ACUTE CONCUSSION MANAGEMENT WITH REMOVE-REDUCE/EDUCATE/ADJUST-ACCOMMODATE/PACE (REAP)

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Abstract—Background: With increased concussion awareness and significantly increased numbers of emergency department (ED) visits for pediatric concussion, a seamless process of managing a patient with a concussion can begin in the ED. Case Report: This article demonstrates the effectiveness of the Remove-Reduce/Educate/Adjust-Accommodate/Pace (REAP) concussion management program in the evaluation, management, and return to play of an acutely concussed pediatric patient. The REAP program was developed in Colorado and promotes a multidisciplinary team approach to concussion management. The team consists of parents, teachers, athletic personnel, and clinicians. The patient described in this case report had concussion management initiated in the ED. He was able to successfully return to sports, having recovered from his concussion with the guidance of the Center for Concussion (Centennial, Colorado) staff utilizing the REAP model of care and the currently recommended graduated return-to-play process. Why Should an Emergency Physician Be Aware of This?: Busy EDs are often the initial point of contact for school-aged patients with concussion. We present a program that we believe represents a good model of patient care with concussion management implemented in the ED and carried through to clearance of the patient. © 2016 Elsevier Inc.

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INTRODUCTION

Per the Fourth International Concussion in Sport consensus statement, “Concussion is a brain injury and is defined as a complex pathophysiological process affecting the brain, induced by biomechanical forces” (1). With the Center for Disease Control and Prevention (CDC) estimating as many as 1.6 to 3.8 million sports- and recreation-related concussions per year and increased concussion awareness, the emergency department (ED) is often the first point of patient contact and offers an excellent opportunity to initiate good concussion management. The primary care provider (PCP) is frequently required to evaluate and manage the acutely concussed child and provide follow-up care after an ED visit. Understanding the perspective of the PCP can be beneficial to the emergency physician and help to provide a seamless transition from ED to recovery.

From 1997 to 2007, ED visits for sports-related concussions increased by >200% in 14- to 19-year-olds, and doubled in 8- to 13-year-olds (2). All 50 states plus the District of Columbia now have legislation regarding concussions in youth sports. While state laws are intended to protect our youth athletes, they provide no guidance on how to manage the patient or how to determine if a player is safe to return to sport. The majority of state laws require annual concussion education for youth coaches, removal of the athlete from play if a concussion is suspected, and medical clearance for return-to-play (RTP). Most states
require the athlete to receive clearance from a medical provider before return to sport. The currently published consensus statements and guidelines have focused on the adult professional athlete and offer only limited commentary on the management of pediatric patients (3).

Although little is known about the long-term risks of concussion in children and young adults, early evidence suggests that most youths with concussion will recover fully (4–6). It is thought that some patients may be at risk for long-term complications, although there are few studies looking at the course of recovery in pediatric patients. One study suggested that as many as 13.7% of pediatric patients were still symptomatic from their concussion 3 months after injury (5). Even for those who recover quickly, the course of recovery can be frightening and challenging for both parents and patients. A recent Institute of Medicine report stated, “The expert consensus opinion is that an individualized treatment plan including physical and cognitive rest is beneficial for recovery from concussion” (6). We present a program developed in Colorado called REAP (Remove-Reduce/ Educate/Adjust-Accommodate/Pace), which supports this recommendation and provides a template for the individualized care of the concussed pediatric patient. Although we do not have evidence that REAP changes outcomes in a patient with concussion, REAP does support the premise that educating a patient about the expected course of recovery with concussion results in fewer symptoms at 3 months (7).

REAP was recently referenced by the American Academy of Pediatrics as a model of care for the acutely concussed student athlete (8). REAP was written to fill the gap that is left by legislation, providing guidance for both medical practitioners and families to support concussion recovery. REAP utilizes the community-based, multidisciplinary approach with the following teams: family team (parent and student/athlete), medical team (PCP and other providers), school team–academic (teacher, counselor, school mental health provider), and school team–physical (coach, athletic trainer, school nurse). REAP clearly outlines the role of each team and can be found at www.Center4Concussion.com/. REAP education includes guidelines to:

- Educate parents, the student, and educators that symptoms reflect underlying cellular recovery, and their presence or absence with various levels of home and school exertion provides information on recovery and should guide intervention;
- Adjust-Accommodate home and school activities depending on the presence or absence of symptoms during home and school exertion; and
- Pace the student/athlete back into physical exertion, following the Fourth International Consensus Statement RTP steps, when they are at 100% preconussion levels during activities at home and at school.

In our community, REAP is facilitated by a process of communication and school notification (ED-REAP) that begins when a patient is seen in any one of the 11 EDs in our hospital system. Patients who are eligible for the ED-REAP program include those of school age (kindergarten through 12th grade) with an ED diagnosis of concussion. At this time, the ED-REAP program is only in place in our hospital system, but numerous EDs outside of our system utilize the REAP manual to facilitate school and patient education and aftercare. ED-REAP begins when the ED staff obtain a release of information when seeing a patient with a concussion and the Center for Concussion is notified of the diagnosis. The Center for Concussion in turn notifies the patient’s school so that the school’s concussion management protocol is put into place. The school is not required to participate in the ED-REAP program, but we have found that almost all schools gratefully receive the communicated information and are open to recommendations on developing a concussion protocol if they do not already have one in place. In fact, at this point, numerous school districts have fully adopted the REAP guidelines as their concussion management protocol in schools. This service is provided at no cost to the patient and does not require that the patient be seen in our clinic.

When ED-REAP was implemented, emergency physicians were in-serviced on concussion management, the REAP manual, and the ED-REAP program either through presentations by the clinic staff at departmental meetings or through an online education module. We have received positive feedback from ED patients about the program and other centers may wish to implement a similar program. ED-REAP has allowed our hospital system to provide concussion education and build relationships with numerous schools, school districts, and PCPs, and has resulted in significant positive feedback from many ED families.

**CASE REPORT**

The local Institutional Review Board provided a statement of exemption from approval for retrospective
medical data review and reporting. The patient is an 11-year-old boy who sustained a head injury during a football game when tackled by a much larger player. The coach immediately assessed the child for signs of a concussion and informed the patient’s mother that his “eyes rolled up in his head.” It was unclear whether or not there was a brief loss of consciousness. The patient was taken by private vehicle to the ED of a local community hospital. There he reported dizziness and headache. He was amnestic to the events of the injury, dazed, confused, and perseverating upon evaluation by the attending physician. On examination, he was anxious, crying, and hyperventilating. Vital signs were blood pressure 133/88 mm Hg, heart rate 88 beats/min, respiratory rate 60 breaths/min and regular, temperature was 38°C, and oxygen saturation was 100% on room air. The remainder of the examination was normal and the child had normal extraocular movements, normal gait, and an otherwise nonfocal neurologic examination. A non-contrast head computed tomography (CT) scan was ordered and was negative for intracranial trauma. It appears the CT scan was ordered due to altered mental status and amnesia. We generally strive to limit CT scanning in pediatric patients, therefore, patients with concussion typically do not undergo CT scanning. In the time since this patient was seen in the ED, we have provided additional education to our ED providers with respect to alternate strategies in head injury (observation) in order to curtail the use of CT scanning.

Vital signs normalized after the patient was reassured and coached on his breathing. The patient was allowed to rest and reported feeling better but was still dizzy and tired at the time of discharge from the ED. Mental status had improved by the time of discharge but the patient remained amnestic to the events of the acute injury. An ED-to-School Notification form was signed by his parents and faxed to the Center for Concussion. The family was given the REAP manual and educated on its use by the ED staff. The patient was instructed to follow-up with his PCP and given the option to follow-up with the Center for Concussion.

The patient’s fax was received at the Center for Concussion the day after the injury. The school’s health assistant was notified of the concussion by phone and therefore was able to initiate the school’s general concussion protocol. Not all school districts have a concussion management protocol, so this initial phone call serves to provide schools and districts with resources, including REAP and the CDC materials, to support all of their students with concussion. The patient was seen at the Center for Concussion 2 days after the injury. Initial intake included evaluation by the clinic physician, followed by an evaluation by the clinical psychologist. The patient reported significant improvement in his symptoms since discharge from the ED. On a formal concussion symptom review, he reported a symptom score of 8 out of a possible 192, reporting 3 out of 6 for “light sensitivity,” 3 out of 6 for “increased sleep,” 1 out of 6 for “feeling tired,” and 1 out of 6 for being “easily distracted.” For concussion symptom review, we utilized the Symptom Checklist available on the appendix page of the REAP manual, which provides a 0 to 6 rating scale for 32 symptoms that are often reported in patients with concussion. Medical history revealed no concussion risk factors with no prior concussions, no history of attention deficit disorder or attention deficit hyperactivity disorder, mental health concerns, learning disabilities, medical problems, allergies, or medications. Complete physical examination including orthostatic vital signs, fundoscopic examination, oculomotor examination, vestibular and balance assessments, and detailed neurologic examination were normal. Neurocognitive testing was done with the ImPACT test (Immediate Post-Concussion Assessment and Cognitive Testing; ImPACT Applications, Inc., Pittsburgh, PA), online version (9). ImPACT tests visual memory, verbal memory, visual-motor speed, and reaction time, which are neuropsychological parameters often altered in concussion. This testing is sometimes helpful in advising the school on academic adjustments and may be helpful in assessing neurocognitive recovery, which can lag behind symptom resolution. This could potentially indicate the patient is still suffering active concussion and would be at risk if the patient were to return to sport. Post-concussion ImPACT scores on day 2 were below the aged normal average and were felt to be consistent with acute concussion. ImPACT post-concussion scores on day 2 were as follows: verbal memory 23%; visual memory 43%; visual-motor speed 15%, and reaction time 22%. This patient did not have baseline ImPACT scores, therefore, percentile scores were utilized, with 50% considered to be average and acceptable for this typically average student. The patient and his mother were educated about concussion and the REAP program and were discharged from the clinic with a personalized concussion management plan. In our clinic, the physician prescribes a concussion management plan in consultation with the psychologist that is specific to the patient’s constellation of symptoms. The plan includes medical, home, and school recommendations including home (electronic) restrictions, how to return to school, expected academic adjustments, and how to slowly ease back to home stimulation, electronics, and increase cognitive load at school.

After obtaining a release of medical information from the patient’s mother, the Center for Concussion’s psychologist communicated directly with the patient’s school health assistant by phone and e-mail. She provided a report on the concussion and the patient’s specific symptoms. Specific return-to-school adjustments based
on the patient’s symptoms were recommended, including removal from physical education class and recess, alternating mental work with mental rest, removal of all nonessential work, and allowing 15- to 20-min “strategic rest breaks” during the day. The REAP manual also includes a Teacher Feedback form for the family to obtain the teacher’s assessment of the patient’s neurocognitive recovery upon return to the Center for Concussion.

The patient returned to the Center for Concussion 9 days after the initial visit, 11 days after the injury, for follow-up. His mother reported that the patient missed 2 days of school after the initial clinic visit due to an incidental upper respiratory infection. Upon return to school, adjustments were provided but then removed within a few days when his symptoms resolved and he could return to his preconcussion school workload. The patient’s mother reported satisfaction with the return-to-school process, as well as good cooperation from the school with the recommended academic adjustments. The Symptom Checklist was negative, with a symptom score of 0 and the physical examination was normal. Repeat neurocognitive testing with ImPACT showed improvement, with three out of four domains above normal national averages. Post-concussion ImPACT scores at day 11 were as follows: verbal memory 78%; visual memory 35%; visual-motor speed 69%; and reaction time 56%. Visual memory was found to be below average, warranting the psychologist to administer portions of the Wide Range Assessment of Memory and Learning (WRAML-2) test to further assess neurocognitive recovery (9). The clinical psychologist at the Center for Concussion has identified a 5- to 10-min paper or pencil assessment to complement or supplement each one of the four ImPACT domains. In this case, visual memory was below average and needed further investigation using the WRAML-2. The WRAML2 Design Memory score of 84% reflected an above-average visual memory ability. To confirm cognitive recovery, the Center for Concussion also requires students to gather observable and functional proof of cognitive recovery from teachers (Teacher Feedback Form is available in the appendix of the REAP book). The patient’s Teacher Feedback form reflected that no signs or symptoms of concussion were evident at school and scholastic performance was considered to be at pre-concussion level, from the teacher’s perspective. After reviewing all neurocognitive testing and teacher feedback, the concussion team determined that this patient had demonstrated neurocognitive recovery.

With the patient demonstrating neurocognitive recovery, symptom resolution, and normal physical examination, the Center for Concussion staff determined per current consensus-recommended guidelines, it would be appropriate to allow him to begin the graduated RTP protocol. The patient and his mother met with the clinic’s occupational therapist/certified athletic trainer who reviewed the specific steps of the graduated RTP protocol (2). Monitoring of the RTP physical steps was turned over to the mother, in this case, of an elementary-aged student, but it is often the responsibility of the school (certified athletic trainer) for high school–aged students. Once these activities were completed, the mother e-mailed the Center for Concussion staff, documenting RTP completion without recurrence of concussive symptoms. At this point, the patient was given final clearance to return to football, but was cautioned about future risks.

DISCUSSION

Busy EDs are often the initial point of contact for school-aged patients with concussion. We present a program that we believe represents a good model of patient care, with concussion management implemented in the ED and carried through to clearance of the patient. While this case utilized infrastructure and resources that might not be readily available at many facilities, there are a number of components that are useful to any ED. It is challenging to provide detailed and extensive patient education and aftercare instructions in a busy ED. The REAP manual can facilitate this process of patient education and can also be utilized as a resource for educating ED providers and staff on concussion management. In our EDs, the printed REAP manual is given to parents and patients early in the course of the visit and parents are encouraged to review the information. Many, if not most, families now carry a smartphone. If printed materials are not available, parents can be referred to the appropriate link so the REAP manual can be viewed electronically. The ED provider or nursing staff can review key portions of the REAP information at the time of discharge so that the patient leaves with a clear understanding of concussion management. The return to learn information may be especially helpful to the emergency physician, who may not be familiar with typical concussion-related school concerns. Discharge information may include a recommendation for a “paced return to school as symptoms improve,” referring the patient to page 8 of the manual for details on how to return to school. It may also be helpful to recommend implementing “academic adjustments” upon return to school, referring the patient to page 10 of the manual for specifics on which adjustments may be helpful based on the patient’s symptoms. There is also a benefit to having educational advice for parents, for schools, and for medical professionals all laid out in one guide. It promotes a feeling of shared responsibility and greater power in knowing what each team is expected to do to maximize recovery.

After discharge from the ED, concussion management generally is the responsibility of the PCP. Although this
patient was managed entirely at the Center for Concussion, most patients in our system are managed by their PCP after ED discharge. An understanding of how the PCP might care for the patient and the anticipated course of recovery may be helpful to emergency physicians so they can confidently provide information to their patients and facilitate seamless transition to the PCP. Concussion management may be a daunting process for a busy PCP who does not have all of the resources described in this case report. While we present an option for concussion management in the context of a more comprehensive setting, excellent care also can be provided without these resources by utilizing REAP.

Clearance requires complete documentation of recovery from the concussion with a comprehensive evaluation. REAP provides a framework for concussion management and has the tremendous advantage of providing the PCP with multiple perspectives of the patient’s recovery. Because of the potential significant risks of returning an athlete to play who has not yet recovered from concussion, medicolegally, it behooves the practitioner to document recovery from as many perspectives as possible. It is impossible to make a complete assessment of recovery in a brief office visit without such a multidisciplinary framework. Enlisting neurocognitive testing may be helpful, but is not always feasible, nor is it an option in those too young for the formal computerized neurocognitive assessments developed for concussion. We believe that a teacher’s perspective on a student’s cognitive demands and school performance is very important. Requesting written feedback from the student’s teacher utilizing the form in the appendix of REAP can provide an excellent assessment of neurocognitive recovery.

This case illustrates a straightforward scenario in which the patient had a prompt and complete recovery. While the majority of pediatric concussion patients experience a similar recovery, we often encounter patients in our practice who do not present or resolve in such a manner. These patients often require specialty support and are beyond the scope of initial REAP management.

WHY SHOULD AN EMERGENCY PHYSICIAN BE AWARE OF THIS?

Emergency physicians frequently evaluate patients for concussion. In order to function efficiently in a busy ED, it is very helpful to have well-organized patient education materials that provide a framework for aftercare. ED providers are typically well versed on initial evaluation of pediatric patients with head injury, but may not be as familiar with the treatment of concussion after discharge. This article provides a resource that may be helpful to the ED provider, to both provide an understanding of concussion management and help with prescribing patient management. For those EDs that wish to implement a more comprehensive concussion program, ED-REAP could also be implemented with some additional resources, likely providing an opportunity to further good concussion management by enlisting the school-based providers in the patient’s care. The ED offers a perfect opportunity to educate a patient and begin the process of acute concussion management.

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REFERENCES