News and Perspectives

Can Neurotech Help Tame Brain Tumors?

Simon Spichak, JMIR Correspondent

Abstract

Is electricity the next frontier in monitoring and treating brain tumors and other cancers? In this *News and Perspectives* article, JMIR Correspondent Simon Spichak reports on advances in the emerging cancer neuroscience field.

Key Takeaways:

- The nascent cancer neuroscience field has established that brain tumors have a bidirectional relationship with the nervous system, setting the foundation for neurotechnology interventions.
- Implants to help surgeons determine how much brain tissue to remove, vagus nerve stimulators to keep cancer at bay, and implants that could both monitor and treat cancer through electrical stimulation are in development and under research.

The last few decades have seen incredible advances in cancer treatment that have made it possible to treat many forms of the disease with increased precision. But better treatments for brain tumors like glioblastoma—a fast-growing, highly aggressive cancer—continue to elude researchers.

In 2015, Michelle Monje, MD, PhD, discovered something unexpected: neuronal activity drives brain tumor growth. Gliomas—tumors like glioblastoma made from the brain's supportive cells—can electrically integrate into neural circuits, connecting and communicating with other brain cells, which may explain why they're able to evade treatment. Parallel discoveries made across the world by Henry Winkler, MD, at Heidelberg University Hospital, strengthened the case that targeting the underlying neurological mechanisms contributing to these tumors could provide a new path forward. These discoveries earned Monje and Winkler the 2025 Brain Prize, the Oscar of the neuroscience world.

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Steven Brem, MD

Now, researchers and companies are developing neurotechnology to map and target hard-to-treat brain tumors. Steven Brem, MD, professor at the University of Pennsylvania and chief scientific advisor for the Musella Foundation, says that it's “really exciting” to see experts from adjacent fields coming together in this burgeoning field. “It keeps me up at night, but also puts the socks on in the morning,” he says.

Guiding Tumor Removal

Nuri Ince, PhD, a neural engineer at the Mayo Clinic, is building neural interfaces that could help neuro-oncology surgeons map out the brain and resect more of a tumor safely. Surgeons must work with a delicate balance: take too much brain tissue around the tumor and it could lead to neurological impairments; take too little and the tumor may grow back.

The practice involves using electrocorticography (ECoG) combined with behavioral tasks or electrical stimulation to spatially map out the regions important for healthy brain function. Electrodes are placed directly onto the brain, usually while patients are awake, and algorithms crunch the information and—alongside clinical judgment—help direct surgeons during resection.

For example, the patient may play the guitar if the tumor is close to the motor areas of the brain to see which areas activate so surgeons can avoid removing them. Since the tumors also become innervated with healthy brain tissue, they can cause electrical abnormalities, leading to seizures. These electrodes could help surgeons cut out the epileptogenic area safely as well.

Expanding how much tumor can be removed safely means that “survival rates will increase dramatically,” says Ince.

This technology is still being tested and hasn't made it into standard practice. Ince predicts that better materials for these electrodes as well as advances in detection algorithms could make this process more efficient.

Neurotechnology to Treat Aggressive Tumors

In the 1990s, evidence emerged linking inflammation to cancer. Old, senescent cells (cells that are alive but have stopped working properly) secreted inflammatory proteins called cytokines that could drive these disease processes. Brem took notice of these ideas.

For a decade, he tried unsuccessfully to bring a rheumatoid arthritis drug, tocilizumab, into human clinical trials for glioblastoma. Tocilizumab blocks cytokine signaling pathways, prolonging survival in animals with glioblastoma. So when Brem learned that the Food and Drug Administration (FDA) approved SetPoint Medical's vagus nerve stimulator for rheumatoid arthritis—which helps by lowering these cytokines—last year, he was excited.

The multivitamin pill–sized device is surgically implanted on the left side of the neck, allowing it to electrically stimulate the longest nerve in the body, the vagus. One minute of stimulation a day is enough to send a signal down the vagus to the spleen, culminating in a reduction of the same inflammatory cytokines implicated in glioblastoma.

"I hope if it works for arthritis and it works for other conditions, maybe it will work for glioblastoma," he says.

Although there are many other commercially available vagus nerve stimulators on the market, they aren't FDA-approved, and Brem worries that the promotion of these devices as a "panacea" has negatively impacted the field. To keep the momentum moving, he's working toward setting up a clinical trial of vagus nerve stimulation for glioblastoma by the end of the year.

First Cancer Neurotech in Clinical Trials

In Melbourne, Australia, Coherence Neuro is developing a device that could be placed in the brain during tumor resection surgery.

"The device will initially deliver a pre-set stimulation protocol whilst simultaneously recording how the electrical activity surrounding the tumor changes as tumors progress," Ben Woodington, PhD, CEO of Coherence Neuro, writes over email. The company is running a small, 10-participant study to test the safety and stability of the device. In the next two years, Woodington says the company will start a long-term trial of 10-15 patients focusing on device safety while measuring treatment efficacy and correlates of brain activity as secondary outcomes.

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The company is also adapting the technology for the torso to target solid tumors throughout the rest of the body, where evidence is emerging that the vagus nerve and other neural signaling may play a role.

Woodington is excited about the prospect of integrating other information like genetic and family history, alongside data from wearables and the tumor biopsy, to improve cancer prediction and monitoring.

"While we can't say for certain from here, we envision a world where recording and correlating petabytes of this data over time could lead to wearables being able to predict cancer's initiation at the earliest possible time," says Woodington. "And in the end, the best way to treat cancer is to catch it as early as possible."

Keywords: brain neoplasms; neoplasms; nervous system; bioelectric therapy; electrical stimulation; neurotechnology; vagus nerve stimulation; brain-computer interfaces

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