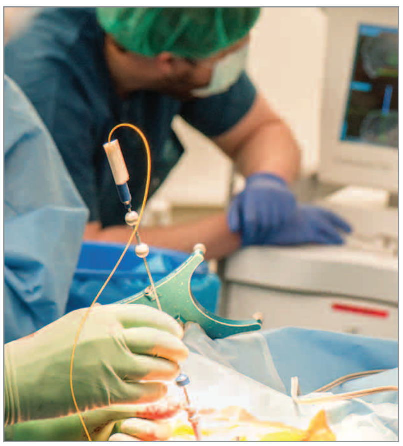
Biotech Innovations

Imaging Needle to Detect Blood Vessels During Brain Tumor Biopsy

Before a patient with a brain tumor undergoes a needle biopsy, magnetic resonance imaging (MRI) is used to locate the mass and major blood vessels. During the biopsy, the position of the needle is tracked with sensors and superimposed onto the scan, allowing the surgeon to sample the tumor while avoiding blood vessels. But there are 2 problems: the MRI doesn't detect blood vessels smaller than about 3 mm in diameter and the needle tracking can be off by a few millimeters. If the needle damages a blood vessel, a brain bleed can occur.



Sir Charles Gairdner Hospital

Writing in *Science Advances* in December, Australian researchers described a new imaging probe designed to improve blood vessel detection and reduce hemorrhages during needle biopsies of the brain. The probe fits inside the needle and consists of a hair-thin optical fiber tipped by 1-mm-long lens. An optical coherence tomography scanner connected to the needle shines light down the fiber and detects the reflected image. Computer algorithms were developed to automatically detect blood flow adjacent to the tip of the needle and alert the surgeon.

In a feasibility study of 11 patients who received craniotomies during brain surgery, the "smart needle" detected surface blood vessels larger than 500 μm in diameter with 91% sensitivity and 98% specificity. The technique also accurately detected blood vessels during deep needle insertions in 3 patients.

Together, MRI and the new imaging needle "give the neurosurgeon a much better understanding of any potential complications," said senior author Robert McLaughlin, PhD, chair of biophotonics at the University of Adelaide, Australia. The next-generation version of the needle will ideally detect cancerous tissue as well as blood vessels, substantially reducing the number of biopsy samples that are needed, McLaughlin said.

Advanced Brain-Computer Interface for People With Paralysis

In a recent study in *PLOS One*, a 63-year-old man with tetraplegia caused by a spinal cord injury sent his first text messages with an off-the-shelf consumer tablet paired to an intracortical brain-computer interface (iBCI). He and 2 other participants with limited arm and hand mobility due to amyotrophic lateral sclerosis also used the iBCI to browse the internet, send emails, chat with researchers, stream music, watch videos, check the weather, and read the news—all by simply thinking about the tasks.

The research team, co-led by scientists at Stanford University and Brown University, implanted 1 or more small microelectrode arrays in the participants' brains, specifically in areas of the dominant motor cortex that control hand and arm movements. A computer with a specialized operating system processed and decoded signals from the arrays, sending the output to a virtual Bluetooth mouse paired with the tablet.

The participants were able to perform all of their assigned tasks on the tablet on each of 3 research days, which occurred at time points ranging from 4 months to 9 months to 2.75 years after the electrode arrays were implanted.

According to the researchers, the study marks the first time a person has used a brain-computer interface to control an unmodified, commercially available, general-purpose computing device.

"The performance of this system demonstrates that iBCIs have the potential to restore meaningful communication and interaction for people with paralysis," lead author Paul Nuyujukian, MD, PhD, of Stanford, told *JAMA*.

New Deep Brain Stimulation Target for Mood Disorders

Deep brain stimulation of the lateral orbitofrontal cortex (OFC) improved depression symptoms in a study involving 25 patients with epilepsy at the University of California, San Francisco. The discovery adds a new electrical stimulation target to the handful of brain regions currently under investigation for treatment-resistant depression.

The study, published in *Current Biology*, involved epilepsy surgical patients who had electrodes temporarily implanted for seizure monitoring. "Many of the patients in the epilepsy monitoring unit suffer from anxiety and depression, so we saw a chance to work with them to gain insights into how neural activity relates to mood and could be therapeutically changed with brain stimulation," said researcher Kristin K. Sellers, PhD.

The researchers looked to see how brief periods of electrical stimulation to different brain regions affected self-reported mood. They also tracked changes in brain activity during the delivery of stimulation to the regions compared with baseline. Stimulation of the lateral OFC produced acute, dose-dependent improvements in mood among patients with moderate to severe baseline depression, with no other regions showing the same effect.

The stimulation shifted the patients' brain activity toward patterns seen during a naturally occurring positive mood. According to Sellers, this indicates that the therapy may facilitate the natural brain activity that underlies positive mood, rather than inducing an unnatural pattern of activity.

Further study is needed to determine if the improvements are long-lasting and occur in patients without epilepsy. **–Jennifer Abbasi**

Note: Source references are available online through embedded hyperlinks in the article text.