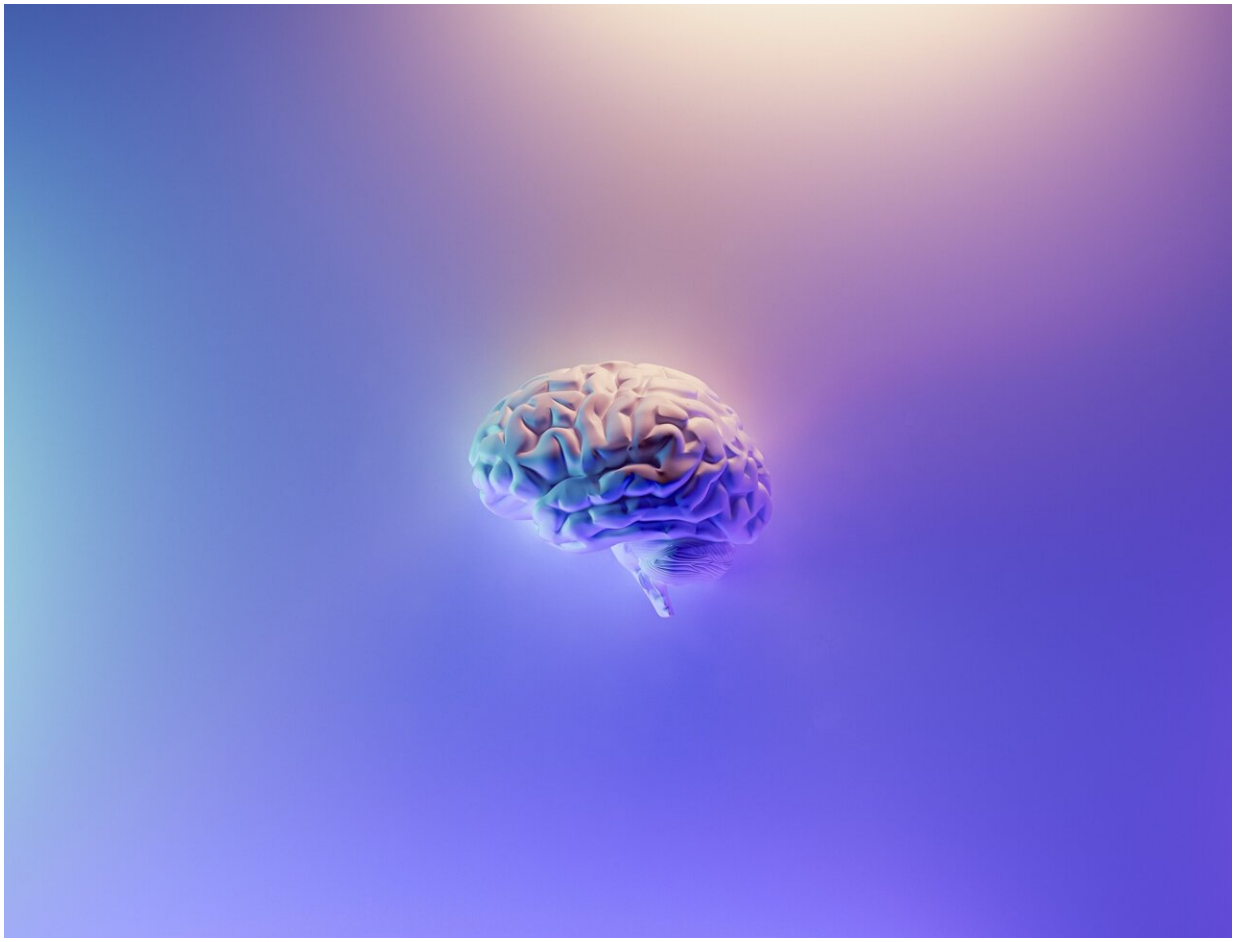
Brain implant could stop epilepsy seizures

August 30 2018, by Christopher Proctor



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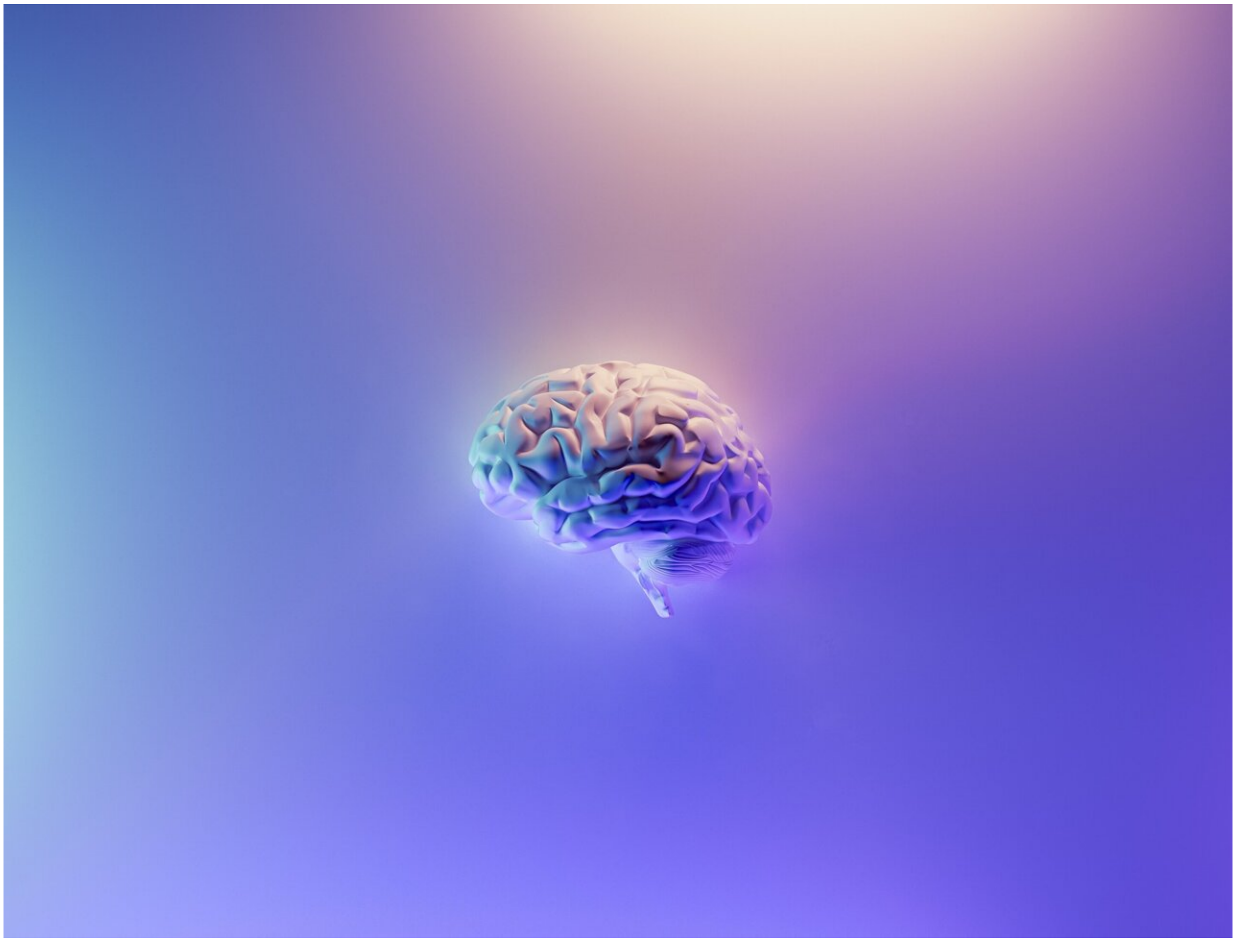
For many people who suffer from neurological disorders, such as epilepsy, there are no viable treatment options. In our latest research, we developed an implantable device that may one day offer relief. We show that the implant can treat problems in the brain, such as epileptic seizures, by delivering brain chemicals – known as neurotransmitters – directly to the cells in the brain that cause the problem.

The implant works by using an electric field to push neurotransmitters out of the device from an internal reservoir. This process, known as electrophoresis, allows for precise control over the dose and timing of drug delivery, which is important for addressing intermittent disorders such as epilepsy.

This way of delivering drugs also has the advantage of not increasing the local pressure where the drug exits the device because the drug molecules are not in a solvent – they exit the device "dry". This is important because it means the drug molecules (neurotransmitters in this case) can interact directly with the tissue surrounding the implant without causing damage to those cells or the surrounding tissue.

Researchers have previously shown that this method for delivering drugs can be used to manage pain, with an implant that was placed in the spinal cord of rats. The novelty of our work, published in *Science Advances*, was to engineer an implant small enough to be implanted in the brain of mice. We also incorporated tiny sensors into the implant to allow us to monitor the local brain activity where the device was implanted.



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Using the on-board sensors, we could see the onset of seizure-like activity in mice. After a seizure was detected, we told the implant to send out inhibitory neurotransmitters to the brain tissue at the centre of the seizures. The neurotransmitters tell the cells in that tissue to stop propagating the seizure message to other cells. This stopped the seizures.

After finding that we could stop seizures, we wanted to see if we could prevent seizures altogether, rather than stop them after they have started. To test this, we started delivering the neurotransmitters before a dose of seizure-inducing chemicals was injected into the brain with a separate implant. These experiments showed that our implant could prevent any seizure-like activity from happening.

Platform technology

We are very excited because this is the first time anyone has seen that an electrophoretic drug delivery device can stop or prevent seizure-like activity. Also, we see this as a platform technology that could be adapted to help treat many different neurological disorders including epilepsy, Parkinson's disease and brain tumours.

It is important to note that, so far, this device has only been tested in mice and rats. Judging from the time it has taken for other technologies to go from this stage to widespread clinical use, it is likely to be at least a decade before this technology would be widely available for humans. During this time much work will be done to prove the long-term viability of these implants for treating epilepsy as well as other neurological disorders.

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