Gillette Children's Specialty Healthcare

A PEDIATRIC Perspective

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Managing Traumatic Brain Injuries:

Best Practices Have Changed

by Mark Gormley Jr., M.D., and Leslie Larson, R.N., C.N.P.

Recommendations for managing traumatic brain injuries (TBIs) have changed significantly during recent years. In the past, for example, athletes who hit their heads and appeared briefly woozy, but whose symptoms resolved within 15 minutes, routinely returned to their activities.

Today, neurotrauma specialists and other providers are more sensitive to the possible long-term consequences of TBIs — particularly multiple ones. Primary-care providers are in a strong position to help children and youth avoid TBIs and prevent or minimize consequences of injuries that do occur.

This article reviews the signs and symptoms of TBIs, discusses the possible effects of TBIs, and identifies the most up-to-date guidelines for managing TBIs. Keep in mind that one of the most important tools for assessing head injuries is the Immediate Post-concussion Assessment and Cognitive Testing (ImPACT™) system. (See column at right.) By suggesting that athletes take an ImPACT assessment as part of their presports physicals, you can alert your patients to the dangers of TBIs and encourage patients to seek treatment if they incur head injuries.

Signs and Symptoms of TBIs

TBIs occur when an impact to the head or body causes the brain to move rapidly inside the skull, injuring cells, nerves and blood vessels. When the brain hits the skull, the axons stretch and the neurons fire simultaneously. The injury is not only structural but also metabolic. The cells release potassium and take in calcium. The calcium makes it difficult for cells to produce adenosine triphosphate, and because the neurons consume glucose to absorb the potassium, the injury ultimately depletes the brain's ability to create energy for healing.

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Using ImPACT to Help Assess Head Injuries

Gillette Children's Specialty Healthcare is the only Minnesota children's hospital certified in using Immediate Post-concussion Assessment and Cognitive Testing (ImPACT) to assess youth who experience head injuries. In addition, Gillette's Minor Neurotrauma Clinic provides follow-up care for patients who sustain traumatic brain injuries (TBIs). In 2009, Gillette staff saw more than 500 patients with TBIs and administered 654 ImPACT tests.

ImPACT is a sophisticated, research-based software tool used to assess the effects and severity of TBIs. Developed at the University of Pittsburgh Medical Center, the multipart test measures reaction time, cognitive function, memory and problem-solving skills.

ImPACT consultants compare a patient's test results to the patient's own baseline score (if one is available) or to normative standards based on criteria such as the patient's age and grades in school. The test results help practitioners determine when it is safe for people to return to activity following TBIs. Many colleges, professional sports teams and sports-medicine clinics use the tool.

ImPACT assessments should take place within 24 to 72 hours of an injury, with repeat tests taking place as necessary. Gillette patients average four ImPACT assessments before they are cleared to return to activity.

For more information about ImPACT, visit www.gillettechildrens.org/impact. Or contact:

- Susan Ellerbusch Toavs, program manager, sell@gillettechildrens.com or 651-229-3915
- Leslie Larson, Physical Medicine and Rehabilitation nurse practitioner, llarson@gillettechildrens.com or 651-229-3907
- Amanda Seeley, Neurosurgery nurse practitioner, aseeley@gillettechildrens.com or 651-325-2307

Gillette's Minor Neurotrauma Clinic provides follow-up care for patients with TBIs. For more information, call Telehealth Nursing at 651-229-3890 and ask to speak to one of our neurotrauma nurse practitioners. To refer a patient, call 651-290-8707.

Immediate symptoms of a TBI can include:

- Disorientation, temporary confusion or a "dazed" feeling
- Dizziness
- Headache
- Memory problems, including amnesia around the time of injury
- Uncoordinated hand-eye movements
- Unconsciousness

Blows to the back of the head are more likely to cause nausea and vomiting than other types of impacts are.

Some symptoms might not appear until hours or days after an injury. Warning signs include chronic headaches, fatigue, sleep difficulties, personality or behavioral changes, sensitivity to light or noise, dizziness when standing quickly, a poor attention span, and deficits in short-term memory, problem solving and general academic functioning. Children and teens should see a health-care provider as soon as symptoms appear.

Avoiding Second-Impact Syndrome

Second-impact syndrome refers to a condition that might occur if a second TBI takes place while someone is still experiencing symptoms and recovering from a previous TBI. A second impact can occur days or weeks after the first injury.

The likelihood of athletes experiencing a TBI after an initial injury is three times that of experiencing the initial TBI. Repeated injuries also increase the risk of symptoms, such as headaches, memory loss and difficulty concentrating. Putting someone at risk for a second TBI before the brain has healed from an initial injury increases the chance of the patient experiencing a serious and permanent brain injury.

Allowing enough recovery time before returning to activities is crucial to preventing further damage to the brain. Second impacts are more likely than initial impacts to cause brain swelling and other widespread damage, and second impacts can be fatal.

Long-Term Effects of TBIs

The long-term effects of multiple TBIs can be severe, and the effects of such injuries might not be evident immediately. Often, patients or their parents remark that they did not realize the extent of the injury until after the patient recovered. Keep in mind, too, that athletes, in particular, might downplay their symptoms so they can return to their activities more quickly.

Patients who experience TBIs often are easily frustrated or angered. They might realize that they are overreacting but be unable to control their responses. TBIs can exacerbate existing psychosocial issues, including anger, depression and anxiety. Some evidence suggests that patients who sustain TBIs become more susceptible to subsequent injuries, even from lesser blows. Some researchers speculate that the higher incidence of Alzheimer's disease and other degenerative neurological diseases in former professional football players is related to the numerous head impacts the players sustained during their careers.

Although many children make complete recoveries following TBIs, others experience ongoing academic and neuro-cognitive issues, especially if the brain does not have time to heal before returning to school and sports. People whose TBIs never fully heal often have trouble with time, school and behavioral issues. Healing and recovery time is crucial to preventing further — and possibly permanent — damage.

Managing a TBI

Children and teens who sustain blows to the head should see a health-care provider who has experience in diagnosing and treating TBIs. Computed tomography (CT) scans and MRI exams are usually of little help in diagnosing TBIs, although positron emission tomography and functional MRIs are sometimes useful.

Although the ultimate ramifications of TBIs are heavily debated, we at Gillette Children's Specialty Healthcare have seen the benefits of managing TBIs in a way similar to that of managing musculoskeletal injuries. Our neurotrauma specialists prescribe rest and provide appropriate treatment until all symptoms dissipate and ImPACT results return to preinjury levels. Treatment also can include medications to help manage symptoms.

When two or more of a patient's ImPACT test results fall below the 10th percentile, we recommend pulling the patient from all activities — including school — to give the brain time to rest and energy to heal. Rest means refraining not only from physical exercise, but also from mental strain, including reading, sending text messages, playing video games and using a computer. We tell youth who experience TBIs to plan on a minimum of four weeks without physical activity.

Initial acute management of a TBI should include:

- A CT scan if the patient has a history of losing consciousness
- A CT scan if the patient's cognitive or other symptoms appear to be worsening
- Observation by a competent adult with access to a hospital if the patient experiences nausea or vomiting
- Intravenous fluids if needed to improve symptoms of headache, nausea or vomiting

Do not allow youth to return to school or sports until all symptoms of the TBI have resolved.

Being physically able to do an activity does not mean a patient is fully healed from a TBI. Cognitive deficits might persist after other symptoms resolve. If symptoms recur when patients return to activities, more rest is warranted.

Case Studies: Athletes Who Sustain TBIs

These case studies show how ImPACT scores help us determine when athletes have recovered from TBIs.

High-School Football Player

A 14-year-old left outside linebacker, playing high-school football, was injured in the first half of an October game. He continued to play, but his father noticed he was stumbling frequently. After several weeks of experiencing headaches, dizziness and mental fogginess, he came to Gillette for an evaluation in November.

His initial ImPACT scores put him in the 13th percentile for verbal memory, the second percentile for visual memory, and the first percentile for both visual motor speed and reaction time. We recommended that he immediately stop attending school and refrain from computer use, video games, text messaging, reading and exercise.

After two weeks of rest, his scores improved to the 29th, 35th, 43rd and 41st percentiles. He returned to school but continued to avoid strenuous exercise. By mid-March, his scores had improved to the 75th, 96th, 85th and 71st percentiles, respectively. At that point, we released him from all restrictions. It is significant that rest alone made such an effect on his symptoms several months after his injury. We suspect that this patient had experienced a previous TBI and that his October injury was a second impact.

17-Year-Old Soccer Player

A 17-year-old played goalie for his soccer team and had experienced several mild TBIs the year before we first saw him. He was kicked in the head in early December and his ImPACT scores put him in the first or second percentile for all measurements. By Christmas Eve, his scores had improved to the 56th, 85th, 79th and 93rd percentiles. Because he had improved so quickly, we cleared him to play in a tournament.

On Jan. 2, he experienced another head injury. His verbal memory score dropped to the second percentile; his other scores decreased but remained above the 50th percentile. After the second injury, he experienced headaches and other symptoms that took almost two months (rather than three weeks) to resolve. We recommended that he stop playing so aggressively; he ultimately chose to continue playing soccer.

Summary

Wearing a helmet, of course, is the best way to reduce the frequency and severity of TBIs.

In addition, athletes who take part in contact sports should take a baseline ImPACT as part of the pre-sports physical. When athletes come to you for a pre-sports physical, ask them to take the ImPACT assessment before you sign their physical form.

If patients' schools do not offer the test, direct them to www.gillettechildrens.org/impact. Testing costs only $4 and takes less than half an hour. We will store the results in Gillette's database for future comparisons. (The cost is even less for patients who are part of groups. If you would like group pricing for your patients, please contact Mary Grimm at mgrimm@gillettechildrens.com or 651-578-5002.)

When a child's scores differ — mildly or significantly — from baseline results, consider referring the patient to Gillette's Minor Neurotrauma Clinic. To schedule an appointment at Gillette, call 651-290-8707.

How to Manage Traumatic Brain Injuries in Athletes

In the past, traumatic brain injuries (TBIs) were graded as mild, moderate or severe, depending on a patient's symptoms at the time of injury. Today, we know that it is impossible to ascertain the severity of an injury until it heals. Patients who experience symptoms for six months following their injuries, for example, do not have "mild" TBIs even if they do not lose consciousness at the time of impact.

- If players sustain impacts to the head and experience any symptoms (such as dizziness, headache, nausea, or mental fogginess), they should refrain from athletic activity until a health-care provider evaluates them.

- If players are diagnosed with a TBI, they should be symptom-free for one week before they return to athletic activity.

- If symptoms last for more than one week, players should sit out of athletic activity for one month.

- If symptoms last for more than one month, players should sit out of athletic activity for an entire season.

- If symptoms warrant a stay in a rehabilitation hospital, players should avoid all contact activities for six months.

Authors' PROFILES

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Mark Gormley Jr., M.D., is a pediatric rehabilitation medicine specialist at Gillette Children's Specialty Healthcare in St. Paul, Minn. He also serves as Gillette's section chief for pediatric physical medicine and rehabilitation.

He graduated from the University of Louisville School of Medicine in Louisville, Ky., and completed his residency in physical medicine and rehabilitation at Tufts Affiliated Hospitals in Boston. He completed a fellowship at the Department of Physical Medicine and Rehabilitation at the University of Michigan Medical Center in Ann Arbor.

Gormley joined Gillette in 1993 and served as chief of staff in 2001-02. He is board-certified in physical medicine and rehabilitation.

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Leslie Larson, R.N., C.N.P., is a certified brain-injury specialist and credentialed Immediate Post-concussion Assessment and Cognitive Testing consultant. She specializes in working with children who have developmental delays, cerebral palsy and traumatic brain injuries.

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Gillette accepts referrals from physicians, community professionals and outside agencies. To schedule an outpatient appointment, contact Patient Appointments at 651-290-8707, Monday through Friday between 8 a.m. and 5 p.m. Physicians who are on staff can admit patients by calling 651-229-3890.

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If you have questions related to course content, contact Sue Murr, manager of pediatric neurosciences, at 651-290-8712 or 800-719-4040 (toll-free). For registration information, call Mary Grimm at 651-578-5002 or 800-719-4040 (toll-free). To register online, visit www.gillettechildrens.org.