Brain Imaging Tech May Diagnose Football-Induced Brain Disorders

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Neuroscientists are coming to realize that brain injuries are far more complicated than once thought. While severe concussions have long been the metric for trauma, many small hits to the brain can cause disorders, too -- and they are wickedly difficult to diagnose.

Football players at several levels of the game appear to suffer from chronic traumatic encephalopathy, a build-up of abnormal proteins in the brain that choke off normal brain functioning. And, as the Washington Post reported this week in a spectacular series, many war veterans are returning from battle with "mild" traumatic brain injuries that can still have "serious consequences."

But even as we unearth the complex brain disorders caused by football and war, current brain imaging technologies can't evaluate these conditions. With chronic traumatic encephalopathy, the only for-sure diagnosis comes at precisely the wrong time: only autopsies can reveal the telltale protein build up.

One researcher, though, is hopeful that a different MRI technique may be able to help. Dr. Martha Shenton, the director of the psychiatry neuroimaging lab at the Harvard Medical School, has been using diffusion tensor imaging to examine schizophrenic patients. The technique was developed in the '90s and has become an important tool for understanding abnormalities in white matter brain connections in patients with schizophrenia.

Unlike standard imaging techniques, DTI can navigate the white matter's architecture. "You need a different kind of technique that allows you to look at the architecture, regular MRI won't," Shenton said.

DTI images white matter by quantifying and mapping the orientation of water diffusion in brain tissue. Like MRI, DTI employs radio-frequencies in a magnetic field to charge particles whose energy creates images. Unlike MRI,
DTI tracks the movement of water molecules. Since white matter restricts the mobility of water in known directions along the fiber tracts, the water's path allows researchers to create an image of the axons by analyzing the direction of the diffusion.

Since this imaging has proven more sensitive to white matter pathology in schizophrenic patients, it is a promising detection technique for mild traumatic brain injuries -- which show up in the white matter -- and might be useful in discerning subtle brain disorders resulting from mild brain trauma, like chronic traumatic encephalopathy.

Researchers believe CTE develops as a result of repetitive head trauma that causes brain tissue degeneration and large accumulations of abnormal tau proteins, which trigger depression, loss of impulse control, paranoia, and other symptoms of dementia.

Since Dr. Shenton's lab already uses this technology to site brain abnormalities in schizophrenic patients, she's hopeful that it will work for concussed patients too. She's part of a clinical consortium that studies post traumatic stress disorder caused by primary blast injuries and she's already involved in an NFL player study with the Center for the Study of Traumatic Encephalopathy. The NFL study will compare retired football players who experienced many collisions, such as linemen, with those who didn't, such as kickers. The study will employ DTI, along with other measures, to evaluate the likely differing brains.
A way to definitively diagnose mild brain injuries would be welcome news for the families of football players and war veterans, whose problems often seem psychological, not physiological.

Last April, University of Pennsylvania football player, Owen Thomas, committed suicide. Most were shocked that a top athlete at a top university would take his own life. Maybe it was the stresses of the Ivy League academic scene and leading a Division I sports team. Maybe Thomas had slumped into a deep depression. Whatever the reasons, nobody thought it had to do with football. Thomas hadn't even reported a single concussion.

Then, last month, the *New York Times* reported that Thomas's autopsy revealed signs of a head trauma-induced condition.

"[H]is C.T.E. -- whose only known cause is repetitive brain trauma -- must have developed from concussions he dismissed or from the thousands of subconcussive collisions he withstood in his dozen years of football, most of them while his brain was developing," the *Times* wrote.

That's a terrifying prospect for parents and players alike; in some ways, a concussion is a good thing because it lets you know you've been injured. It's terrible to think that you wouldn't even know that you were doing serious damage to your brain.

Dr. Robert Cantu, co-director of the Center for the Study of Traumatic Encephalopathy explained "you can suspect [C.T.E.] clinically, but it is not something that you can diagnose by any imaging study with certainty."

Through her new work, Dr. Shenton hopes DTI will reveal changes in the white matter integrity as a marker for C.T.E's development. That would give doctors a definitive diagnostic tool to aid their clinical evaluations.

Shenton has only seen the pilot data, but even after looking at a small data set, she is hopeful, believing the technology could be used clinically within at least the next five years, "The technology is there, the processing is there, and we've already done this with schizophrenia."
This is a great article that shows that nurture (or lack thereof) can affect our brains just as much as nature does. I've explored the concept--and the repercussions-- further on my own blog, http://thebrodskyblog.com. Thanks for an insightful article!
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