Title: PEDIATRIC TRAUMATIC BRAIN INJURY GUIDELINE

Scope/Patient Population:

1. Condition – Mild, Moderate, and Severe Traumatic Brain Injury (TBI)
2. Guideline purpose – Identify patients and provide clinicians with an evidence based framework to base clinical decision making
3. Guideline objectives –
    a. Define mild, moderate, and severe TBI
    b. Provide evidence-based recommendations to optimize care of the pediatric patient with a head injury
4. Target population – Pediatric patients (<18 yrs) who have suffered a head injury as the result of traumatic mechanism
5. Define common terms and definitions (please see p.6)

Policy Statement/Background:

Methodology:

1. The guideline developer performed a literature search through Ovid, The Cochrane Database of Systemic Reviews; The Joanna Briggs Institute, The National Guideline Clearinghouse
2. Search terms
    a. Pediatric head injury treatments
    b. Traumatic Brain Injury (TBI) treatment
    c. Pediatric TBI treatment
    d. TBI guidelines

Procedure:

1. Pre-hospital Recommendations
    a. Pediatric patients with severe TBI should be transported directly to Mary Bridge Children's Hospital and Health Center
    b. Hypoxia must be avoided and adequate oxygenations and airway stabilization maintained
        i. There is no evidence to support airway support via endotracheal intubation over bag-valve-mask
        ii. Children with GCS<9 should have a controlled airway in order to avoid hypoxemia, hypercarbia, and aspiration
        iii. If endotracheal intubation is instituted for pediatric patients with TBI, then specialized training including the use of end-tidal CO2 detection is necessary
    c. Prophylactic hyperventilation should be avoided but may be utilized in the pre-hospital setting as an intervention in the patient with suspected cerebral herniation
        i. Hyperventilation is defined as:
            1. >20 in adults
            2. >25 BPM in children

3. >30 BPM in infants

ii. Hypotension should be identified and corrected as soon as possible
   1. Hypotension is defined as SBP below the fifth percentile for age or by clinical indication of shock
   2. Lower limit of SBP may be estimated by 70 + (2 X age in years)

2. Hospital Management

TBI Classification	Mild	Moderate	Severe
Blunt traumatic acceleration/deceleration mechanism with:			
Post-resuscitative GCS	13-15	9-12	3-8
Loss of consciousness at time of incident	May be present but <30 minutes	>30 minutes	>30 minutes
Impaired or amnesic memory of event	Present <24 hrs	Present	Present
Neurological impairment	Possibly disoriented, confused or dazed at time of incident. Focal impairment may include H/A, Sz, N/V, dizziness, blurred vision, fatigue, sleep disturbances, behavioral changes, difficulty concentrating, or memory impairment		Global
Neuroimaging results	See Algorithm	May be present	Evidence of hematomas, contusions, cerebral edema, or compressed basal cisterns

Treatment Recommendations

TBI Classification	Mild	Moderate	Severe
Airway support	Prevent hypoxia	Oxygenation by appropriate means to prevent hypoxia	• Obtain controlled airway and prevent hypoxia • Mild hyperventilation (PaCO2 30-35) may be considered for longer periods of IC HTN unresponsive to sedation analgesia, neuromuscular blockade, CSF drainage, and hyperosmolar tx.
Neuroimaging	Refer to Mild Traumatic Brain Injury Guideline algorithm	Head CT	Head CT
Disposition	Refer to Mild Traumatic Brain Injury Guideline algorithm	Admission	Admission w/ appropriate specialty consults
Surgical intervention	Rarely	As indicated	As indicated for mass lesions • For GCS less than 8, refer to airway management and recommend ICP monitoring • Consider decompressive craniectomy as adjunct; most viable candidates include patients with some or all of the following: Diffuse cerebral swelling, intervention within 48 hours of injury, no episodes of ICP>40 mm Hg prior to surgery, GCS>3 at some time subsequent to injury, secondary deterioration, evolving

			cerebral herniation
Analgesia, sedation or neuromuscular blockade	Analgesia per discretion	Analgesia per discretion	Analgesia per discretion *Little evidence available regarding sedation and neuromuscular blockade – use MD discretion
Temperature regulation	Normalize	Normalize	Normalize *Some adult evidence supporting mild hypothermia (32-33°C) for refractory intracranial HTN (IC HTN)
Intracranial HTN* control (IC HTN) *IC HTN defined as ICP>20 mmHg	N/A	N/A	Open fontanels do not preclude development of IC HTN IC may be helpful w/ traumatic lesions of when serial neuro exams are compromised IC HTN effect is r/t peak and duration of elevation; initiate tx for ICP>= 20 mmHg for >= 10 minutes or presence of plateau waves or spot elevations >30 mmHg w/ noxious stimuli ICP interpretation includes clinical assessment and physiological monitoring in conjunction with cerebral imaging Optimal CPP in children not known but CPP<40 is associated w/ poor outcomes Hypertonic saline (3%) is supported for IC HTN; Maintain serum osmolarity <360 mOsm/L Mannitol is supported for IC HTN; Maintain serum osmolarity <320mOsm/L Monitor serum sodium levels

			Small studies suggest high-dose barbiturate tx may be effective for refractory IC HTN; therapy effects warrant selective utilization and careful monitoring limited to critical care providers w/ appropriate systemic monitoring to identify and rapidly treat hemodynamic instability
Anti-epileptics	N/A	N/A	Option for early prophylaxis (first 7 days)
Glucose control	N/A	N/A	Avoid prolonged hyperglycemia (BS>220); goal 100-180
Nutritional support	Normalize	Normalize	Replace 130-160% of resting metabolic expenditure; enteral route preferred Begin within 72 hours of injury with full support by day 7
Corticosteroids	No	No	No
DVT prophylaxis	N/A	N/A	Little evidence available regarding DVT prophylaxis in pediatric trauma – use MD discretion
Rehabilitation	Mild TBI follow-up	Early rehabilitation recommended (undefined)	Consult Mary Bridge Pediatric Rehabilitation Medicine for inpatient consult if possible; otherwise, outpatient consult is acceptable.
Neuropsychology	If admitted, consult Mary Bridge Pediatric Neuropsychology.		Consult Mary Bridge Pediatric Neuropsychology.

3. Definitions:

   BPM - breaths per minute

	CPP - cerebral perfusion pressure CSF - cerebrospinal fluid ED - emergency department GCS - Glasgow Coma Scale H/A - headache HCT - head computed tomography (CT) HTN - hypertension IC - intracerebral ICP - intracerebral pressure LOC - loss of consciousness N/V - nausea/vomiting O2 - oxygen PaCO2 - arterial partial pressure of carbon dioxide PO - per os (oral intake) Sat - saturation SBP - systolic blood pressure Sx - symptoms Sz - seizures TBI - traumatic brain injury Tx – treatment
	Related Policies: Non-Accidental Trauma Screening and Management Guideline
	Related Forms: MBCH TBI Discharge Instructions
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Point of Contact: Carolynn Morris MB Trauma Program Manager 403-4417, AMC Trauma Program Manager 545-2859

Approval By:	***Date of Approval:***
MBCH Pediatric Trauma Multidisciplinary Committee	*09/19/2013*
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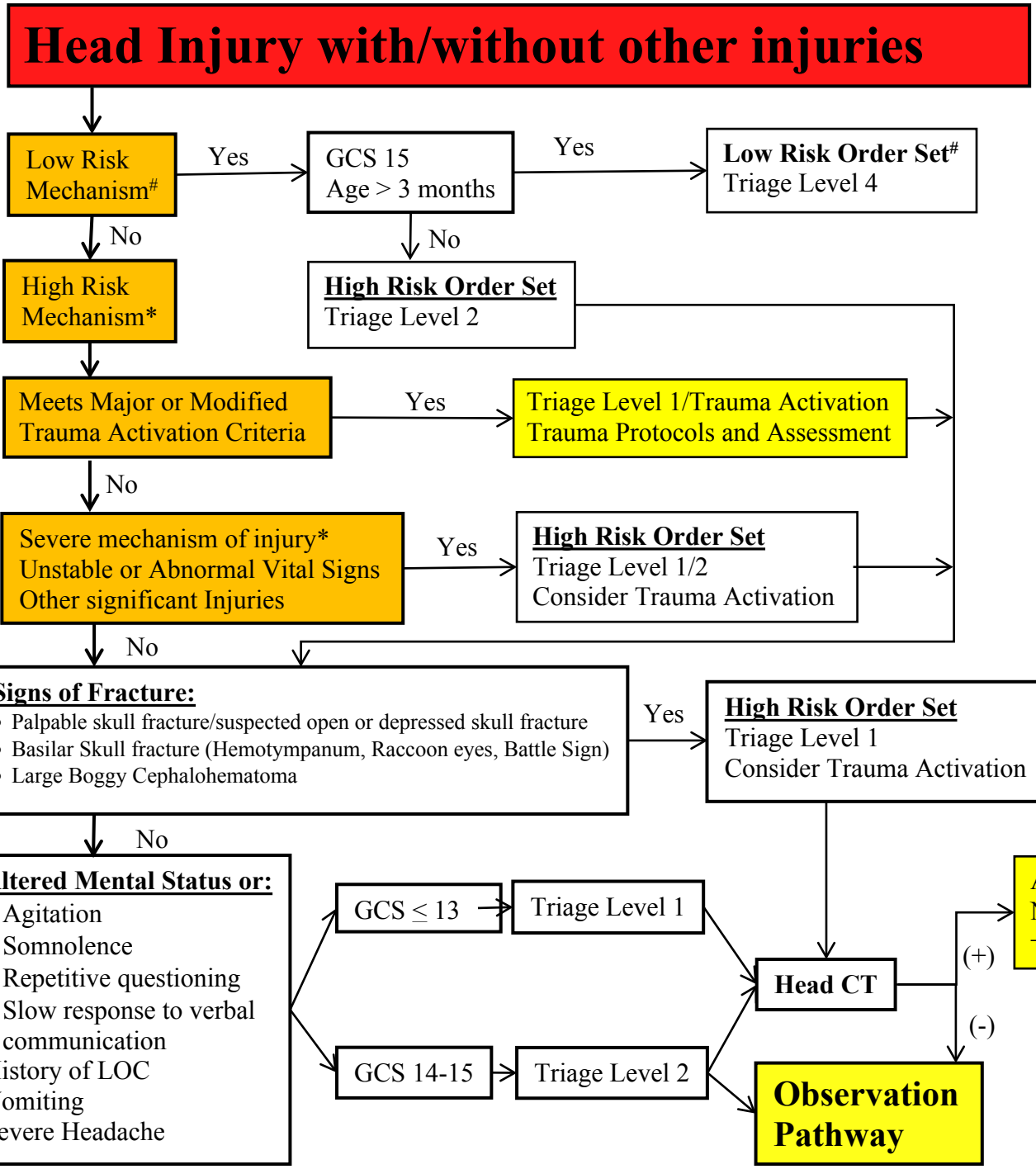
Mild Traumatic Head Injury Guidelines (GCS ≥ 13)



Low Risk Criteria:

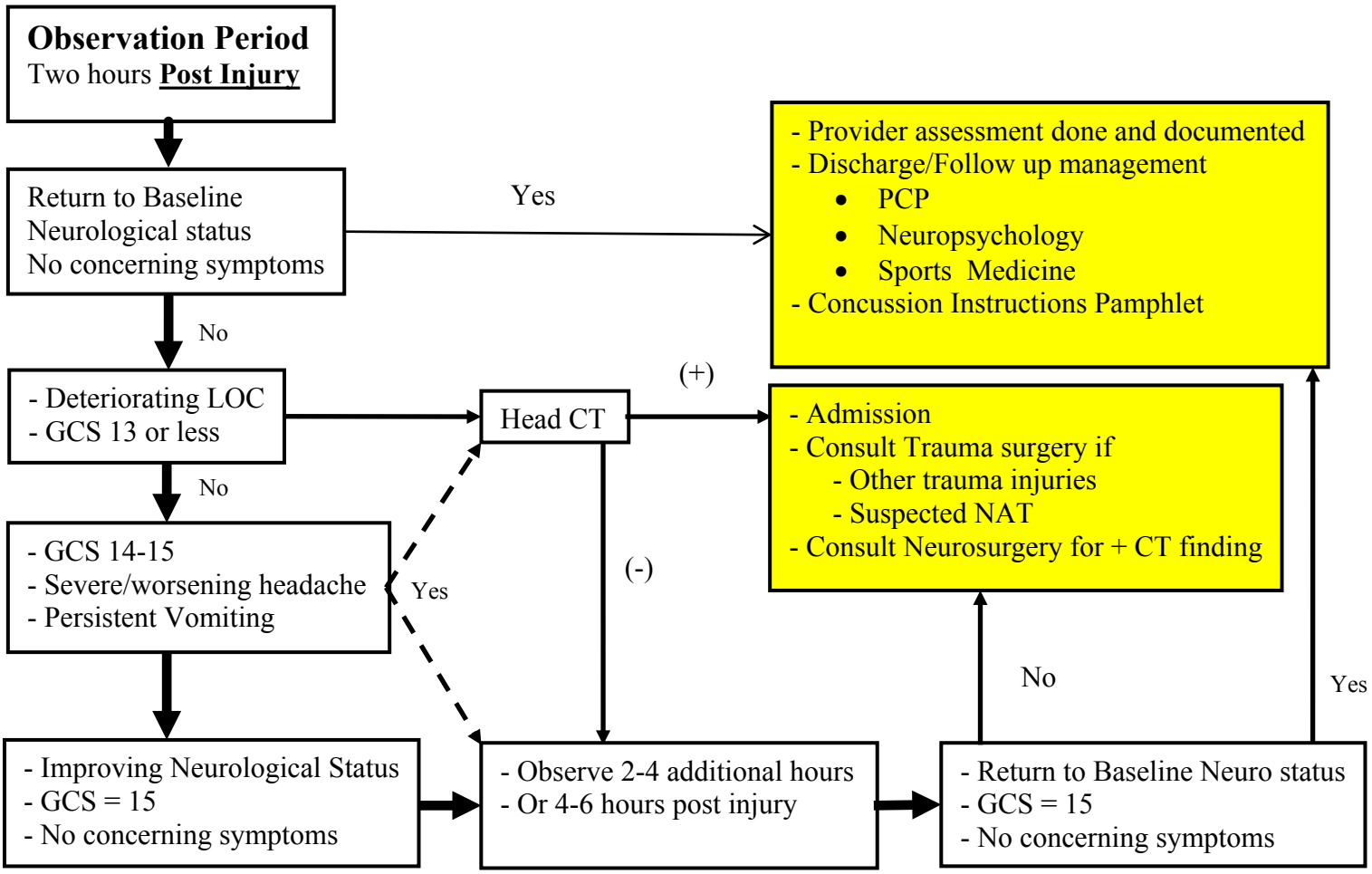
- Ground Level Fall
- Walked or fall into stationary object
- Bumped heads
- Abrasions/lacerations
- No "Significant" Hematoma
- No concern for Non Accidental Trauma

UMATIC BRAIN INJURY IDELINE

* Severe mechanism of injury:

- MVC with patient ejected/rollover/death
- Pedestrian/bicyclist struck by a motorized vehicle
- Falls of more than 0.9 m (3 feet)
- Head struck by a high-impact object
- Consider increased risk if:
  - Mechanism unknown
  - Patient needs operative procedure
  - Late at night (difficult to monitor mental status)

Mild Traumatic Brain Injury Observation Pathway



Consider admission:

- Concern for NAT (see NAT guidelines)
- Social concerns/Lack of follow up
- Difficulty in assessment of mental status (pre-existing neurologic condition or late night assessment)
- Isolated skull fracture less than 1 year with other concerns for mechanism/cause/mental status

Positive Head CT:

- Skull Fracture (depressed)
- Subdural/Epidural Blood
- Intraparenchymal hemorrhage
- Subarachnoid hemorrhage
- Intraventricular hemorrhage
- Evidence of cerebral edema
- Intraparenchymal contusion

Non-depressed skull fractures with no other injuries do not require neurosurgical consult or admission

Observation Pathway

- Baseline Vitals/GCS/Neurologic Exam
- Vitals/GCS/Neuro Check q30" for first 2 hours
  - then Q1-2 hours (ED or floor)

Pediatric GCS Scoring

Eyes		Verbal			
Spontaneous	4	0-23 mo	2-5 yr	>5 Yr	
To Speech	3	Smile/cry, follow object	Approp. words	Oriented	5
To Pain	2				
None	1	Cry, consolable	Inapprop. words	Confused	4
Motor					
Spontaneous	6	Innaprop cry, inconsist consolable	Cries and/or screams	Inaprop.	3
Localize to Pain	5				
Withdraw to Pain	4	Inconsolable persistent cry, grunts	Moan to pain	Incompre hensible	2
Decorticate (Flex)	3				
Decerebrate (Ext.)	2	None	None	None	1
None	1				

This guideline is endorsed by Mary Bridge Emergency Department but it is not intended as a substitute for clinical judgment. It should be used as an adjunct to sound clinical decision making which accounts for individual patient considerations.