CASE PRESENTATION

A 16-year-old male junior varsity football player with no reported previous medical history and no history of concussion presented to the emergency department after sustaining a suspected concussion during a game with a rival high school that evening. He was witnessed to sustain an on-field helmet-to-helmet collision when attempting to dive into the end zone for a touchdown. Witnesses reported a brief loss of consciousness lasting “a few seconds,” after which he was noticeably confused and perseverating, repeatedly asking the score.

The school’s athletic trainer initially assessed the athlete for cervical spine injury and cleared him to participate in a concussion assessment in the locker room. A Sport Concussion Assessment Tool 3 (SCAT 3) and King-Devick (K-D) test were used for evaluation. The athlete reported symptoms of headache, photophobia, and “dizziness” but did not report any cognitive complaints. Deficits were noted on delayed recall, attention, balance, and he was unable to complete the K-D without errors. He was transported by his parents to the emergency department where his exam was described as “non-focal” and non-contrast CT of the head was read as normal. He was discharged home with a diagnosis of concussion after a brief period of observation.

In clinic the following day his parents reported that he seemed to be “more like himself” cognitively; however, he did report numerous cognitive symptoms, including feeling foggy, and difficulty with concentration. He could not recall any details of his injury, could not recall details of the game for about 10 minutes before his injury, and states he “woke up” to find himself in the emergency department. He continued to complain of headache with photophobia and phonophobia, which responded to 400mg ibuprofen. A focused history revealed a prior history of milder headaches starting at age 12 also with associated mild photophobia and phonophobia, occurring roughly twice per year, and also responsive to ibuprofen. A family history of migraine in both his mother and paternal aunt was also identified.

On examination, his vital signs, general, and musculoskeletal exams were normal. On neurological exam, although no gross deficits were noted, his K-D was three seconds delayed (with no errors), and he had maximal errors on Modified Balance Error Scoring System (mBESS) for single-leg stance, and tandem stance.

This article will explore some of the current opinions regarding this athlete’s evaluation, rehabilitation, and treatment, with specific attention to interpretation of his examination findings, the need for cognitive and physical rest, eventual return to learn and return to play, as well as treatment of his headache and prognosis.
Increased public awareness surrounding concussion has led to the inevitable development of a number of tools that claim to accurately identify abnormalities consistent with concussion. Despite the ever-expanding marketplace in concussion, there remains a relative lack of evidence supporting the use of many of these tools (many of which are expensive, time-intensive, or cumbersome) and the gold standard for concussion diagnosis continues to be the clinical exam.

The SCAT 3 is frequently used as a sideline assessment tool and is a gross measure of cognitive and balance function after suspected injury. Frequently, it is also used in the clinic to evaluate and track concussion; however, it is somewhat limited by a high degree of inter-rater variability and modest sensitivity and specificity. The symptom checklist has a sensitivity of 65 to 89 percent and a specificity of 91 to 100 percent for concussion and results may vary widely if the athlete is asked to complete the questionnaire on his or her own versus completing it under the supervision of the provider. Input from parents and other family members may also influence the reliability of this self-reported data.

The Standardized Assessment of Concussion (SAC) portion of the SCAT 3 is a gross estimate of cognitive function including orientation, immediate memory, concentration, and delayed recall. The SAC has a sensitivity of 80 to 94 percent and specificity of 76 to 91 percent, is subject to practice effects and can be difficult to interpret without a baseline or well-established normative data.

The mBESS is the balance portion of the SCAT 3 and also has a high degree of inter-rater variability in that the scoring of errors is highly subjective. The exam includes having the athlete maintain a stable posture with feet together and eyes closed for 20 seconds, then standing on the non-dominant leg for 20 seconds, then with the feet in tandem stance with the dominant foot forward for 20 seconds. It has a sensitivity of 34 to 64 percent and a specificity of 91 percent. Contributing to the overall poor reliability of the mBESS is the fact that the double leg stance is undersensitive as it is frequently normal in concussion and the single leg stance is over-sensitive as it is overly difficult (even for non-concussed individuals) with many elite athletes achieving maximal error scores even on their normal baseline examination.

The K-D test is a timed rapid number naming test that requires the athlete to read a series of numbered cards as fast as possible without making any errors. Cognitive and oculomotor abnormalities that frequently occur in concussion are frequently identified on K-D when compared to a pre-injury baseline. A decrement in performance by five or more seconds is seen in mixed martial arts fighters after sustaining head trauma; however, the manufacturer recommends that any decrement should warrant remove from play and more in-depth evaluation for concussion. The K-D is abnormal in the setting of concussion 79 percent of the time, but one small study determined that any identified abnormality when combining the K-D, SAC and mBESS agrees with the clinical diagnosis of concussion nearly 100 percent of the time.

The Pitfalls of “Strict Rest”

Despite earlier recommendations that cognitive and physical rest were the mainstays of concussion treatment, a number of studies have recently suggested that complete rest may be ineffective and, in some cases, counterproductive. One highly cited study addressed this very question by randomizing 99 concussed youth athletes into either a five-day “strict rest” group or a “usual care” group with one to two days rest followed by a graduated return-to-learn and return-to-play. Key findings in this study were that at three days and 10 days post-injury, no between-group differences were noted in assessments of cognition or balance. Furthermore, the “strict rest” group was noted to display slower symptom resolution and a statistically significant higher symptom severity scores at the 10-day endpoint.

Although this study supports current practice and beliefs that the social isolation and inactivity of “strict rest” likely leads to deconditioning, higher rates of anxiety and depression, and a more protracted recovery, these data should be interpreted with caution as there appear to be a number of flaws with the methodology used to reaching these conclusions.

It is questionable whether there was a significant enough difference between the control and treatment groups as the differences in physical exertion were not much different between groups despite the treatment group being counseled to observe “strict rest” and the strict rest group did not appear to properly observe the protocol as the mean school and after-school attendance on days two to five was 3.8 hours (when it should have been zero if the protocol had been properly observed). Arguably, the relative homogeneity between the groups may have led to an unsurprising finding that balance and neurocognitive performance were not statistically different.

Regarding the differences observed in the symptom severities, there were no baseline severity assessments to adequately gauge true symptom resolution keeping in mind that 68 percent of male and 76 percent of female athletes will have one or more symptoms at baseline—even in the absence of concussion. Furthermore, at the time of initial assessment in the ED, the mean scores of the two groups differed by two points and, at the end of 10 days, the mean scores of the two groups only differed by a total of five—for a total difference of only three points over 10 days in the control group. It is unclear how statistically significant this
difference is (as it is not reported), but the clinical significance is questionable in the context of a scale with scores that can range between zero to 132.

The “sweet spot” for the frequency and intensity of cognitive and physical activity appears to exist; however, there have been no studies to adequately quantify how much is too much and how much is too little. Although most experts would agree that the extremes of “strict rest” and “full activity” are both counterproductive to the recovery process, there is also wide agreement that supportive evidence is lacking and the degree to which a concussed athlete should rest is need of further research.9

Current Concepts Regarding Rest and Reintegration of Cognitive and Physical Activity

Overall, prognosis after concussion is very good with most athletes recovering to their pre-injury baseline within days to weeks. Although 90 percent college football players return to their baseline symptom severities, and performance on cognitive and balance testing within seven days10 caution should be exercised in applying this timeline to youth athletes in whom cognitive, somatic, and emotional symptoms can persist for up to five weeks.11,12 Consensus opinion is that a step-wise, graduated return to learn and return to play should be implemented with gradual increases to the athlete’s physical and cognitive load as long as they remain asymptomatic at each interval.4

Coordinating return to learn protocols can be more difficult than return to play protocols since “cognitive rest” and recovery are difficult to define or quantify the way “physical rest” can. For lack of evidence-based guidance, some consider one to two days of cognitive rest appropriate in the acute phase of injury with return to the classroom (in some capacity) during the sub-acute phase.13 During this time, school accommodations may be necessary including the allowance of extra time to complete assignments and tests.

Although the concept of “physical rest” is also somewhat nebulous, it is arguably easier to define and implement than cognitive rest. Although there is some evidence that forced exercise may be detrimental to recovery in animal models, there is a growing body of evidence supporting early implementation of symptom-limited exercise.14 There is wide agreement that any athlete suspected of having concussion should immediately be removed from competition and should never return on the same day; however, the specific process through which an athlete is reintegrated into physical activity remains unclear.4 Current guidelines recommend a six-step graduated protocol which implements higher levels of physical activity with a progression to the next level if the athlete remains asymptomatic. Unfortunately, the specific goals and levels of exertion at each step are somewhat open to interpretation.

In the setting of acute injury, low-level exercise appears to be safe and potentially assists in recovery.14 For athletes who remain symptomatic at four-to-six week after injury, the Buffalo Concussion Treadmill Test (BCTT) has been studied as a specific exercise protocol that also appears to be safe and effective for symptom recovery. The BCTT establishes the symptom exacerbation threshold after which the athlete is exercised until reaching 80 to 90 percent of the threshold heart rate for 20 minutes or terminated early if symptoms occur. This is repeated for five to six days per week for two weeks at which time a new symptom threshold can be established. Once the athlete is able to exercise at 85 to 90 percent of their age-predicted maximum heart rate over the course of several days, physiologic recovery is felt to have occurred and the remaining steps of the traditional return to play protocol can then be initiated.14 Clearly, the BCTT cannot truly determine if the structural and metabolic derangements associated with concussion are fully resolved and more research is needed to help determine the role of exercise in recovery and rehabilitation.

Managing Headache Post-Concussion

Post-traumatic headache (PTH) is the most common symptom after concussion and has been reported in up to 94 percent of athletes after injury.15 The predominant phenotype of PTH is migraine or probable migraine and comprise greater than 60 percent of all headaches reported.16 Unfortunately, there are no treatment guidelines specific to PTH and the current guidance is to manage according to accepted treatment algorithms based on the phenotype they most represent.17

PTH is frequently multifactorial, and it is important to consider cervicogenic contributors (suggesting a role for trigger point injections or regional nerve blockade) as well as other issues including dehydration, and side-effects to medications which may have been prescribed to treat post-concussion symptoms.18 In the absence of any of these contributors, a number of uncontrolled, open-label studies have demonstrated efficacy of a variety of medications commonly used for migraine in the setting of PTH. For abortive treatment, non-steroidal anti-inflammatories and triptans are commonly used and tricyclic antidepressants, beta-blockers, and anticonvulsants such as valproate or topiramate have demonstrated some degree of efficacy for prophylaxis. Caution should be exercised, however, as many of these prophylactic medications can cause sedation or cognitive side effects which may be misinterpreted as residual effects of concussion potentially prolonging treatment and recovery.
Additional factors that may complicate PTH treatment include the presence of pre-existing or pre-disposition to primary headache disorders as identified on a detailed headache history and/or family history. Although it is generally felt that an athlete may only return to play after symptomatic recovery and discontinuation of any medications, which may mask symptoms, identification of untreated and frequently occurring headache may have warranted prophylactic treatment even prior to concussion. These decisions are nuanced and may require the guidance of both a headache and a concussion specialist. The prolonged and frequent use of abortive treatments should be also monitored closely as one recent study identified over 70 percent of children with headache at three months post-concussion as meeting criteria for medication overuse headache the majority of whom improved once the overused medication was discontinued. 19

Although the prognosis of PTH is generally favorable, mostly resolving with other symptoms over a matter of weeks, headache may persist at three months in 47 to 78 percent of individuals. 18 This, coupled with the fact that athletes with PTH tend to have a prolonged recovery course, 20,21 suggests that thoughtful and aggressive treatment of headache should be considered.

Case Conclusion and Outcome

The athlete from the case presentation was able to return to school the following day without a need for accommodations and was prescribed a graduated sub-threshold exercise plan under the guidance of physical therapy. His headaches appeared to be of similar phenotype to his pre-existing headaches, which were determined to meet criteria for migraine. Additional history revealed that ibuprofen only partially resolved his headaches and he was therefore prescribed rizatriptan, which he reported as more effective at partially resolving his headaches and he was therefore prescribed rizatriptan, which he reported as more effective at mostly resolving with other symptoms over a matter of

number of issues that the clinician frequently must address when evaluating concussed athletes. Current recommendations are mostly based on expert opinion and more well-controlled studies are clearly warranted. At this time, a more conservative approach is warranted—especially with youth athletes and any new or unusual symptom occurring in the context of suspected concussion should warrant immediate removal from play and thorough evaluation by an expert. Although a common mantra regarding suspected concussion is “when in doubt, sit them out,” many believe that “when in doubt, sit them out, and check them out” 22 may represent a better and more sensible approach.

Bert B. Vargas, MD, FAAN is an Associate Professor of Neurology and Neurotherapeutics Director, Sports Neurology and Concussion Program, University of Texas Southwestern Medical Center Dallas, Texas.

Article adapted with permission from the Texas Neurological Society’s (www.texanurologist.org) Broca’s Area Summer 2016 Newsletter.
