

Pediatric Major Head Injury

Not a Minor Problem

Aaron N. Leetch, MD^{a,b,*}, Bryan Wilson, MD^{a,b}

KEYWORDS

- Traumatic brain injury • Intracranial hemorrhage • Blunt head injury
- Abusive head trauma

KEY POINTS

- Emergency department management should focus on identifying the primary brain injury and preventing secondary brain injury. Secondary injury is multifactorial but most pronounced with hypotension and hypoxia.
- Hyperventilation should be avoided except as a temporizing measure for symptoms of acute herniation.
- Goals for preventing secondary injury include maintenance of physiologic normalcy, prevention of ischemia, and reduction of increased intracranial pressure.
- Induced hypothermia and decompressive craniotomy have not shown to lead to neurologically favorable outcomes in large recent studies.
- Abusive head trauma should always be considered in younger children with traumatic brain injury.

INTRODUCTION

Head injury is an increasingly common cause of emergency department (ED) visits for pediatric patients.¹ In 1 year in the United States, pediatric traumatic brain injury (TBI) led to more than 2.5 million encounters and 50,000 hospitalizations, accruing more than \$1 billion in hospital charges.² Deaths from pediatric TBI are most common in the adolescent/young adult (from motor vehicle collisions) and in those younger than 4 year of age (from falls).^{1,3} In 2013, pediatric trauma contributed to more than 40,000 hospitalizations and 7000 deaths. Nonaccidental trauma or inflicted trauma is an unfortunately common cause of TBI in the very young. Male infants, those

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^a Department of Emergency Medicine, The University of Arizona, PO Box 245057, Tucson, AZ 85724-5057, USA; ^b Department of Pediatrics, The University of Arizona, PO Box 245057, Tucson, AZ 85724-5057, USA

* Corresponding author. Department of Emergency Medicine, The University of Arizona, PO Box 245057, Tucson, AZ 85724-5057.

E-mail address: aletch@aemrc.arizona.edu

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younger than 6 months of age, and those with mothers less than 21 years of age seem to be at the greatest risk.^{4,5}

Much work has been done to risk stratify head-injured children with decision rules to be discussed elsewhere. Recently, the goal of the ED evaluation seems to be shifting toward a patient-oriented outcome measure rather than a disease-oriented outcome.⁶⁻⁹ The idea of a clinically important TBI (ciTBI) separates those patients with intracranial hemorrhage requiring immediate intervention from those managed similar to a severe concussion. There is no consensus on what constitutes a ciTBI for pediatric patients, but the inclusion criteria from the 4 largest trials provide an excellent framework for discussion^{10,11} (Table 1). The evaluation and management of ciTBI focuses on 2 goals:

1. Identification of the primary injury, and
2. Prevention of secondary injury.

| Table 1 "Clinically important" traumatic brain injury definitions | | |
|--|---|--|
| Study | Clinical Outcome | CT Findings |
| <i>PECARN</i> | Death from head injury Neurosurgical intervention Intubation for >24 h Hospital admission >2 nights for persistent neurologic symptoms | Intracranial hemorrhage or contusion Cerebral edema Traumatic infarction Diffuse axonal injury Shearing injury Sigmoid sinus thrombosis Midline shift or herniation Diastasis of skull Pneumocephalus Skull fracture depressed by more than the width of the skull table |
| <i>CHALICE</i> | Death from head injury Neurosurgical intervention | Any new, acute traumatic intracranial pathology Intracranial hematomas of any size Cerebral contusion Diffuse cerebral edema Depressed skull fracture |
| <i>CATCH</i> | Within 7 d: death from head injury Neurosurgical intervention Intubation | Any acute intracranial finding attributable to acute injury |
| <i>NEXUS II</i> | Neurosurgical intervention Likely to have significant long term impairment | EDH/SDH >1 cm or causing mass effect Cerebral contusion >1 cm or multiple Extensive SAH Mass effect or sulcal effacement Herniation Basal cistern compression or midline shift Posterior fossa hemorrhage Bilateral hemorrhage Depressed/diastatic skull fracture Pneumocephalus Diffuse cerebral edema Diffuse axonal injury |

Abbreviations: CT, computed tomography; EDH/SDH, epidural hematomas/subdural hematomas; SAH, subarachnoid hemorrhage.

*Data from Refs.*⁶⁻⁹

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