Rapid Physical Assessment of the Injured Child

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Abstract

Traumatic injuries that involve the dentition and maxillofacial region may occur as isolated events in pediatric patients but are often associated with multisystem injuries and traumatic brain injuries. The primary trauma survey serves to identify and treat life-threatening injuries. The secondary trauma survey is a complete examination of the patient after the stabilization of physiological parameters. Frequent neurologic and physical assessments of the injured child are crucial to preventing deterioration. The role of the dental professional is to identify and refer for medical evaluation patients who present with concerning neurologic signs and symptoms after traumatic injuries to the maxillofacial region. (J Endod 2013;39:59–S12)

Key Words
Primary survey, secondary survey, trauma, traumatic brain injury

Dental professionals may be the first medical providers to assess children who sustain traumatic injuries to the maxillofacial complex. The timely referral of children who present with concerning neurologic signs and symptoms to a trauma center is crucial to prevent serious sequelae. This case presentation outlines the rapid assessment of the acutely injured child.

Case Scenario

A 4-year-old male was involved in a motor vehicle crash on August 4, 2004. The patient was extricated from the vehicle and found to be unconscious. Examination of the patient showed the following: a 6-cm laceration of the forehead with associated hematomas, abdominal ecchymoses presumably from a seatbelt, and no obvious skeletal injuries. The estimated weight of the patient was 30 lb (15 kg). The patient displayed poor respiratory effort and no purposeful movement. He was intubated in the field using C-spine precautions. Two peripheral intravenous catheters were placed. His vital signs were as follows: heart rate of 160 beats/min, blood pressure of 60 mmHg/palpable, capillary refill of 5 seconds, pulses rapid and thready, cool skin, and oxygen saturation of 100% on an O2 flow of 100%. He was placed in a cervical and on a backboard. Three 20-mL/kg Ringer lactate fluid boluses were administered. The reassessment of vital signs showed a heart rate of 130 beats/min and a blood pressure of 95/50 mm Hg. There was no change in the level of consciousness. The patient was transported to the emergency department.

On arrival to the emergency department, the patient was admitted to trauma bay 4. A rapid primary survey was performed, which involved an assessment of the airway (ie, the endotracheal tube position), the adequacy of ventilation, and hemodynamic status; a neurologic assessment; and a complete rapid examination. The patient (Fig. 1) was completely exposed. Blood was obtained for the following laboratory examinations: a complete blood count, a coagulation panel (ie, international normalized ratio, partial thromboplastin time, and fibrinogen levels), a complete metabolic panel (ie, kidney and liver function), the type and cross for a possible blood transfusion, and venous blood gas. An oral gastric tube and a urinary catheter were placed. Urine was obtained for microscopic examination.

A chest radiograph and head/cervical spine/abdominal/pelvic computed tomography (CT) scans were obtained along with radiographs of all extremities. The head CT scan showed the presence of ventricular and parenchymal blood and a hemorrhage without a midline shift (Fig. 2). The abdominal CT scan showed the presence of a completely transected spleen (Fig. 3). The patient was transferred to the pediatric intensive care unit. Resuscitation continued with packed red cell, fresh frozen plasma, cryoprecipitate, and crystalloid infusions. The patient continued to bleed, so he was taken to the operating room and a splenectomy was performed. The patient ultimately recovered without sequelae.

Trauma is the leading cause of morbidity and mortality in children. It has been estimated that about 1.5 million injuries occur yearly, which account for 500,000 hospitalizations, 20,000 deaths, and greater than 120,000 disabled victims (1, 2). Head injuries account for approximately 80%–90% of all traumatic injuries (2). The maxillofacial area can also be significantly involved with head injuries. Children less than 4 years of age most often sustain injuries from falls (including falls from windows), motor vehicle crashes, and nonaccidental trauma. In school-age children (ie, 5–12 years of age), sports and motor vehicle crashes are the most common mechanism for injury (3). The purpose of this review was to discuss the pediatric assessment of the acutely injured child to prevent morbidity and mortality and the role of the dental
professional in recognizing concerning neurologic signs and symptoms that mandate immediate evaluation.

**Primary Pediatric Survey**

The purpose of the pediatric primary trauma survey is to identify and treat life-threatening conditions. The patient's vital signs are assessed quickly and efficiently. This entire process is the essence of the ABCDE's of trauma care.

**Airway Maintenance and Cervical Spine Protection**

Establishing a patent airway is a primary objective. The inability to establish or maintain an airway and ensure adequate oxygenation and ventilation is a principal cause of pediatric cardiac arrest. The cervical spine should be kept in alignment and stabilized. Patients with a Glasgow Coma Scale (GCS) less than 8 should have the airway secured because of a high probability of not being able to maintain airway patency.

**Breathing and Ventilation**

Hypoxia is poorly tolerated in the pediatric population. Not only can cardiac arrest occur but also patients with severe traumatic brain injury have an increased incidence of mortality if hypoxic and hypotensive. Adequate oxygenation and ventilation are necessary to prevent excessive cerebral blood flow in traumatic brain injuries, which may exacerbate cerebral edema.

**Circulation and Management of Shock**

Injuries in children may result in a significant loss of blood. Children have a remarkable ability to compensate physiologically in shock states. The heart rate increases, the systemic vascular resistance

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**TABLE 1.**

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Score</th>
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<tbody>
<tr>
<td>Eye opening</td>
<td></td>
</tr>
<tr>
<td>Spontaneous</td>
<td>4</td>
</tr>
<tr>
<td>To speech</td>
<td>3</td>
</tr>
<tr>
<td>To pain</td>
<td>2</td>
</tr>
<tr>
<td>None</td>
<td>1</td>
</tr>
<tr>
<td>Best motor response</td>
<td></td>
</tr>
<tr>
<td>Obeys commands</td>
<td>6</td>
</tr>
<tr>
<td>Localizes pain</td>
<td>5</td>
</tr>
<tr>
<td>Withdrawal</td>
<td>4</td>
</tr>
<tr>
<td>Decorticate</td>
<td>3</td>
</tr>
<tr>
<td>Decerebrate</td>
<td>2</td>
</tr>
<tr>
<td>None</td>
<td>1</td>
</tr>
<tr>
<td>Verbal response</td>
<td></td>
</tr>
<tr>
<td>Oriented</td>
<td>5</td>
</tr>
<tr>
<td>Confused</td>
<td>4</td>
</tr>
<tr>
<td>Inappropriate words</td>
<td>3</td>
</tr>
<tr>
<td>Incomprehensible</td>
<td>2</td>
</tr>
<tr>
<td>None</td>
<td>1</td>
</tr>
</tbody>
</table>

GCS Score + (E+M+V): 15 = best score, 3 = worst (4).
Increases, and blood pressure is maintained. The goal of fluid resuscitation is to rapidly replace circulatory volume. When shock is suspected, a fluid bolus of 20 mL/kg isotonic crystalloid solution is needed. A return toward a normal physiological state is indicated when the heart slows, peripheral pulses return, skin color normalizes, blood pressure increases, and urine output increases (4).

Failure to improve hemodynamically after 2 or 3 boluses of 20 mL/kg crystalloid fluid raises the issue of a continuing hemorrhage. The use of type specific or O negative packed red blood cells should be considered. If the child’s condition cannot be normalized hemodynamically, a laparotomy to control the hemorrhage is indicated.

**Disability: Neurologic Examination**

A rapid neurologic evaluation is performed. The examination assesses the patient's level of consciousness, pupil size and reaction, localizing signs, and spinal cord injury level. Generally, the GCS is used (Table 1), and the AVPU scale is used for infants (Table 2). A decrease in the level of consciousness may indicate an impairment of cerebral oxygenation and perfusion secondary to bleeding or cerebral edema. Serial neurologic examinations are extremely important. A decreasing GCS value needs to be taken seriously because a re-evaluation of the patient’s oxygenation ventilation and perfusion status is warranted.

**Exposure**

The patient should be completely undressed to ensure a thorough examination. Hypothermia should be avoided by using warm blankets and warmed intravenous fluids.

**Secondary Trauma Survey**

The secondary survey does not start until the stabilization of physiological functions has been shown. This survey is a complete physical examination. A history often cannot be obtained in trauma patients. The history may need to be obtained from other personnel.

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**TABLE 2. AVPU (Infant) (4)**

<table>
<thead>
<tr>
<th>A</th>
<th>V</th>
<th>P</th>
<th>U</th>
</tr>
</thead>
<tbody>
<tr>
<td>alert</td>
<td>responds to voice</td>
<td>responds to painful stimulus</td>
<td>unresponsive</td>
</tr>
</tbody>
</table>

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**Figure 4.** A skull radiograph of the basilar skull fracture.

**Figure 5.** CT scan showing depressed skull fracture.

**Figure 6.** CT scan showing nondepressed skull fracture.

A useful guide for obtaining a trauma history is the algorithm AMPLE (ie, A, allergies; M, medications used; P, past illnesses; L, last meal; and E, events/environment leading to injury) (4). The mechanism and time of injury are very important because some injuries can be predicted based on the direction and impact of the event. A comprehensive physical examination follows the sequence of head, maxillofacial structures, cervical spine/neck, chest, abdomen, perineum/rectum/vagina, and musculoskeletal and neurologic systems. Tetanus status is assessed, and tetanus immunoglobulin is administered if warranted. Constant re-evaluation of the patient is necessary to ensure that other life-threatening problems are intercepted.

**Maxillofacial and Head Trauma**

Dentoalveolar and maxillofacial trauma may occur as separate entities but are often associated with concomitant head injuries or traumatic brain injuries. Determining what constitutes a clinically significant head injury can be a formidable task. There may be situations in which a dentist may be consulted to evaluate a patient immediately after an injury to the maxillofacial region. A rapid history that includes the mechanism of injury is mandatory. Neurologic symptoms that are clinically important and necessitate an immediate referral to the nearest...
emergency department with imaging capabilities include the following: any loss of consciousness (including very brief episodes), a headache that increases in intensity, nausea/vomiting, ataxia, blurred vision/unequal pupils, confusion, slurred speech, changes in breathing pattern, and fluid leaks from the ears or nose. The presence of any of these neurologic signs may be associated with a traumatic brain injury. Traumatic brain injuries may include skull fractures and intracranial lesions. Basilar skull fractures (Fig. 4) may be suspected by the presence of periorbital ecchymosis, posterior auricular ecchymosis, a cerebrospinal fluid leak from the nose or ear, and seventh and eighth nerve dysfunction (4). Skull fractures that involve the carotid canals may damage the carotid arteries (4).

Depressed fractures (Fig. 5) and nondepressed skull fractures (Fig. 6) may also occur. A linear vault fracture in conscious patients increases the likelihood of an intracranial hematoma by about 400 times (4). Epidural hematomas (Fig. 7) are convex or lenticular in shape. They essentially displace the dura away from the inner table of the skull. Epidural hematomas occur from tearing of the middle meningeal artery as a result of the fracture.

Subdural hematomas (Fig. 8) are more common than epidural hematomas. They develop from the shearing of bridging vessels of the cerebral cortex. These hematomas conform to the contour of the brain and are usually more severe than an epidural hematoma. Surgical evacuation is considered in patients who have midline shifts of the brain (Figs. 7 and 8), mental status changes, or focal neurologic deficits.

Management of Traumatic Brain Injury
Not all patients who sustain maxillofacial or head injuries require imaging of the brain or cervical spine. The Pediatric Emergency Care Applied Research Network has published criteria for predicting which patients require imaging (5). Generally, patients who are neurologically stable (GCS 13–15), have had no loss of consciousness, are not amnesic, have no cerebral spinal fluid leak, and are actively engaged in conversation do not need imaging (4–7). The treatment of traumatic brain injuries ranges from observation from minor injuries to osmolar therapy, sedation, airway control, or surgical decompressive craniectomy for very severe injuries.

Conclusions
Pediatric patients who sustain maxillofacial injuries may have associated traumatic brain injuries as well as multiple organ injuries. The pediatric patient who presents for dental treatment immediately after a traumatic injury to the facial complex requires a rapid detailed history and neurologic assessment to identify those patients who have significant intracranial injuries that require immediate medical evaluation and treatment.

Acknowledgments
The author denies any conflicts of interest related to this study.

References

Figure 7. A CT scan showing the epidural hematoma with a midline shift.

Figure 8. A CT scan showing the subdural hematoma with a midline shift.