Mild Traumatic Brain Injury In Children: Practice Guidelines For Emergency Department and Hospitalized Patients

[Nursing Forum]

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Abstract

Mild traumatic brain injury (MTBI) is a frequent occurrence in children. Current practice in treating such injuries varies in terms of evaluative studies, length of observation, need for inpatient hospitalization, sports restrictions, and follow-up. A multidisciplinary panel of
experts from a level I pediatric trauma center was convened to develop and implement a clinical pathway to improve the quality and consistency of care provided to children after MTBI. The clinical pathway, based on current literature and expert consensus, provides a management guideline for the management of MTBI in the emergency department through discharge. The algorithm provides reasonable management options based on the child’s clinical presentation, history, and age.

Exemplary care of children and their families after MTBI includes appropriate patient/family education. Standardized discharge instructions for MTBI were developed to provide comprehensive information in a succinct and easy-to-read format. The instructions for home management focus on expected symptoms and guidance for when to seek further medical attention. They also incorporate injury prevention, return to sports guidelines, and resources for additional information.

Mild traumatic brain injury (MTBI) in children is common and may leave children with long-term consequences if unrecognized. Variations in diagnosis, treatment, anticipatory guidance, and follow-up are evident in current practice. This potentially puts children at increased risk for delayed or undiagnosed learning and behavioral disabilities, as well as raising the danger and consequences of reinjury.

A multidisciplinary panel of experts from a level I pediatric trauma center was convened to examine current management and to develop a clinical pathway for children with MTBI. The group consisted of health care professionals involved in the clinical management of children with MTBI from the resuscitative through rehabilitative phases of care to represent the full spectrum of patient care issues. The team’s efforts, coordinated by the institution’s trauma clinical nurse specialist, included representation from trauma surgery, emergency medicine, physiatry, critical care medicine, speech language pathology, trauma social work, and emergency, critical care and surgical nursing. In addition, all of the materials were reviewed by the entire emergency medicine staff and the Trauma Committee. Institutional systems guidance and expertise was achieved through Trauma and Rehabilitation management participation.

The group’s objectives included the integration and expansion of currently accepted management guidelines to address children of all ages seen in the emergency department (ED) or requiring hospital admission for MTBI. Given the lack of evidence about the predictive ability of specific symptoms, the group made a deliberate decision to err on the conservative side of evaluation and treatment options. A goal unique from previously published reports was to advance the scope of the practice guideline to incorporate education, injury prevention as well as the role of rehabilitation services in the management of MTBI.

Recommendations were made after a thorough review of the literature and discussion over the course of approximately 1 year. Clinical algorithms and supportive educational materials were developed for the evaluation of patients in the ED as well as for patients admitted to the inpatient units. What follows is a detailed discussion of the group’s findings and recommendations.

BACKGROUND

Annually in the United States, approximately 1.5 million Americans sustain traumatic brain injuries, ranging from mild to severe, and 50,000 of those die. Estimates are that more than 1 million Americans are treated in EDs for TBI with 300,000 requiring hospitalizations.
In 1999, the American Academy of Pediatricians (AAP) and The American Academy of Family Physicians (AAFP) released evidence-based practice guidelines on the management of isolated minor closed head injury in children aged 2 to 20 years. In 2000, the Eastern Association for the Surgery of Trauma subsequently published practice guidelines for the management of MTBI in both pediatric and adult patients. Both of these widely accepted guidelines facilitate a safe, more uniform, and cost-effective approach to the understanding and management of MTBI.

In the AAP and AAFP parameter, a subcommittee of experts strove to find evidence-based support of one or more patient management options and provided a range of currently acceptable practice options in cases where adequate data were not available in the medical literature. The EAST parameter likewise was based on a thorough and comprehensive review of the literature and integrated current research and review literature in both the adult and pediatric populations. Therefore, both of these management guidelines are based on current evidence-based literature combined with consensus recommendations of a subgroup of experts. The guidelines proposed here were designed not to duplicate, but to build upon these established practice guidelines.

CLINICAL PATHWAY FOR MTBI

A clinical pathway for MTBI is not intended to be a replacement for clinical judgment. It is meant to provide clinicians with a theoretical framework on which to base clinical decision-making. The ultimate goal is to provide safe guidelines and management options for the management of children with MTBI that will effectively and cost-efficiently identify children that are at risk for underlying intracranial injury. The pathway furthermore identifies areas for future clinical investigation on which to base modifications.

The guidelines proposed by the AAP and AAFP algorithm were used as the foundation but were modified and expanded to address the management of children 0 to 18 years. An additional goal was to develop improved standardized instructions for patients and families after MTBI.

Working Definition of MTBI

The first objective in the clinical pathway development was to establish a working definition of mild traumatic brain injury. Children with MTBI were defined as those [less than or equal to] 18 years who have a history of impact to the head, have a Glasgow Coma Score of 14 to 15 at the initial examination, and no focal neurologic deficits. Stein recently reported that 33.8% of patients with a GCS of 13 had an intracranial lesion and 10.8% required emergency surgery. A GCS of 14, therefore, was used as the defining point for the pathway to isolate those patients that unquestionably have MTBI.

The children addressed by the pathway may have a history of loss of consciousness, seizure, vomiting, headache, amnesia, lethargy, or confusion following the head trauma. Patients with multiple trauma, known or suspected cervical spine injury, a preexisting neurologic disorder, bleeding diathesis, suspected intentional head trauma, or presence of drugs or alcohol were excluded as these diagnoses all have confounding factors which would prevent adherence to the pathway.

The pathway addresses infants and toddlers as well as children with skull fractures to provide as comprehensive a guideline as possible. Children under the age of 2 years have historically been considered separately due to unique considerations related to development as well as the additional challenge of assessing the neurologic status of a preverbal child. Special considerations for these young children are outlined within the pathway algorithm.
highlighting the need to have a lower threshold for diagnostic evaluation and treatment in this higher risk group. This component is based largely upon the work of Schutzman et al \(^8\) and this group’s proposed guidelines on the evaluation and management of children under 2 years with apparently minor head trauma.

**FIGURE 1.** Emergency department clinical pulmonary algorithm for MTBI in children

The AAFP and AAP exclude children with any physical evidence of skull fracture such as hemotympanum, Battle sign, or palpable bone depression. \(^4\) However, children with clinical evidence of skull fractures, in the absence of additional abnormalities on computed tomography (CT), were included in the proposed practice pathway. The presence of a skull fracture in a child clearly warrants further investigation but does not necessarily change the ultimate management plan.

**Imaging Guidelines**

CT of the head remains the gold standard for evaluating the brain in the early phases of trauma care. \(^9\) The primary goal of the head CT is the early identification of brain injury requiring medical and/or surgical intervention to minimize secondary brain injury. It additionally promotes the provision of appropriate anticipatory guidance and services to patients and families.

Patients with a normal head CT after head injury have a low probability for neurologic deterioration. Head CT recommendations after head injury in the pediatric population vary due to the lack of objective pediatric-specific clinical criteria (e.g. loss of consciousness, amnesia, and vomiting) predictive of intracranial injury. Most children with radiographic evidence of intracranial injury described in the literature have at least some clinical signs of brain injury, although the true incidence of radiographic evidence of intracranial injury in children with asymptomatic head injuries is unknow. \(^10\) Simon et al, \(^11\) however, were unable to identify reliable detectors of pediatric intracranial injury in their analysis of children with MTBI seen at a Level I trauma center over an approximately 8 year period. They, therefore,
advocate liberal CT scanning by injury mechanism criteria to detect the small percentage of children who require intervention or close monitoring.

Until further data on the indications for CT becomes available, there needs to be a relatively low threshold for brain imaging in the pediatric population. However, the decision to image or not image requires understanding of current evidence-based recommendations tempered by clinical judgment. The AAP found no evidence of improved outcomes in asymptomatic and even neurologically normal children with loss of consciousness evaluated with immediate neuroimaging as compared to children managed primarily with examination and observation. 4 Imaging of all children after an injury to the head is unnecessary, costly, inconvenient, and could, in addition, place the child at risk from sedation, which is frequently needed to complete the diagnostic study. A large, prospective multicentered study is needed to ultimately define clear clinical criteria for obtaining head CT in injured children.

Magnetic resonance imaging (MRI) is another imaging modality available in the evaluation of MTBI. Although MRI has been shown to be more sensitive than cranial CT in detecting certain types of intracranial abnormalities, CT is more useful in the resuscitative period to quickly identify acute injury amenable to medical and surgical intervention. Moreover, the logistical complexities inherent in performing MRI on trauma patients have relegated MRI to a secondary role in the management of acute head injury. 12 Therefore, MRI is intentionally omitted from the proposed ED MTBI clinical pathway.

**Children >2 Years Old**

In The Children’s Hospital of Philadelphia ED MTBI pathway (Fig. 1, 6), a head CT is recommended for children over 2 years if the child presents with abnormal mental status, abnormal neurologic examination, or has physical evidence of skull fracture. Furthermore, it is recommended that CT be strongly considered if there is a history of loss of consciousness, amnesia, or previous history of traumatic brain injury (Fig. 1, 7).

**Children <=2 Years Old**

Children with MTBI under the age of 2 can be stratified into groups based on their risk for intracranial injury as initially described by Schutzman et al. 8 Children in the high risk group for intracranial injury include those presenting with depressed mental status; signs or symptoms of a depressed or basilar skull fracture; seizure; irritability; acute skull fracture (<24 hours); bulging fontanel; significant or prolonged vomiting (greater than 5 times or lasting longer than 6 hours); and loss of consciousness longer than 1 minute (Fig. 1, a). Head CT is indicated to expediently identify any intracranial injury.

Children under 2 are defined at intermediate risk if they present with the following history: vomiting 3 to 4 times; loss of consciousness less than 1 minute; history of lethargy or irritability; higher force mechanism; caretaker concern about patient’s behavior; mechanism of a fall onto a hard surface; unwitnessed trauma with possible significant mechanism; vague or no history of trauma but with signs or symptoms of traumatic brain injury; younger than 12 months of age (especially if under 3–6 months old) (Fig. 1, f). In this group, CT should be considered although it is not necessarily indicated unless the child develops further symptoms during a 4 hour to 6 hour period of observation. The use of skull radiographs in the presence of a significant scalp hematoma may be considered to guide the decision regarding the need for head CT (Fig. 1, g).

Children in the low-risk group represent those with low-energy mechanisms; have no signs or symptoms at least 2 hours after the injury; and are at least 12 months of age (Fig. 1, o). These children are highly unlikely to have intracranial pathology and may simply qualify for
ED observation or even observation by a reliable adult at home.

Once the CT findings are determined, the need for further observation in the ED versus inpatient observation can be decided as described in the algorithm (Fig. 1, c). Patients with normal head CT findings and a normal neurologic examination have a negligible risk for subsequent neurologic deterioration and, in most cases, can be safely discharged.

Skull Radiographs

The usefulness of skull films in the evaluation of head injury is controversial. The AAP notes the limitations of skull radiographs in children over 2 years with MTBI since skull fractures may be detected on skull radiographs in the absence of intracranial injury, and intracranial injury may be present when no skull fracture is detected on skull radiographs. If a child in this age group exhibits clinical indications for head CT, skull radiographs are usually not necessary.

The clinical guidelines of Schutzman and Greenes include the optional use of skull radiographs in the presence of a significant scalp hematoma in children under the age of 2. Their investigation of predictors of intracranial injury in infants found that scalp hematoma was a more sensitive predictor of intracranial injury than any of the other clinical signs of brain injury evaluated. Although the use of skull films as a screening tool for skull fractures in intermediate risk patients under 2 years old with a significant scalp hematoma has merit and potentially decreases the number of unnecessary CTs, further study is needed to see if this, in fact, holds true. If head CT is conducted regardless of the skull radiograph results, skull films add little or nothing to the ultimate treatment plan and incur additional costs. Therefore, the decision to obtain skull films in the presence of a scalp hematoma was left with the individual clinician.

Indications for Home Versus Hospital Observation

All children presenting to an emergency department with a potential MTBI require a thorough history as well as a clinically appropriate physical and neurologic examination. Although careful evaluation is warranted, mandatory hospital admission is not. Adams et al, in a large retrospective analysis of National Pediatric Trauma Registry data, reported that routine admission after isolated mild closed head injuries is unnecessary for children who present with a GCS of 15 after a concussion, with or without a history of brief loss of consciousness, if they have a negative CT scan and normal neurologic findings. Discharge is appropriate for children after MTBI as long as they have a normal neurological examination, are free of significant extracranial injury, and are without social or caretaker concerns. If the cranial CT reveals abnormalities, disposition depends on a thorough consideration of these abnormalities with input as indicated from appropriate consulting subspecialists.

An acceptable amount of ED observation is needed based on the team’s assessment of the individual patient. For children younger than 2, this period of observation should be at least 4 to 6 hours postinjury. Discharge instructions for home observation must include specific parental guidelines for what to expect at home, under what circumstances should further medical attention be sought, and how to prevent future injuries.

Admitted Patients

Once the decision is made to admit a child who has sustained a MTBI, specific treatment goals should be achieved prior to discharge. Since these admissions tend to be quite brief, approximately 24 to 48 hours, a clinical pathway assures improved consistency and quality of care achieved on the inpatient units. Along with algorithm development, the group developed
and is in the process of implementing standardized computerized orders. These orders include specifics regarding rehabilitation evaluation and standardized discharge instructions. Expanded and improved standardized directions for home management were implemented with highlights automatically computer-generated on discharge based on the grade concussion selected by the admitting physician. Furthermore, ongoing inservice for nursing staff and rotating surgical residents promotes compliance with the pathway.

Along with the obvious clinical management goals of diet and activity advancement, the clinical pathway includes an evaluation for continued symptoms including subtle cognitive sequelae of MTBI in the absence of anatomic findings. This includes routine consults to speech therapy and physiatry. Speech therapists routinely administer cognitive screenings to identify high-risk patients. Physiatry evaluates the patient, whenever possible, prior to discharge. Further rehabilitation services are consulted as needed based on the patient’s symptoms. All patients are provided with specific discharge instructions to follow up in rehabilitation clinic for an evaluation by a physiatrist at 4 weeks post injury. Patients with continued symptoms at rehabilitation follow-up are referred for formal neuropsychologic testing.

**Patient/Family Education**

It is imperative that patients and families receive appropriate and accurate verbal and written discharge instructions regardless of whether they are being discharged from the ED or from an inpatient unit. Although by definition, children with MTBI have normal findings on head CT, postconcussive sequelae are common and appropriate anticipatory guidance must be provided. Children who sustain MTBI usually do not show visible signs of being incapacitated, resulting in the expectation that they will be able to perform at school as before the injury. Learning difficulties after MTBI may, therefore, be falsely attributed to misbehavior or laziness. This misinterpretation unfortunately leaves the child and family without proper guidance and resources.

Results from a prospective study on the immediate effects of concussion in high school and college athletes demonstrated that significant neurocognitive changes in orientation, concentration, and memory function can be detected after injury without loss of consciousness, posttraumatic amnesia, or physical neurologic abnormalities. MTBI patients performed less well on complicated tasks requiring prolonged attention and rapid response times when compared with controls, and this deficit resolved in most patients by 1 month postinjury. Ponsford et al. identified a subgroup of children at greater risk for significant ongoing problems 3 months after MTBI to include those with a history of previous head injury, learning difficulties, other neurologic or psychiatric disturbance, or family stressors. In cases where difficulties persist, especially in high-risk children, an evaluation by a pediatric physiatrist and possibly neuropsychologic testing is recommended. Neuropsychologic evaluations examine brain-behavior relationships and thereby accurately reflect a child’s learning strengths and needs.

Patient/family education is essential when a child suffers a MTBI to provide appropriate anticipatory guidance, decrease unnecessary stress, and empower families to obtain assistance when needed. It is important that standardized teaching instructions be easy for the general population to understand, evidenced by an evaluation of appropriate readability. In addition, the pathway group believed that optimal home instructions must highlight “need to know information” of what to expect at home and when to seek further medical attention as well as incorporate injury prevention education, guidance regarding return to sports, and direction in cases of continued sequelae after MTBI. The ED discharge instructions developed by the pathway group are provided in Figure 2.
THE CHILDREN'S HOSPITAL OF PHILADELPHIA

CARING FOR YOUR CHILD

HOME MANAGEMENT FOLLOWING CONCUSSION

Your child was seen in the Emergency Department for a head injury. Head injury/head trauma results from a hit to the head. There may be cuts, scrapes, abrasions, broken bones, eye injuries, headache or symptoms of a concussion (knocked out, forgetfulness, confusion, or feeling dazed).

The Doctor who examined your child feels that he/she can safely be watched at home. You will need to watch your child closely for the next several days and return to the Emergency Department or your Doctor if needed. Please talk with the Doctors/Nurses in the Emergency Department before leaving if you feel that you cannot do this.

AFTER A HEAD INJURY YOUR CHILD MAY:

- Be sleepy. It is O.K. to let him/her sleep. You must check on your child every 2-4 hours for the first 12 hours after the injury. Your child should wake easily and act normally. (If your child acts normally when you wake him/her up at night, it is O.K. to let him/her go right back to sleep.)
- Vomit (throw up) the first few hours after the head injury
- Have an upset stomach
- Have mild or moderate headaches - give Tylenol® (acetaminophen). Read the label for the dose to give your child.
- Be more irritable, cranky, or moody
- Have a shorter attention span and poor memory
- Feel dizzy from time to time

RETURN TO THE EMERGENCY DEPARTMENT OR CALL YOUR DOCTOR/PRACTITIONER IF YOUR CHILD HAS ANY OF THESE SYMPTOMS:

- He/she is hard to wake up during the day and tends to fall back to sleep shortly after being awakened.
- You are unable to wake your child at night.
- A very bad headache not helped by Tylenol®
- A major change in behavior (for example: confused, impulsive, reckless, aggressive, or abnormal behavior)
- Begins or continues vomiting 8 hours after the injury
- Bloody or clear fluid from the nose or ears
- He/she is very dizzy.
- He/she is unsteady or sways when walking.
- Weakness in the arms or legs

FIGURE 2. Patient/family emergency department discharge instructions after MTBI.
- Seizures (twitching or jerking movement of part(s) of the body; may look still)
- Changes in vision
  - blurred or double vision
  - appears to have trouble seeing
- Trouble hearing
- Seems to be getting worse instead of better

**AT YOUR FOLLOW UP VISIT AND AFTERWARDS:**

- Let your child’s teacher know he/she had a head injury.
- Let your doctor know if your child has trouble doing things he/she was able to do before the injury (including schoolwork).
- If your child has new problems with attention, memory, behavior, school, etc. that last more than 1 month after the injury, talk to your doctor about seeing a Pediatric Rehabilitation doctor.
  The Pediatric Rehabilitation Department can be reached at (215) 590-1243.

**RETURN TO CONTACT SPORTS/ROUGH PLAY**

How soon your child can return to sports/rough play depends on how bad the head injury was. Do not return to sports/rough play until you see your doctor and talk about it with him/her. These are some general suggestions:

**Grade 1 Concussion:** Your child had confusion less than 15 minutes, no loss of consciousness, and no amnesia.
- 1st concussion: return to sports/rough play when back to normal.
- 2nd concussion of the season: return to sports/rough play when back to normal for 2 weeks.

**Grade 2 Concussion:** Your child had confusion more than 15 minutes, amnesia, and no loss of consciousness.
- 1st concussion: return to sports/rough play when back to normal for 1 week.
- 2nd concussion of the season: return to sports/rough play when back to normal for 4 weeks.

**Grade 3 Concussion:** Your child had confusion with loss of consciousness and amnesia.
- If loss of consciousness was a few seconds: return to sports/rough play when back to normal for 2 weeks.
- If loss of consciousness was more than a few seconds: return to sports/rough play when back to normal for 4 weeks.
- If 2nd Grade 3 concussion of the season, no contact sports for at least 6 months.
- If your child had 3 or more concussions (any grade) within the year: no contact sports for at least 6 months. We recommend that your child get a pediatric rehabilitation evaluation.

FIGURE 2. (Continued).
A challenging issue commonly faced by parents, and therefore, physicians, after a child suffers a MTBI, is when the child can return to sports and/or rough activity. The objective of providing specific guidelines is to avoid the cumulative effects of repetitive MTBI as well as the potentially devastating results of “second impact syndrome.” Second impact syndrome occurs when an athlete experiences a second concussive insult closely following a first. A recent study by Collins et al suggests a cumulative effect of concussion in high school athletes evidenced by more severe, on-field concussion markers in athletes with a history or 3 or more prior concussions.

Current recommendations generally categorize concussion as grade 1 (mild), grade 2 (moderate), or grade 3 (severe). Currently, there are at least 17 disparate concussion scales constructed for the purpose of grading the severity of concussion and ultimately determining return to play; none of which has evolved scientifically to the point that they can be relied upon to make accurate and safe return to play decisions. These parameters differ in terms of their concussion grade definitions and specific recommendations for safe return to play. Common points of current return to play guidelines include the incorporation of prior

For more information:

Brain Injury Association of Pennsylvania
www.biaap.org
Brain Injury Resource Line (toll free) 1-866-635-7097

Brain Injury Association of New Jersey
www.bianj.org
(within New Jersey toll free) 1-800-669-4323

Brain Injury Association of Delaware
www.biausa.org/DelawareDelhi.htm
(Nationwide toll free) 1-800-441-0505

Brain Injury Association of America
www.biausa.org
Family Helpline (toll free) 1-800-444-6443
concussion history as well as emphasis on the importance of being completely asymptomatic prior to return to play. A summary of selected widely used guidelines for return to play after concussion is found in Table 1. 5,20–22

TABLE 1. Summary of Recent Guidelines for Return to Play After Concussion

<table>
<thead>
<tr>
<th>Grade</th>
<th>AAN 199720</th>
<th>EAST 20005</th>
<th>Cantu 200121</th>
<th>Brain Injury Ass 199922</th>
<th>Imaging</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade I</td>
<td>No LOC or amnesia, normal in &lt; 15’</td>
<td>15’</td>
<td>1 week</td>
<td>20’</td>
<td>No</td>
</tr>
<tr>
<td>unique</td>
<td>1 week</td>
<td>1 week</td>
<td>2 weeks</td>
<td>1 day</td>
<td>Yes</td>
</tr>
<tr>
<td>2× &gt;2×</td>
<td>2 weeks</td>
<td>Next season</td>
<td>Next season</td>
<td>Next season</td>
<td>Yes</td>
</tr>
<tr>
<td>Grade II</td>
<td>No LOC but amnesia, normal in &gt; 15’</td>
<td>1 week</td>
<td>1 week</td>
<td>LOC &lt; 5’ or amnesia &gt; 30’ but &lt; 24 hours</td>
<td>Yes</td>
</tr>
<tr>
<td>unique</td>
<td>1 week</td>
<td>1 week</td>
<td>1 month</td>
<td>1 month</td>
<td>Yes</td>
</tr>
<tr>
<td>2× &gt;2×</td>
<td>2 weeks</td>
<td>Next season</td>
<td>Next season</td>
<td>Next season</td>
<td>Yes</td>
</tr>
<tr>
<td>Grade III</td>
<td>LOC &lt; 1 min</td>
<td>1 week</td>
<td>2 weeks</td>
<td>LOC &gt; 24 hours</td>
<td>Yes</td>
</tr>
<tr>
<td>Multiple</td>
<td>1 minute</td>
<td>Next Season</td>
<td>Next Season</td>
<td>Next Season</td>
<td>Yes</td>
</tr>
</tbody>
</table>

*One week asymptomatic at rest and with exertion
†Two grade 1 concussion during same day
‡Seriously consider no further contact sports
§Two weeks asymptomatic at rest and with exertion.

Current guidelines stem from studies on primarily high school and college athletes involved in contact sports, mostly football, and advocate for the routine use of an objective, validated neuropsychologic evaluative tool. For example, the Standardized Assessment of Concussion, designed to easily detect subtle cognitive changes associated with concussion right on the sidelines, incorporates rapid measures of orientation, immediate memory, concentration, and delayed recall. 23 A major recent advancement in evaluating athletes with MTBI has been the use of computerized neuropsychologic testing which allows for cost-efficient evaluation of a large number of athletes. 24 One such test, Immediate Measurement of Performance and Cognitive Testing (ImPACT) evaluates multiple aspects of neuropsychological functioning among athletes, including attention span, sustained and selective attention, reaction time, and several dimensions of memory. 25 Neuropsychologic testing is an indirect measure of brain function and thereby has a beneficial role in the diagnosis and assessment of cognitive dysfunction associated with concussion. It, therefore, is an effective way to obtain valuable data on the short- and long-term effects of MTBI. 25

A major drawback of current concussion guidelines is that they provide identical return-to-play criteria for athletes regardless of age despite data suggesting that high school and younger populations may be a higher risk and may recover more slowly than their collegiate counterparts. 17 Recent findings suggest that return to play criteria for grade 1 concussion in high school athletes may not be conservative enough to maximize protection of younger athletes from premature return to play. 26 In fact, the authors were unable to identify any studies that specifically addressed young children (below high school) involved in competitive or noncompetitive sports leagues or even the active youngster involved in typical childhood activities at home, on the playground, etc. Because of the lack of pediatric specific data regarding return to play after MTBI combined with the increased vulnerability of the child’s brain, the pathway group consciously chose to err on the side of being conservative until further data are available.
MTBI versus Mild Injury to the Head

The emergency physician staff, prior to the completion of the clinical pathway, routinely provided all patients treated and released from the ED with generic head injury instructions to provide anticipatory guidance about post-concussive symptoms along with directions if concerns arise once home. After further discussion, however, it became evident that 2 different categories of discharge instructions were necessary to appropriately meet the educational needs of the families. Many children discharged from the ED truly have MTBI, but many other patients seen in the ED for treatment for head injury have simply soft tissue injury with no reported symptoms of MTBI. Therefore, 1 set of instructions focuses on true MTBI patients and includes the information as listed in Figure 2 along with resources for further information on MTBI. The second set of directions is modified and appropriately streamlined in an effort to avoid unwarranted parental anxiety.

Future Directions

The proposed recommendations are based on “best practice” literature and consensus to date. Although the unique clinical presentation of each child with MTBI must always be considered individually, these guidelines are useful for the management of many children with MTBI. Further research into this all too common occurrence in childhood is certainly warranted, and the hope is for various points of the algorithm to be further studied to provide objective data to support or refute our current recommendations and to further refine the clinical guidelines. Specifically, the clinical significance of individual symptoms of MTBI in the pediatric population needs to be explored further to more precisely define what and when diagnostic testing is indicated as well as an analysis of the potential cognitive, behavioral and motor sequelae. In addition, investigation of prognostic factors and validated guidelines for safe return to play is crucial to address and ultimately minimize any possible cumulative effects of MTBI in children.

The authors thank the members of the multidisciplinary team who contributed their time, expertise, and dedication to develop a clinical pathway for children with mild traumatic brain injury and who continuously provide outstanding care to injured children and their families.

REFERENCES


7. Stein, SC. Minor head injury: 13 is an unlucky number. J Trauma Inj Infect Crit Care 2001; 50:759–760. [Context Link]


17. Savage RC. Children and head injuries. A silent epidemic Recovery 2001;Summer:4–7. [Context Link]


Key Words: mild traumatic brain injury; concussion; clinical pathway; head trauma

Accession Number: 00006565-200312000-00014