



Episode 3 – Pediatric Head Trauma

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Canadian Pediatric Society's classification of head injury (multiple others exist):

- Taken from CMAJ 1990;142(9):949–52
- Mild: GCS of 15 and asymptomatic or with mild headache, ≤ 3 episodes of vomiting, and loss of consciousness < 5 minutes
- Moderate: GCS of 11–14, loss of consciousness ≥ 5 minutes, progressive headache or lethargy, > 3 episodes of vomiting, post-traumatic amnesia or seizure, serious facial injury or signs of basilar skull fracture, multiple trauma, possible penetrating injury or depressed skull fracture, or suspected child abuse
- Severe: GCS ≤ 10 or declining by 2 points without clear cause, focal neurologic signs, penetrating skull injury, palpable depressed skull fracture, or compound skull fracture

Kuppermann et al.: Identification of children at very low risk of clinically-important brain injuries after head trauma: a prospective cohort study. Lancet 2009;374(9696):1160–70

NO CT HEAD RECOMMENDED for low-risk criteria for clinically-important traumatic brain injury ($< 0.05\%$ of death, neurosurgery, intubation for 24hrs or admission for 48hrs due to traumatic brain injury on CT scan):

- Patient less than 2y.o.: Normal mental status, no scalp hematoma except frontal, no loss of consciousness > 5 seconds, no palpable skull fracture, AND non-severe mechanism
- Patient more than 2y.o.: Normal mental status, no loss of consciousness, no vomiting, no signs of basilar skull fracture, no severe headache, non-severe mechanism



- Definition of severe mechanism: MVA with ejection, death of other passenger or roll-over, pedestrian or cyclist without helmet struck by car, fall >5feet if patient >2y.o. or fall >3feet if patient <2y.o., or head struck by high-impact object

CATCH study: Osmond et al. Canadian Assessment of Tomography for Childhood Injury. CMAJ 2010;182(4):341-8

NO CT HEAD REQUIRED for low-risk criteria: no high-risk AND no medium-risk factors present:

- 4 "high-risk" factors (which are 100% sensitive for the need for neurologic intervention): failure to reach GCS of 15 within 2hrs, suspicion of open skull fracture, worsening headache, or irritability
- 3 "medium-risk" factors (which are 98.1% sensitive for prediction of brain injury on CT scan): large, boggy hematoma on scalp; signs of basal skull fracture; dangerous mechanism (MVC, fall from elevation >3feet or 5 stairs, fall from bicycle with no helmet)

Differences between Kuppermann and CATCH studies:

- CATCH study recruited sicker patients (GCS of 13-15 vs. 14-15), but has not been validated yet (as opposed to Kuppermann's)
- Kuppermann study might validate what astute clinicians already do, whereas CATCH study might change practice, as sicker patients fulfilling certain criteria could avoid CT scan
- BOTH studies are only guides and are not absolute, and they DO NOT claim that if a patient does not fill ALL the criteria he/she necessarily needs a CT scan

Role of skull x-ray for patients <1y.o.:

- Controversial: although there is an association between skull fracture and intracranial hemorrhage, the sensitivity is not great even with seasoned clinicians reading them; it could be considered when a hematoma is present but CT scan is not indicated



Return to sport:

- Variety of guidelines exist, but every athlete needs an individual approach to prevent 2nd-impact syndrome
- Suggestions include to stay off activities until 1 week after resolution of post-concussive symptoms (headache, amnesia, dizziness), and then to use a step-wise approach: mild exertion to increase HR, sport-related activity with no contact, progressive return to full practice, then return to game situations
 - if symptoms develop at any of these stages, go back to the previous stage and consult the primary care giver of the patient

Clear discharge instructions (preferably written):

- First 6hrs is the “red zone”, then 24hrs is the “yellow zone”
- Waking up patient q2hrs is probably not necessary (and if the clinician believes the patient to be high-risk, he/she should be kept in the department longer)
- Partially waking up the patient once during the night to assure reasonable behaviour might be reasonable, especially if in the “red zone” time

Major head injury:

- Consider pre-medication of fentanyl or lidocaine as part of rapid-sequence intubation (RSI) algorithm to blunt the body’s sympathetic response to intubation, which results in increased intracranial pressure (ICP) – these medications need to be given a full 2 minutes before intubation to be effective, therefore not suitable in ‘crash’ intubation
- Induction agent should aim at preventing drop in blood pressure given that $CPP = MAP - ICP$ [cerebral perfusion pressure equals mean arterial pressure minus ICP]
 - Etomidate probably remains the best agent given that there is not enough data as of yet on Ketamine (which offers neuroprotective effect but raises ICP)
- Clinical clues of increased ICP: worsening headache, visual or neurologic complaints, persistent vomiting, as well as abnormal pupillary reflexes, decreasing level of awareness, lateralizing features, Cushing’s triad



- Methods of decreasing ICP: elevation of head of bed 30 degrees, medications to cause osmotic pull, and hyperventilation, which is only used as a temporizing measure in a patient who is coning (target pCO₂ is 30–35mmHg)
- Mechanism of mannitol: decrease in blood viscosity, as well as osmotic pull to decrease brain swelling given that it does not cross the BBB (provided it is intact)
- Dose of medications:
 - Mannitol: bolus of 0.25–1g/kg
 - Hypertonic saline 3%NS (used when patient hypotensive because it has no osmotic diuretic effect): bolus of 2–6cc/kg, then infusion of 0.1–1cc/kg/hr

Tricks for sedating for CT head:

- Keep the very young children awake as long as possible, then do the CT scan when they fall asleep; or feed them and do the CT scan during their post-feed nap