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Brain scan hints at first simple test for concussion

Small study suggests long-sought biological marker for brain injuries.

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A biological marker for concussion could make it easier to diagnose the problem on the sports field, and track recovery.

A test that records the way the brain processes sound might provide a simple and reliable measure of concussion, a small study suggests. If the method works, it could help scientists work out how best to treat the poorly understood brain injury.

In a paper published on 22 December in *Scientific Reports*[1], neuroscientist Nina Kraus of Northwestern University in Evanston, Illinois, and other researchers say that they have found that a particular signal in neural activity, recorded with electrodes placed on the head as children listen to 'da' sounds from a speech synthesizer, can objectively demarcate concussed children from a healthy control group. The research was done on just 40 people — a tiny group — and will have to be repeated in larger samples. But other researchers are still excited by the report, because concussion is hard to diagnose, particularly in children.

The study “may for the first time offer a simple and objective biomarker to measure the severity of brain injuries”, says Thomas Wisniewski, a neurologist at New York University’s Langone Medical Center. There is intense interest in finding a clear-cut biological signature for concussion, he says. “We have been crying out for a reliable method."

Millions of people enter hospitals every year with blows to the head, and some of have concussion, a minor brain injury that can betoken more serious damage. To diagnose it, physicians rely on subjective complaints of dizziness, coordination tests and sometimes more involved procedures, such as magnetic resonance imaging (MRI) or computed tomography (CT) scans. But there’s no single objective way to detect concussion and measure its severity — and no simple test that can be administered regularly to determine when someone has recovered, a particularly important issue for athletes keen to be allowed back on the field.

Child-friendly tests

Besides brain scans, some companies have tried searching for particular proteins in the blood released after brain injuries — but haven’t yet shown unambiguous proof that these are a consistent measure of concussion, Wisniewski says. And even if blood tests do

work, they are hard to justify for young children who have hit their heads, notes trauma surgeon Christian Kammerlander of the university hospital at the Ludwig Maximilian University of Munich in Germany. “We always try to avoid the drama of taking blood from young children after a traumatic accident.”

Researchers are particularly interested in finding a way to track concussion in children, to measure its long-term effects on brain health. But children are difficult to diagnose with concussion, because they often report their symptoms less clearly than adults.

Kraus thought that measuring brain activity in response to sound might provide an objective measure of the problem, because concussed people can find it hard to process sounds in noisy environments. She worked with Cynthia LaBella, a sports doctor at the Ann & Robert H. Lurie Children’s Hospital of Chicago in Illinois, to study the brain activity of 20 children aged between 11 and 15, four weeks after clinicians had pronounced them to be concussed following sports accidents. The team compared the results with the brain activity of healthy children.

Signal from noise

Kraus says that her team picked out an objective neural signature that correctly identified 90% (18 out of 20) of the concussed children, and ruled out 95% (19 out of 20) of the healthy control group. “The sensitivity is impressive,” says Wisniewski, “even though the number of children in the study is very small.” The impairment seemed to be most pronounced in the children with the most serious symptoms. And when some of the children returned to the clinic and reported improvements — such as fewer episodes of dizziness or less difficulty concentrating — their neural responses to sound likewise improved.

Much more work needs to be done on larger groups of people, says Kraus. Her team is now testing the auditory responses of athletes immediately after head injury and several weeks later. She hopes to commercialize her research, and is working with colleagues to reduce the cost and size of the hardware required, to create a concussion-detection kit for use in labs or at sports grounds.

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References

1. Kraus, N. *et al. Sci. Rep.* **6**, 39009 (2016).