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Cheap Magnetic Helmet Detects Some Kinds of Brain Damage

Prototype spots swelling and bleeding in a pilot study—but the novel technique employed is relatively unproven.

By Lucas Laursen on May 16, 2013

A helmet that sends a magnetic field through the wearer's head might someday offer a quick way to reveal whether the brain is swelling or bleeding as the result of an injury.

In a prototype of the helmet, a small halo-like coil generates a magnetic field above a person's head; another coil, just above the ears, detects the magnetic field induced in the volunteer's brain. Because liquid such as blood affects the magnetic field's phase, the team behind the device was able to distinguish eight brain-injured patients from 46 healthy volunteers in a pilot study, they report in the journal *PLOS One*.

The device does not allow researchers to create an image of the brain damage as is possible with computerized tomography (CT) scans or magnetic resonance imaging (MRI), state-of-the-art techniques used in major hospitals. But it might one day offer those in more remote settings a simple, cheap method of deciding whether a patient needs to travel for advanced medical care (see "Imaging Method Reveals Hidden Brain Injuries"). It might also point to a way of using a helmet to detect brain injury in professional sports, although the technique has yet to win over all experts on neurological injury detection.

"We thought there was room for an intermediary technology," says bioengineer Boris Rubinsky of the University of California, Berkeley, one of the leaders of the study, who also holds patents related to the technology.

Medical researchers have known for decades that each body tissue has its own electrical impedance, which can be changed by the presence of fluids. An emerging technology called electrical impedance tomography (EIT) detects those impedances by means of electrodes attached to a person's head. But electrodes are fiddly, and getting an accurate signal requires some training. The magnetic coils developed by Rubinsky and his colleagues at the National Polytechnic Institute in Mexico City do not require electrodes.

Others have tried to detect fluid buildup in the brain by measuring changes in the strength of a magnetic field, says bioengineer Antoni Ivorra of the Pompeu Fabra University in Barcelona. But swelling and bleeding may account for only a tiny fraction of the brain's volume, making that a difficult signal to extract. Rubinsky's system, called volumetric electromagnetic phase shift spectroscopy, or VEPS, relies instead on the magnetic field's phase shift, which Ivorra says is more reliable.

The pilot study does not have the statistical power to permit generalizations about the technology's promise, says neurologist David Brody of Washington University in St. Louis. Rubinsky acknowledges that he and his colleagues need more samples: they are now collecting more VEPS measurement data from

brain injury patients at the University of California, San Francisco, to build up a much larger database. Another goal is to distinguish not only between damaged and healthy volunteers but between patients with swelling and those with bleeding, since each condition requires a different treatment.

Biomedical engineer Javier Rosell of the Polytechnic University of Catalonia in Barcelona learned about the VEPS technique at a meeting last month. He is also skeptical, saying that the magnetic phase shifts seen in some of the healthy patients in this study were so close to those seen in the injured patients that it would be hard to make reliable diagnoses. “There could be other explanations,” he says. “It’s a very new topic, and we don’t have models which explain all the results we’re getting.”

Critics may want to see the team replicate its results across larger numbers of volunteers, but Rubinsky is forging ahead. His company, Cerebrotech, won a $250,000 grant from the National Space Biomedicine Research Institute earlier this year to develop a related device to monitor buildup of brain fluid in astronauts.

Tagged: Biomedicine, electrodes