CASE REPORT

Postconcussive syndrome in a high school athlete

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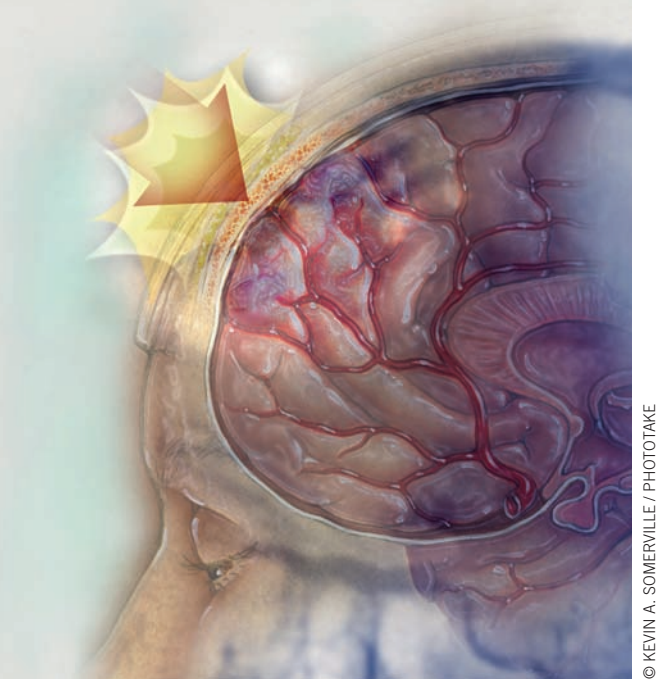
ABSTRACT

This article describes an adolescent female who had postconcussive symptoms for more than 2 years after sustaining two concussive injuries without complete recovery between them. The case illustrates the significant effect of mild traumatic brain injury and the need for appropriate evaluation and management.

Keywords: postconcussion syndrome, mild traumatic brain injury, return to play, vestibular therapy, neurocognitive testing, Sport Concussion Assessment Tool



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CASE

A 15-year-old girl was injured when she sustained a direct blow to the front of the head when colliding with another player during a basketball game. She did not lose consciousness and attempted to continue playing, although she reported initial headache and dizziness. Her coach removed her from the game when she appeared dazed. She was evaluated by the school's athletic trainer and was unable to recall basic information such as her birthdate, address, or phone number. She reported headache, dizziness, confusion, nausea, and sensitivity to light. One hour post injury, an initial sideline assessment was completed using the Sport Concussion Assessment Tool 2 (SCAT 2); the patient scored 38 out of a possible 100, indicating significant injury. She also had difficulty with balance, coordination, and orientation on initial examination. Retrograde and anterograde amnesia were reported, with anterograde amnesia lasting about 3 hours after the injury.

She was evaluated by her primary care provider (PCP) after the injury, diagnosed with a concussion, and advised to take complete cognitive and physical rest from school and activity until a follow-up appointment. Three days after the injury, the patient returned to school at her own request, before release from her PCP. After reevaluation by her athletic trainer, she was encouraged to return home to rest for the remainder of the week. Initial symptoms including headache were somewhat improved over the month following the injury, but remained persistent. One month later, she was unable to perform satisfactorily on her final examinations. Before her injury, she had been a strong student, regularly scoring in the top 10% on standardized examinations.

On her return to school for the spring semester, she continued to have daily headaches and difficulty concentrating and sleeping. In an attempt to return to normal activities in school and basketball, she downplayed these symptoms to her parents and healthcare providers. She was able to memorize the words her physician repeatedly asked her on examination for recall and studied these to ensure she would perform well. Eight weeks following initial injury, she was allowed to begin a 5-day return to play progression and subsequently returned to basketball.

Upon return to competition, while diving for a ball, she sustained a head-to-head collision and another player. This caused a whiplash type injury, and the back of her head hit the floor. She was slow to get up, but after resting on the sidelines, she returned for the final minutes of the game.

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Key points

- Concussion in adolescents is a serious condition with significant possible implications in the short and long terms.
- Careful evaluation should include a variety of testing modes including evaluation of symptoms, neurocognitive performance, balance and proprioception, and other emerging laboratory and imaging options.
- Return to play, school, and activity should follow a stepwise approach.
- Ongoing research is providing greater insight into appropriate evaluation and management of the concussed athlete. As this research continues to develop, a thoughtful and conservative approach should be taken with these patients.

She had no loss of consciousness and no associated amnesia. She did have light and noise sensitivity, dizziness, and a dazed feeling. She rested for 2 days and attempted to return to school, but was unable to complete a full day due to an exacerbation of her symptoms. She was then seen by her PCP, who recommended 2 weeks of complete cognitive and physical rest and referred her for a neuropsychologic evaluation. This testing, completed 2 weeks after the second injury, showed evidence of significant postconcussion syndrome.

Through the rest of the school year, she continued to fail to progress appropriately due to memory and concentration difficulties. Her school schedule was modified to allow part-time attendance while she received treatment for her postconcussive symptoms. Between her initial injury in the late fall and the end of the school year in May, her symptoms caused her to miss about 70 school days.

The next fall, as a junior in high school, she returned to school with a lightened schedule and online course options. Her symptoms slowly improved, although she still had daily headaches, often provoked by noxious stimuli. Because physical activity continued to trigger symptoms, the patient decided not to return to competitive athletics. The injury and its complications affected her psychologically and socially as well (see The Patient's Voice for this issue).

More than a year and a half after her injuries, she continues to be treated with vestibular therapy, which has been beneficial. She still suffers headaches regularly, particularly at the end of the day following significant cognitive efforts. Her prognosis remains uncertain.

When the patient's symptoms did not quickly abate after the first concussion, she underwent initial imaging with a noncontrast head CT, which showed no bleeding or other abnormality. In the initial SCAT 2 evaluation in which she scored 38 out of 100, all but one of 22 concussion symptoms evaluated as part of the examination were present. Serial evaluation with the SCAT 2 was completed at 1 month post injury, with a score of 68 out of 100, showing improvement despite continued significant symptoms.

Neurocognitive testing with the ImPACT program was completed once after the initial concussion (at 2.5 weeks) and twice after the second concussion (at 6 days and at 9 weeks). Over this time, the patient showed a downward trend in her scores, particularly in verbal memory, visual motor speed, and reaction time. ImPACT testing 18 months after the first injury showed continued scores below the first percentile in all areas.

Further testing with a neuropsychologist 2 weeks after the second concussion revealed severe deficits in verbal and visual recall, along with mild deficits in processing speed, learning, executive function, and basic attention. The patient was also seen and evaluated by an optometrist who specialized in visual rehabilitation. A visual processing evaluation was performed that showed a convergence insufficiency.

DISCUSSION

Concussive injury to the brain disrupts the neuronal membranes, causing massive efflux of potassium ions and concurrent influx of calcium ions, along with release of glutamate and nonspecific depolarization. These ion concentration changes lead to an increase in the activity of membrane pumps that require increased glucose metabolism. However, the increased intracellular calcium prevents mitochondria from adequately replenishing adenosine triphosphate. This causes an energy crisis in which the neuron cannot meet energy demands to restore normal function. Compounding this, cerebral blood flow decreases by as much as 50% acutely and the decrease may persist for up to 10 days.[1]

The postconcussion physiologic cascade noted above continues subacutely for up to 10 days.[2] During this critical time, when cellular metabolism is altered, the cell is more vulnerable to further insults.

This vulnerability is of particular concern in the developing adolescent brain, where second-impact syndrome can occur when a second, often relatively mild concussive injury occurs before the patient has completely recovered from the initial concussion. Second-impact syndrome can cause potentially fatal cerebral edema.

Although by 10 days postinjury, 85% to 90% of patients who suffer an initial concussion will be symptom-free, the remaining 10% to 15% will continue to experience postconcussive symptoms, most commonly headache, difficulty concentrating, and problems with learning.[3] These patients need a more conservative management plan and return-to-play progression.

Promptly recognizing and evaluating concussion is crucial. If a head injury is suspected, the athlete should be removed from competition or practice and not allowed to return until a concussion has been ruled out. The immediate sideline evaluation should include assessment of orientation, memory, and mental status. Balance testing is also helpful to evaluate vestibular symptoms. A variety of

quick assessment tools, including the SCAT 2, may be used. The patient should not be left alone and should have serial monitoring for clinical deterioration.

Once the clinical diagnosis of a concussion is made, the athlete should be removed from activity and referred to a provider with experience evaluating and managing concussions. Much of this can be done in a primary care setting for concussions that are not complex. Further evaluation should include neurocognitive testing (such as with ImPACT), balance testing with the Balance Error Scoring System (BESS), and serial symptom scoring. Imaging, specifically noncontrast head CT or MRI of the brain, is generally not indicated, except when additional pathology is suspected or if symptoms are more complex or prolonged. Each of these tools provides information, but should not be used as standalone measures when considering management decisions.[4]

Initial treatment should be directed at both physical and cognitive rest, typically for the first 24 to 48 hours. Young athletes may need to be excused from school and may need accommodations upon return. Pharmacologic treatment has not been shown to be effective in modifying the concussive process, but can be used carefully to treat symptoms including insomnia and headache.[5]

Additional treatment may include vestibular therapy, visual rehabilitation, and learning strategy education. Treatment of associated psychologic aspects of the injury process (including isolation, anxiety, and depression) should also be addressed and treated as appropriate. This is particularly true for athletes with more complex concussions who are likely to miss a significant portion of their competitive season.

The return-to-play decision is complex. Athletes should be symptom-free and have returned to school and social activities without increased symptoms. When this is achieved, generally 5 to 10 days after injury, the athlete should be guided through a stepwise return-to-activity program, progressing as long as symptoms are not exacerbated. Once a complete return-to-play protocol has been completed, generally over 5 days, the athlete should be considered for return to full activity, as is prudent. This process should be guided by a medical provider and is often implemented by a certified athletic trainer.

CONCLUSION

Although most athletes who suffer a concussion recover in a short time period, some patients have a much more protracted course. As seen in this case, the consequences and sequelae of a second concussive injury and postconcussion syndrome are significant in the short and long terms. Providers must be thoughtful and conservative in management of concussions. **JAAPA**

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