



## Heads Up!



Achelle LeBlanc, BSc, Med III, and Katrina Hurley, MD, MHI, FRCPC

### Kamini's Case

Kamini, 8-years-old, presented at the pediatric emergency department with a worsening headache. His mother, who accompanied him, suggested that Kamini was "not at all himself" since being hit in the forehead with a basketball and falling onto the pavement earlier that day. She suggested that his speech and his movements were unusually slow. Kamini does not remember the episode and is unsure whether he lost consciousness. He vomited once and feels quite nauseous. He was found to be afebrile (temp: 36.2°C), with a heart rate of 83 beats per minute, a respiratory rate of 18 breaths per minute, and blood pressure of 112/57 mmHg. His score was 15 on the Glasgow Comma Scale (GCS). Kamini's gait was slow but otherwise normal and steady. His neurological examination was unremarkable. His fundi were normal, and there was no evidence of skull fracture upon inspection or palpation; however, there was swelling on the right occipital region of the scalp. Kamini also had a sore right wrist and a minor abrasion on his forearm.

Read on for more on Kamini.



- Altered mental status, unusual drowsiness, and/or irritability
- More than one episode of vomiting
- Suspicion of skull fracture
- Focal neurologic signs
- Suspicion of abuse/non-accidental injury
- Injury from a projectile object or from a high-speed motor vehicle collision
- Post-traumatic seizures

### Questions and Answers

#### 1. What findings on the history and physical examination suggest a higher risk of brain injury?

Risk factors for brain injury include:<sup>1-5</sup>

- GCS < 15
- Loss of consciousness, especially if prolonged
- Amnesia (usually retrograde), especially if prolonged

#### 2. When does a child have a concussion?

A minor head injury is usually considered a concussion when it results in an altered mental status, whether or not there is loss of consciousness.<sup>5</sup> The mental status changes are caused by stress on the brain and its vasculature that is caused by the forces of acceleration or deceleration in

head injury. Symptoms may be somatic, cognitive, emotional, or behavioural in nature. Mental status changes resolve spontaneously in concussion, and no evidence of structural damage is seen on neuroimaging.<sup>6,7</sup>

### 3. *When is skull radiography indicated?*

Skull radiography is not recommended for routine imaging of minor head trauma. Its sensitivity for predicting intracranial injury is lower than that of clinical examination. CT should be used when imaging is required to detect visible brain injury. Skull radiography may be used to detect or exclude depressed skull fracture or penetrating injury. It may also be indicated in cases of suspected abuse or in children less than two years of age.<sup>8</sup>

### 4. *When to order a CT?*

CT needs to be used judiciously in children presenting with minor head injury. Reducing CT use has the potential for health care savings, both because the imaging procedure is expensive and because the resulting radiation poses an important risk of leukemia and solid tumours to the patient.<sup>9,10</sup> The younger the child, the higher the lifetime attributable risk of cancer associated with ionizing radiation.<sup>9</sup>

The Canadian Assessment of Tomography for Childhood Head Injury (CATCH) study established guidelines for head CT use in pediatric patients with

minor head injuries.<sup>3</sup> In this study, minor head injuries were defined as having a GCS of 13 to 15, with witnessed loss of consciousness or disorientation, definite amnesia, persistent irritability, or more than one episode of vomiting. The presence of any one of the CATCH signs or symptoms after a minor head injury may justify CT use (see Table 1).

Table 1

#### CATCH: Rule for CT Use in Pediatric Minor Head Injury<sup>3</sup>

##### High risk factors (need for neurological intervention):

- GCS below 15, 2 hours after injury
- Suspicion of open or depressed skull fracture
- Worsening headache
- Irritability on examination

##### Medium risk factors (brain injury on CT scan):

- Large, boggy scalp hematoma
- Signs of basal skull fracture
- Dangerous mechanism of injury\*

\* Includes motor vehicle collision, fall from 3 or more feet or 5 stairs, or fall from bicycle without helmet

### 5. *How can radiation from head CT in pediatric patients be reduced?*

There are two ways to avoid unnecessary CT radiation. First, follow a set of guidelines as outlined above, thereby ordering head CT only for higher-risk patients.<sup>3,4</sup> Second, when a head CT must be done, the child's neck should be fully extended to reduce exposure to the cervical spine and thyroid gland (providing there are no concerns about injuries to the spinal column).<sup>10</sup>

### 6. *When to admit the patient?*

The Head Injury Severity Scale suggests indications for admission for patients with head injuries that are similar to the risk factors identified above: GCS less than 15, seizure, under two-years-of-age with severe headache or repeated vomiting, reliable caregiver unavailable, medical condition with increased risk (e.g., hemophilia), palpable depressed skull fracture, or suspicion of abuse or non-accidental injury.<sup>2</sup>

### 7. *What are some potential sequelae of minor head injury?*

Various cognitive, behavioural, emotional, and physical changes may persist for weeks to months after a mild traumatic brain injury, such as concussion. More severe initial symptoms increase the likelihood of postconcussive syndrome. Children older than six-years-of-age are more likely to have postconcussive syndrome than younger children. One month after a mild traumatic brain injury, nearly 60% of children can be expected to have postconcussive symptoms. By twelve months post-injury, only about 2% of children have the syndrome. Symptoms may include fatigue, headache, dizziness, impaired concentration or memory, photophobia, irritability, emotional lability, and phonophobia. Treatment is not usually required, as it is most often self-limiting.<sup>11, 12</sup>


When a patient suffers a second head injury, while still symptomatic from the first, a rare and often fatal complication can result, called second-impact syndrome (SIS). Though the mechanism of SIS is not entirely clear, it is thought to involve cerebrovascular changes that render the brain more vulnerable to subsequent insults. Even a mild second injury during the symptomatic phase of the first can rapidly increase intracranial pressure and cause uncal and cerebellar herniation, resulting in death in about 50% of cases and severe morbidity in others. It is therefore imperative that a patient suffering from symptoms of concussion avoid sports and other high-risk activities.<sup>13</sup>

### 8. *What are some potential sequelae of minor head injury?*

According to the latest guidelines for sport-related concussions, patients should be encouraged to return to playing sports gradually.<sup>7</sup> They should begin with light aerobic activity to increase heart rate (e.g., walking), then attempt sport-specific, non-contact activity (e.g., running or skating), then non-contact training drills (e.g., passing). At this point, medical advice to return to full-contact practice should be sought. Once all of these steps are accomplished symptom-free without medication, the patient may return to game play.<sup>7</sup>

A patient having any intracranial injury confirmed by neuroimaging should not participate in sports or other high-risk

activities for at least the remainder of the season; future participation in contact sports should be discouraged entirely.<sup>12</sup>

Pediatric patients and their caregivers should be carefully instructed on when it is important to return to the ED for re-evaluation. Decreasing consciousness, worsening headache or irritability, focal neurologic signs, persistent vomiting and/or declining mental status indicate that the patient needs to be urgently reassessed. 

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## Back to Kamini

Due to persistent vomiting in the ED and worsening headache, Kamini was sent for a CT scan to rule out traumatic brain injury. The scan was unremarkable. He was sent home after a period of observation in the ED where his symptoms improved. His mother was given instructions to return if his symptoms worsened or persisted. He was given a letter to exempt him from gym class, and he was recommended to gradually return to sports and other activities over the course of the following week.

**Achelle LeBlanc** is a Third Year Medical Student at Dalhousie University, Halifax, Nova Scotia.

**Dr. Katrina Hurley** is an Assistant Professor in the Department of Emergency Medicine and Director of Medical Informatics, Dalhousie University, Halifax, Nova Scotia.

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