows location of electrical field stimulating electrode (Stim) in area CA3, and whole cell intracellular recording electrode (Rec) in area CA1. Femtosecond pulses (Laser) were applied via the use of a 2-Photon microscope. Expanded schematic of CA1 shows location of

dendrites (red) and liposomes (purple) in relation to sequential laser scan lines (dashes), forming a grid pattern in the dendritic zone. Example cryo-transmission electron microscope image shows liposomes tethered to hollow gold nanoshells (black; scale bar = 50 nm). (B) Entorhinal cortex wedge experiments. Schematic shows position of entorhinal cortex wedge, and wedge positioned in two-compartment grease gap chamber. Liposomes were stimulated with ultrasound as they passed into the tissue chamber. Gray arrows indicate flow of ACSF. (C). In vivo preparation. Field potential signals were obtained via an extracellular recording electrode (Rec) in the left frontal cortex. Liposomes were stimulated using an ultrasound transducer coupled to an acoustic collimator and positioned on the dura above the cortex. Credit: *Pharmaceutics* (2022). DOI: 10.3390/pharmaceutics14020468

A research collaboration involving the University of Otago could change the lives of people living with seizures.

Researchers from Otago and Okinawa Institute of Science and Technology Graduate University have developed a new system that uses specialized sound waves (above the frequency that we can hear) or light (above the wavelength that we can see) to release medication into specific areas of the brain to stop seizure activity.

Otago lead researcher Professor John Reynolds says this novel new way of delivering drugs could be an effective solution, and a life-changer for some [patients](#) with epilepsy.

"The [sound waves](#) can be applied from outside the head to target an area where epileptic [seizures](#) can start, and will release the drug from tiny biological packages circulating in the blood stream as they pass through the area, to suppress the [seizure activity](#)," he says.

A device would be connected to the head of the patient, and drug-

containing liposomes—a drug delivery vehicle—will be injected into the [blood stream](#). These liposomes will float around, but not change the brain unless activated.

"The device could then be triggered by the person when they sense an aura that a seizure is coming on, or automatically by a system that detects seizure brain waves, activating the liposome to release the drug to stop the seizure from developing," Professor Reynolds says.

Laboratory testing focused on [epileptic seizures](#) in particular because of the challenges of long-term treatment with current anti-epileptic drugs and the large number of patients with drug-resistant epilepsy.

Ideally, treatment for epilepsy should prevent seizures before they occur. However existing treatments are not effective for prevention in about one third of patients and these patients are at significant risk of morbidity and mortality, he says.

"What is needed, therefore, is a means to deliver the [drug](#) immediately on the first sign of a seizure and our studies showed this system does just that—release of the drugs is rapid, immediate and effective.

"Our system could present the possibility of further reducing seizure frequency and allowing the person to take fewer drugs to reduce their seizures, improving their quality of life."

Professor Reynolds says this work represents an important collaboration between medically-qualified neuroscientists, physiologists, pharmaceutical scientists and chemists and a collaboration internationally between University of Otago and with neuroscientists in Okinawa.

Research will now focus on developing the system to make it safe and

ready for human use.

More information: Takashi Nakano et al, An On-Demand Drug Delivery System for Control of Epileptiform Seizures, *Pharmaceutics* (2022). [DOI: 10.3390/pharmaceutics14020468](https://doi.org/10.3390/pharmaceutics14020468)

Provided by University of Otago

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