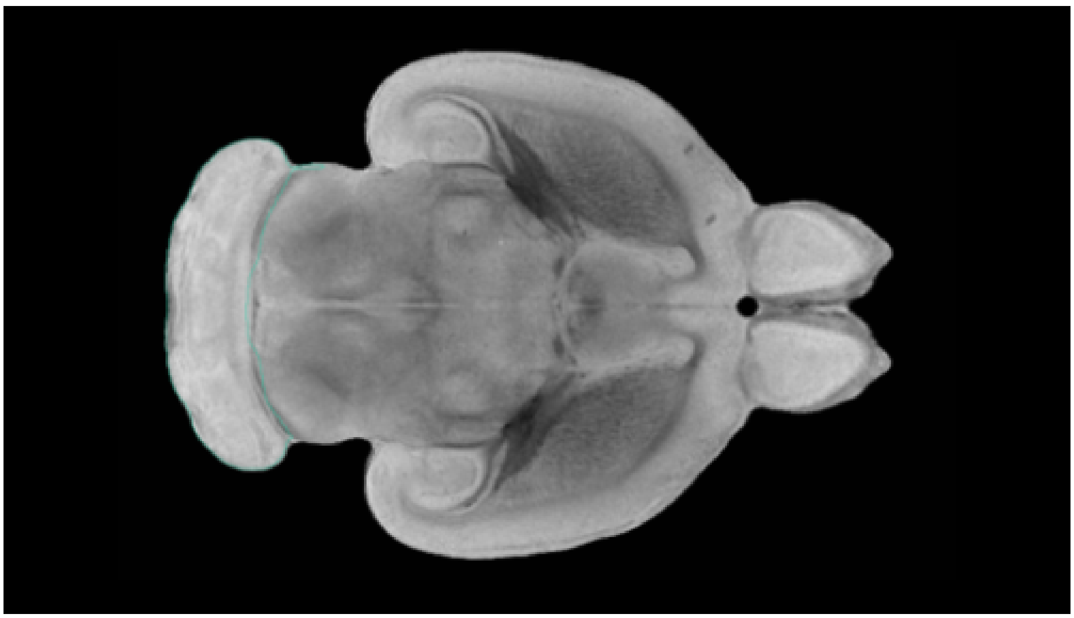
Implantable brain device relieves pain in early study

June 21 2021



Cerebellum of CIVM postnatal rat brain atlas. Credit: Neurolex

A computerized brain implant effectively relieves short-term and chronic pain in rodents, a new study finds.

The experiments, conducted by investigators at NYU Grossman School of Medicine, offer what the researchers call a "blueprint" for the development of brain implants to treat pain syndromes and other brain-based disorders, such as anxiety, depression, and panic attacks.

Publishing June 21 in the journal *Nature Biomedical Engineering,* the study showed that device-implanted rats withdrew their paws 40 percent more slowly from sudden pain compared with times when their device was turned off.

According to the study authors, this suggests that the device reduced the intensity of the pain the rodents experienced. In addition, animals in sudden or continuous pain spent about two-thirds more time in a chamber where the computer-controlled device was turned on than in a chamber where it was not.

Researchers say the investigation is the first to use a computerized brain implant to detect and relieve bursts of pain in real time. The device is also the first of its kind to target chronic pain, which often occurs without being prompted by a known trigger, the study authors say.

"Our findings show that this implant offers an effective strategy for pain therapy, even in cases where symptoms are traditionally difficult to pinpoint or manage," says senior study author Jing Wang, MD, Ph.D., the Valentino D.B. Mazzia, MD, JD Associate Professor in the Department of Anesthesiology at NYU Langone Health.

Chronic pain is estimated to affect one in four adults in the United States, yet until now, safe and reliable treatments have proven elusive, says Wang, also the Vice Chair for Clinical and Translational Research at NYU Langone. Particularly for pain that keeps coming back, current therapies such as opioids often grow less effective over time as people become desensitized to the treatment. In addition, drugs such as opioids activate the reward centers of the brain to create feelings of pleasure that may lead to addiction.

Computerized brain implants, previously investigated to prevent epileptic seizures and control prosthetic devices, may avert many of these issues, says Wang. The technology, known as a closed-loop brain-machine interface, detects brain activity in the anterior cingulate cortex, a region of the brain that is critical for pain processing. A computer linked to the device then automatically identifies electrical patterns in the brain closely linked to pain. When signs of pain are detected, the computer triggers therapeutic stimulation of another region of the brain, the prefrontal cortex, to ease it.

Since the device is only activated in the presence of pain, Wang says, it lessens the risk of overuse and any potential for tolerance to develop. Furthermore, because the implant does not offer a reward beyond pain relief, as opioids do, the risk of addiction is minimized.

As part of the study, the researchers installed tiny electrodes in the brains of dozens of rats and then exposed them to carefully measured amounts of pain. The animals were closely monitored for how quickly they moved away from the pain source. This allowed the investigators to track how often the device correctly identified pain-based brain activity in the anterior cingulate cortex and how effectively it could lessen the resulting sensation.

According to the study authors, the implant accurately detected pain up to 80 percent of the time.

"Our results demonstrate that this device may help researchers better understand how pain works in the brain," says lead study investigator Qiaosheng Zhang, Ph.D., a doctoral fellow in the Department of Anesthesiology, Perioperative Care and Pain at NYU Langone. "Moreover, it may allow us to find non-drug therapies for other neuropsychiatric disorders, such as anxiety, depression, and post-traumatic stress."

Zhang adds that the implant's pain-detection properties could be improved by installing electrodes in other regions of the brain beyond the anterior cingulate cortex. He cautions, however, that the technology is not yet suitable for use in people, but says plans are underway to investigate less-invasive forms with potential to be adapted for human use.

More information: A prototype closed-loop brain–machine interface for the study and treatment of pain, *Nature Biomedical Engineering* (2021). DOI: 10.1038/s41551-021-00736-7 , www.nature.com/articles/s41551-021-00736-7

Provided by NYU Langone Health