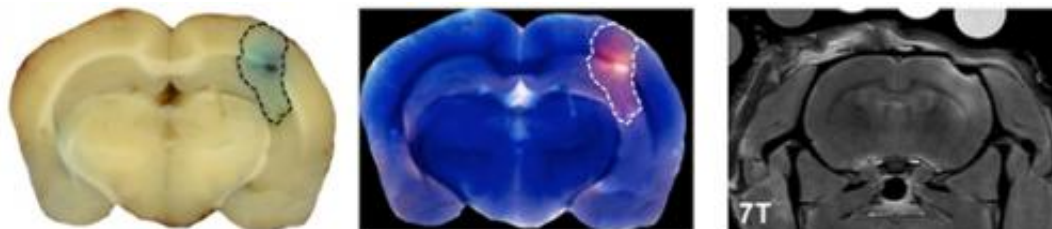


Focal blood-brain-barrier disruption with high-frequency pulsed electric fields

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Two, minimally invasive needle electrodes with 1 mm active length were spaced 4.0 mm apart and inserted into the right cerebral hemisphere 1.5 mm beneath the surface of the dura. A burst of 200, 500 ns duration square pulses of alternating polarity with a voltage-to-distance ratio of 250 V/cm were applied through the electrodes. In the case shown above, bursts were repeated once per second for 10 min. The extent of BBB disruption is shown by the dotted line surrounding Evans blue-albumin complex uptake on the gross brain slice preparation (left) and the corresponding fluorescent image (middle). Additionally, areas of BBB disruption appear as hyperintense (white) on the T1-weighted MRI exam, due to the uptake of a gadolinium-Evans blue tracer. Scale bar represents 5 mm. Credit: John H. Rossmeisl Jr., Neurology and Neurosurgery, Virginia-Maryland College of Veterinary Medicine and Virginia Tech-Wake Forest University School of Biomedical Engineering and Sciences

A team of researchers from the Virginia Tech-Wake Forest University School of Biomedical Engineering and Sciences have developed a new way of using electricity to open the blood-brain-barrier (BBB). The Vascular Enabled Integrated Nanosecond pulse (VEIN pulse) procedure

consists of inserting minimally invasive needle electrodes into the diseased tissue and applying multiple bursts of nanosecond pulses with alternating polarity. It is thought that the bursts disrupt tight junction proteins responsible for maintaining the integrity of the BBB without causing damage to the surrounding tissue. This technique is being developed for the treatment of brain cancer and neurological disorders, such as Parkinson's disease, and is set to appear in the upcoming issue of the journal *Technology*.

The BBB is a network of tight junctions that normally acts to protect the brain from foreign substances by preventing them from leaking out of blood vessels. However, it also limits the effectiveness of drugs to treat [brain](#) disease. Temporarily opening the BBB is a way to ensure that drugs can still be effective.

For the treatment of [brain cancer](#), "VEIN pulses could be applied at the same time as biopsy or through the same track as the biopsy probe in order to mitigate damage to the healthy tissue by limiting the number of needle insertions," says Rafael V. Davalos, Ph.D, director of the Bioelectromechanical Systems Laboratory at Virginia Tech.

Additionally, the group shows that VEIN pulses can be applied without causing muscle contractions, which may dislodge the electrodes and require the use of a neuroblocker and general anesthesia. According to Christopher B. Arena, Ph.D., co-lead author on the paper with Paulo A. Garcia, Ph.D. and Michael B. Sano, Ph.D., "the fact that the pulses alternate in polarity helps to avoid unwanted, electrically induced movement. Therefore, it could be possible to perform this procedure without using a neuroblocker and with patients under conscious sedation. This is similar to how [deep brain stimulation](#) is implemented clinically to treat Parkinson's disease."

The team now plans to translate the technology into clinical applications

through a university spin-out company, VoltMed, Inc.

More information: [www.worldscientific.com/doi/ab ...
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