

# Management of Pediatric Head Injury

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## Objectives

- Discuss initial evaluation and risk stratification of pediatric head injury
- Discuss immediate management of pediatric head injury based on severity
- Review ongoing management recommendations for mild traumatic brain injury (concussion)

## Background

- Head Injury
  - Trauma is the leading cause of death in children >1 year of age
  - 75-97% of trauma deaths involve brain injury
  - Minor head trauma accounts for >95,000 children seen in ED each year
  - One of the most common reasons for MD visit

## Traumatic Brain Injury (TBI)

- TBI: Insult to the brain from an external mechanical force possibly leading to permanent or temporary impairment of neurological function
  - 10-20% with moderate/severe short term memory problems and delayed response times
  - >50% will have permanent neurologic deficits
  - 5-10% will end up in long term care facilities
- ciTBI: Death, neurosurgical intervention, intubation more than 24 hours or admission of 2 nights

## Background: Causes of Head Injury

- **Motor vehicle accidents:** (27-37% of cases)
  - Ages: less than 15 years usually a pedestrian or bicyclist
  - Ages: 15-19 years are passengers, alcohol common
- **Child abuse:** ages < 2 years (24% of brain injury)
- **Falls:** (24% of cases) common ages < 4 years
- **Recreational Activities:** ages 10-14 (21% of cases)
- **Assaults and firearms:** (10% of cases)

## Evaluation of the Head Injured Child

- **History:**
  - Time of injury
  - Mechanism
  - Loss of Consciousness
  - Vomiting
  - Behavior at the time of injury and since then
  - Other injuries that the family/patient noted (ex: nosebleed, knocked out a tooth)
  - Seizures
  - Previous head injury (timing and management)
  - PMH: shunt, bleeding disorder, neurologic baseline
  - Pre hospital GCS

## Evaluation of the Head Injured Child

- Physical:
  - GCS and Pupils
  - Head
    - Abrasions/Lacerations
    - Hematoma (location!)
    - Step off
  - Neck Pain—muscular versus bony
  - HEENT
    - Raccoon eyes
    - Facial tenderness
    - Septal hematoma
    - Nasal drainage
    - Dentition
    - Hemotympanum
  - Other Injuries

## Glasgow Coma Scale

Eye Opening (E)	Verbal Response (V)	Motor Response (M)
4 = Spontaneous	5 = Coos or babbles (normal)	6 = Spontaneous, purposeful
3 = To voice	4 = Irritable and continually cries	5 = Withdraws from touch
2 = To pain	3 = Cries to pain	4 = Withdraws from pain
1 = None	2 = Moans to pain	3 = Abnormal flexion (decorticate)
	1 = None	2 = Extensor response (decerebrate)
		1 = None
		Total = E+V+M

## Evaluation of the Head Injured Child

- Vital Signs—Cushing's Triad
  - Hypertension
  - Bradycardia
  - Disordered breathing
- Imaging
  - Early signs of edema
  - A negative CT is less important than what your patient is showing you

## Management of the Head Injured Child

- Many factors to consider for interfacility transport
  - Changes in neuro evaluation over time
  - Distance of transport
  - Mechanism of injury
  - Findings on imaging
  - Vital signs
  - Other injuries
- Why send the critical care team--associated with decreased mortality (and for the hospital \$\$)!

## Management of Severe Injury

- GCS <8 → Intubate!
- If your patient is intubated on arrival:
  - Prophylactic ICP management
    - Hypertonic Saline
    - Head of bed elevation (40 degrees)
    - Hyperventilation\*
    - Consider seizure prophylaxis
  - Get a blood gas—including chemistry
  - End Tidal CO<sub>2</sub> monitoring
  - Initiate these measures while waiting for transport

## Just a note on outcomes

- Cardiac arrest and mortality
- We are still learning
  - The management has changed significantly in the last 10 years and will likely be different again 10 years from now

## Guidelines?

- Guidelines for the Acute Medical Management of Severe Traumatic Brain Injury in Infants, Children, and Adolescents
  - Initial guidelines in 2003
  - Updated in 2012
- No official guidelines for transport

## In-Hospital Guidelines

- Cerebral Perfusion Pressure
- Hyperosmolar Therapy
- Temperature Control
- Hyperventilation
- Corticosteroids
- Glucose and nutrition
- Antiseizure prophylaxis

## Cerebral Perfusion Pressure

- Level III
  - A minimum CPP of 40 mm Hg may be considered in children with TBI
  - A CPP threshold 40–50 mm Hg may be considered; there may be age-specific thresholds with infants at the lower end and adolescents at the upper end of this range

## Hyperosmolar Therapy

- Level II
  - Hypertonic saline should be considered for the treatment of severe pediatric TBI associated with intracranial hypertension; effective doses for acute use range between 6.5 and 10 mL/kg
- Level III
  - Hypertonic saline should be considered for the treatment of severe pediatric TBI associated with intracranial hypertension; effective doses as a continuous infusion of 3% saline range between 0.1 and 1.0 mL/kg of body weight per hour, administered on a sliding scale; the minimum dose needed to maintain ICP 20 mm Hg should be used; serum osmolarity should be maintained below 360 mOsm/L
- Although mannitol is commonly used in the management of raised ICP in pediatric TBI, no studies meeting inclusion criteria were identified for use as evidence for this topic



## Temperature Control

- Level II\*\*\* NEW DATA REFUTES THIS RECOMMENDATION
  - Moderate hypothermia (32–33°C) beginning early after severe TBI for only 24 hrs duration should be avoided
- Level II
  - Moderate hypothermia (32–33°C) beginning within 8 hrs after severe TBI for up to 48 hrs' duration should be considered to reduce intracranial hypertension
- Level II
  - If hypothermia is induced for any indication, rewarming at a rate of 0.5°C per hour should be avoided
- Level III
  - Moderate hypothermia (32–33°C) beginning early after severe TBI for 48 hrs duration may be considered

## Hyperventilation

- Level III
  - Avoidance of prophylactic severe hyperventilation to a PaCO<sub>2</sub> 30 mm Hg may be considered in the initial 48 hrs after injury
- Level III
  - If hyperventilation is used in the management of refractory intracranial hypertension, advanced neuromonitoring for evaluation of cerebral ischemia may be considered

## Corticosteroids

- Level II
  - The use of corticosteroids is not recommended to improve outcome or reduce ICP for children with severe TBI

## Analgesics, Sedatives, NM blockade

- Level III
  - Etomidate may be considered to control severe intracranial hypertension; however, the risks resulting from adrenal suppression must be considered
- Level III
  - Thiopental may be considered to control intracranial hypertension
- In the absence of outcome data, the specific indications, choice and dosing of analgesics, sedatives, and neuromuscular-blocking agents used in the management of infants and children with TBI should be left to the treating physician
- As stated by the FDA, continuous infusion of propofol for either sedation or the management of refractory intracranial hypertension in infants and children with severe TBI is not recommended

## Glucose and Nutrition

- Level II
  - The evidence does not support the use of an immune-modulating diet for the treatment of severe TBI to improve outcome

## Anti-Seizure Prophylaxis

- Level III
  - Prophylactic treatment with phenytoin may be considered to reduce the incidence of early posttraumatic seizures in pediatric patients with severe TBI

## Management of the Head Injured Child-Mild

- Pediatric Emergency Care Applied Research Network (PECARN)
- It DOES NOT tell you who to scan, it tells you who not to scan

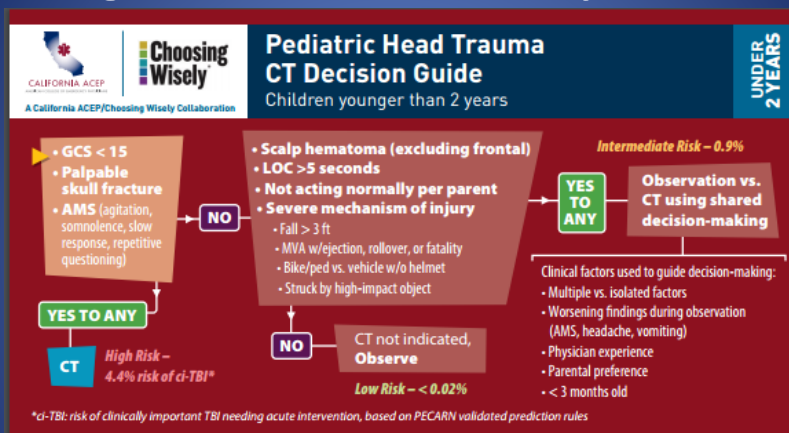
## PECARN Decision Rules

- Included 43,904 pts from 25 US hospitals
  - 25% being less than 2 years of age
  - Presenting within 24 hrs
- Exclusion Criteria
  - Excluded Trivial injuries – ground level falls, walking/running into stationary objects (mild injuries) & no signs or symptoms of head trauma other than abrasions and lacerations, pre-existing neuro d/o, shunts, bleeding d/o
- Evaluated young pts separately:
  - Greater sensitivity to radiation
  - Decreased ability to communicate
  - Different mechanism of injury
  - Different risks for TBI

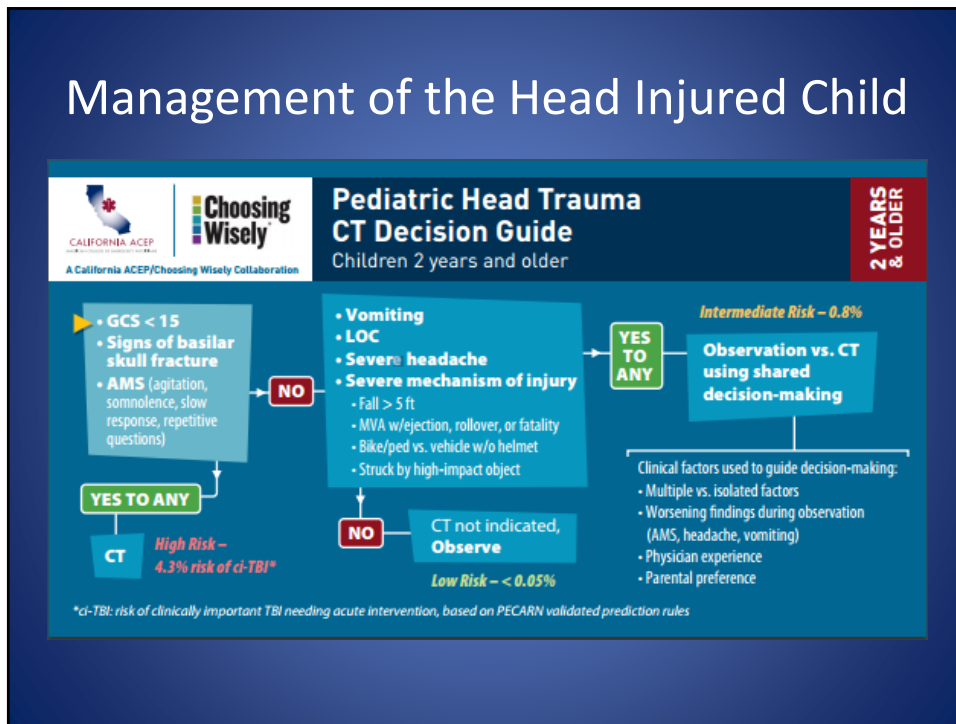
## PECARN Decision Rules

- Decision predictors <2yo
  - AMS
  - non-frontal scalp hematoma
  - LOC > 5 sec
  - severe injury mechanism
  - palpable skull fracture
  - not acting normally according to the parent.
- Decision predictors >2yo
  - AMS
  - Any LOC
  - Hx of vomiting
  - Severe injury mechanism
  - Clinical signs of basilar skull fracture
  - Severe headache
- Results
  - For pts < 2 yo — NPV 100% (1176/1176) and sensitivity of 100% (25/25)
  - For Pts > 2 yo — NPV 99.95% (3798/3800) and sensitivity of 96.8% (61/63)
  - Prediction rule missed 2 unhelmeted biker/inline skater —both large frontal hematoma and “moderate headache”

## Management of the Head Injured Child



# Management of the Head Injured Child



## So I decided not to scan... Now what?

- PO Challenge
- Observation
- Concussion
- Symptomatic management
- Return Precautions
- Documentation

## Observation

- The answers to the questions “For how long?” and “Where?” depends on many factors and provider comfort level
  - Age
  - Length of time since injury
  - Symptoms
  - Time of day

## Concussion Discussion

- Concussion is a clinical diagnosis!
- Patient definition: brain injury that alters the way your brain functions and makes you feel miserable
- Symptoms are temporary but may vary in duration
  - headaches
  - problems with concentration and memory
  - dizziness, balance, and coordination issues
  - nausea and vomiting
- Myths to dispel
  - They do not have to stay awake!
  - They can be caused by blunt trauma but also from violent shaking
  - You did not have to lose consciousness to have a concussion

## Concussion Discussion

- The treatment is rest and symptom management
  - Brain Rest
    - School, Screens, Sleep
  - Physical Rest
    - You are physically restricted from doing things that bring on symptoms
    - Gradual return to play
    - Sports medicine follow up for athletes or severe concussions
- Restricted from high risk head injury activities
- Severe concussions are to be admitted to surgery

## Symptomatic Management

- Headache:
  - Rest/Sleep
  - Motrin
  - Hydration
- Nausea
  - Small, frequent amounts of liquids
  - Zofran
- Dizziness
  - Rest
  - Hydration
- Concentration and Memory
  - School note from PCP
- Muscle Soreness
  - Motrin
  - Heat
  - Occasionally valium



## Patient Education

- Always send a school note
- Return Precautions:
  - Altered mental status
  - Persistent vomiting
  - Worsening of any symptoms (headache, balance issues, dizziness) despite rest
  - Follow up with PCP within the week (sports medicine if athlete or severe concussion)
- Soreness may worsen over 24 hours, then gradually get better over a week

## Documentation

- \_yo\_ s/p closed head injury, \_ appearing, \_ hydrated, GCS \_ with \_ neurological exam. Meets \_ risk criteria for intracranial bleed. Likely with concussion given sx.
- 1. CT head discussed with caregiver, given \_ mental status and \_ risk criteria, \_
- 2. Concussion guidelines discussed at length, including typical concussion symptoms, needs for both physical activity and mental activity rest until all symptoms resolved, and gradual step wise reintroduction of activity to be directed by their pediatrician
- 3. Anticipatory guidance: pain control with motrin for headaches prn, seek medical attention for persistent headaches
- 4. Return to ED for any new or concerning symptoms, including: altered mental status, irritability, lethargy, persistent vomiting, altered speech or gait, severe headache

## >24 hours after injury

- No published data to guide decision making
- Depends on type and severity of symptoms
- Shared decision making with the caregiver

Questions??