

Second Impact Syndrome

By: Edward W. Pegg, III, M.D.
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September 29, 2003 was a big day for Ryan Jones. He and his football teammates were pumped for the big game against their biggest rivals. At halftime, Ryan was feeling great and was ready to start the second half. However, in the third quarter Ryan suddenly walked over to his friend and said, "I'm going down." He then collapsed to the turf and went into a generalized seizure. There hadn't been any injury during the game, not even a bad hit. Ryan, to this day, has no recollection of "getting dinged" or "seeing stars".

Ryan had suffered a concussion, an alteration to his mental status due to a mechanical trauma to the brain. This produced swelling and bleeding of the brain. How could damage this bad occur in the brain without any obvious head injury? In looking back, there were telltale clues that Ryan was at risk for a condition called Second Impact Syndrome (SIS). Second impact syndrome is a devastating complication of recurrent concussions. It goes mostly unrecognized and it is not known how often this happens each year. There are 9 documented deaths in the past decade. It is more common in younger or maturing brains. Our knowledge of head injury and concussion has come a long way in the last ten years. We are now becoming more aware of second impact syndrome, finding out how to prevent it as well as minimize the risks.

For two weeks before his incident, Ryan had been complaining of "killer headaches". He also had some nausea and vomiting which was initially thought to be the flu. But when it went on for over two weeks they saw a doctor. What is clear now is that the headache, nausea and vomiting, intolerance to bright light and some of the other symptoms that had gone on for the prior two weeks were symptoms of a prior head injury, even though Ryan does not recall any type of prior head trauma. Even minor second injuries on top of an already sick brain can cause catastrophic events. When Ryan returned to play with an incompletely healed brain, he was at high risk for second impact syndrome.

The autonomic nervous system handles regulation of blood flow to the brain. This is a very complex process in which the nerves act like valves on the blood vessels opening and closing, allowing more blood flow to active areas of the brain. As you read this article, there is an increased flow of blood to your visual cortex. It supplies increased nutrients to the nerves while they are at work. In second impact syndrome, the autonomic nervous system loses control and the valves are all wide open. This increased flow leads to leakage in the blood vessels and swelling in the brain, and even possible rupture of an artery and bleeding. The brain cells cannot function in this environment and shut down, leading to coma. If the swelling worsens the brain can then be squeezed, leading to brain damage or herniation, a process in which the injured brain

pushes on the remaining normal brain and forces it down through the only hole in the bottom of the skull, resulting in death if not surgically decompressed.

September 29, 2007 will be four years since Ryan's traumatic brain injury. He has adjusted well and he understands and has accepted that he will have to redirect his career goals. He continues to work in therapy and sets out new goals for his strength and coordination. Although the brain has plasticity and potential for repair, some of the things that Ryan might have obtained with an IQ of 158 are no longer possible.

We now have ways to reduce the risk of this type of injury through computerized neuro-psychological testing. In the next article we will discuss the testing and show an example of how it can help to decide when it is safe to send a player back into the game.

Head Injuries

Second Impact Syndrome Part II

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While playing volleyball, Jamie Garrett went up for a spike and had her legs knocked out from underneath her. Her head bounced off the concrete gym floor. Knocked out for less than a minute, her first recollection was stumbling to the sideline to shake it off. Jamie Garret felt sure she had a concussion.

Jamie's concussion was typical, with headache, nausea, memory problems and dizziness. Most of these symptoms seemed to resolve with time. The problem was that Jamie continued to have difficulty with memory. Plans made with a friend were forgotten. There were also occasional word-finding problems. Her migraine headaches become more frequent. Several months went by and she was still plagued with symptoms. Her symptoms were too subtle to be picked up on neurological exam, MRI or lab testing. In the past, she may have been told that it was all in her head.

Jamie underwent ImPACT™ testing to help determine if she had recovered from her concussion. ImPACT™ was developed in the late 90's to take the guesswork out of concussion treatment. The test measures multiple aspects of neuro-cognitive function such as reaction time, attention span, working memory, visual processing speed and much more. This test showed that she was only performing at the 24th percentile. As a neuro floor nurse, she had done well all through college. These numbers did not reflect the true Jamie. The ImPACT™ test showed without a doubt that Jamie had an ongoing brain injury or neuro-metabolic disorder. She was immediately sidelined to avoid any chance of second impact syndrome, which can produce an extremely serious brain injury if there is a repeat head trauma before the brain has completely healed.

Allowing a month for additional recovery, Jamie repeated the test in May and her performance had moved up to about the 52nd percentile. This was still not thought to be her baseline and the ban on sports continued. By July, Jamie's test score shot up to the 84th percentile. Her symptom score also showed improvement. At that point she was allowed to safely return to sports without any subsequent problem.

Most head injuries improve in 7-10 days. However, there is a variation between athletes depending upon their age and severity of the injury. Athletes with prior concussions or younger brains (up to college age) tend to heal more slowly. Recent studies also show that migraine patients can develop more severe head injury and are also among those who are slow to heal. No good benchmark has

been found to determine with accuracy the amount of brain injury that a concussion has caused. Neuro-psych testing is a very sensitive, but expensive way to look at brain function. It requires highly –trained professionals who work one-on-one with the patient. Prior to ImPACT™ testing, Jamie might have been allowed to return to sports before her brain was fully healed, as it is difficult to know when an athlete is recovered from the first concussion.

ImPACT™ testing was developed by Dr. Mark Lovell and Micki Collins. They used the Pittsburgh Steelers as a test population and realized the great potential of this computerized program. This tool was found to be more sensitive and a better indicator of when an athlete could be safely put back into the game. Anywhere from 4% to as high as 20% of football players may suffer a concussion in any one season. When a player suffers a concussion, appropriate measures are taken including visits to the primary care physician or emergency room. A CT or MRI may be done at that time, depending on the severity of the concussion. Two to five days later the patient is tested on ImPACT™. If the injury is significant, then one can see a drop from baseline performance. Subsequent tests are done every 2-5 days until the patient returns to a baseline. This improvement in score correlates with improvement in brain function.

ImPACT™ testing is especially recommended for sports where concussion is more likely to occur. Athletes take the ImPACT™ test before the season starts in order to have a baseline score. ImPACT™ takes only 25 minutes to complete. Players find it challenging, but enjoyable. The baseline is not rated, but stored to be used if the player has a head injury. If a head injury occurs, the post-injury score is compared to the baseline score. This year, Illinois State University began participation in ImPACT™. All ISU athletes participating in contact sports took preseason baseline tests. ImPACT™ is now used in the NHL and Cart Series Racing, and was made mandatory by the NFL just this season.