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GUIDELINES FOR THE MANAGEMENT OF PEDIATRIC HEAD INJURY IN ALASKA

BACKGROUND

These guidelines are the efforts of representatives of the Alaska medical community to present a reasonable evidenced-based approach to pediatric head injured patients in our state. They have been developed as an extension to the Alaska State Head Trauma Guidelines previously published. Although blunt head injury is a frequent injury in Alaska, the number of pediatric head injuries is a much smaller cohort. Pediatric specific resources in the state are scarce and located in the larger urban areas of the state. There are large regions in the state that do not have access to neurosurgical specialty care or pediatric intensive care resources. Some regions may not have computerized tomography (CT) imaging readily available. These recommendations are based on standard guidelines for pediatric head imaging protocols, our reading of the current medical literature, and the experience of clinicians from around the state. This is a multi-disciplinary consensus of local providers and specialists actively caring for head injured patients in Alaska. These guidelines are not meant to replace clinical judgment, but to offer a reasonable approach to these patients. We recognize that local protocols for the care of pediatric head injured patients may vary based on resources and aim to provide guidelines that can be applied in both rural and urban centers.

The Alaska State Trauma Registry from 2011 – 2015 records 364 pediatric isolated blunt head injuries, with 164 injuries in children aged 0-4 years, 143 injuries in children aged 5-14 years, and 57 injuries in children aged 15-17 years. It is estimated an even larger number of patients are evaluated in clinics and emergency departments and discharged home, as the registry only captures patients who are admitted or transferred. Of the 364 isolated blunt head injuries, 289 (79.4%) were considered mild with a Glasgow Coma Scale (GCS) of 14 or 15. The remainder 10.7% (39) were moderate, defined as GCS 9-13, and 6.3% (23) severe, defined as GCS 3-8; there were 13 injuries with an unknown GCS recorded.

Neurosurgical and pediatric intensive specialty care is a geographically scarce resource in the state of Alaska. There are two Level-II pediatric trauma centers in the state, both located in Anchorage. Pediatric patients who need neurosurgical care require transfer to either Anchorage or Seattle, Washington. During the four year period reviewed, 53.3% (194) of pediatric patients with isolated blunt head injuries had their initial care in or were transferred to Anchorage or Seattle. There were 187 pediatric patients initially cared for in Anchorage. Of these patients, 9% (13/147) of children with GCS 14-15 required neurosurgical intervention, 25% (6/24) of children with GCS 9-13 required neurosurgical intervention, and 28% (4/14) of children with GCS 3-8 required neurosurgical intervention. There were 5 mortalities, all with initial GCS 3-8. There were 177 pediatric patients initially evaluated in rural hospitals, 111 or 62.7% of whom underwent CT head imaging. Of those children who underwent CT imaging, the majority of children are transferred to centers with neurosurgical specialty care; 14% of children with GCS 14-15 and normal CT, 65% of children with GCS 14-15 and abnormal CT, 75% of children with

GCS 9-13, and 80% of children with GCS 3-8. During the review period, there were 87 children admitted to non-neurosurgical facilities and no mortalities in this group.

Patient transport throughout Alaska is complicated by many factors, geography foremost. Alaska has three distinct regions when considering patient transport. The first, Southcentral region is composed primarily of towns connected to Anchorage by the road system, including the Kenai Peninsula, Matanuska Valley and continuing north to Fairbanks. The second, Southeast region, is comprised of many island and coastal communities that have transportation and referral ties to both Anchorage and Seattle. The third is the remote 'bush' areas of Alaska, villages not on the road system and often great distances from referral medical centers. Many times, transporting patients to definitive neurosurgical care requires aeromedical evacuation. Air ambulance systems are a limited resource within the state and inefficient use reduces their availability for other patients with time critical emergencies. In addition, because of weather, terrain, and the vast distances involved, flying in Alaska is inherently more dangerous for flight crews and patients. The National Institutes of Occupational Safety and Health (NIOSH) reported that commercial pilots flying on commuter airlines or charters in Alaska have a mortality rate five times that of pilots in the rest of the United States.[1] Although the safety of aeromedical evacuation services have improved over time, the risk to patients and flight crews remains an important factor in deciding to transfer patients. Regarding fatalities specific to aeromedical evacuation, the NIOSH database was queried from 1990 – 2016 and found two aeromedical transport fatality incidents in Alaska, which together resulted in the death of five crew members and 2 patients. The monetary cost of aeromedical transportation varies greatly across the state with fixed wing transportation costs to Anchorage ranging from approximately $19,000 from the Mat-Su Valley to $82,000 from Barrow. Transport costs to Seattle are even higher, averaging approximately $160,000 per transport. Aeromedical evacuation in the Southeast region while still expensive has similar or somewhat reduced costs when patients are transported directly either to Seattle or Anchorage. These risks and costs must be weighed when considering patient transport across Alaska.

The management of blunt head injuries has been addressed in other regions that share similar challenges of rural transport and scarce specialty resources. One of the emerging technologies to help rural and remote areas gain access to specialty care is teleradiology. Several studies have shown that head injured patients can be managed using teleradiology with neurosurgeon review. Telehealth consultations reduce patient transfers with subsequent low rates of late transfer due to either clinical or radiological deterioration.[2-4] This is relevant as over the last decade, many Alaskan hospitals have now acquired CT scanners. Most patients are able to undergo radiological and clinical evaluation at outlying regional hospitals. However, for pediatric head injuries, local resources may vary widely in capability to care for children.

In addition, management of the pediatric trauma patient must include consideration of radiation exposure for children. The concept of "As Low As Reasonably Achievable" (ALARA) radiation exposure is in effort to minimize lifetime risk of cancer incidence. We developed management algorithms in adherence to evidenced-based and validated guidelines of pediatric imaging.[5]

These guidelines seek to address the question of which pediatric patients require CT imaging as well as which pediatric patients can safely be kept locally for clinical observation with the help of telehealth neurosurgical consultation.

METHODS

In April 2018 the Alaska Trauma Systems Review Committee convened an ad hoc group to develop consensus recommendations for the evaluation of the acute head injured pediatric patients, focusing on considerations of care with the challenges of sparse specialty resources in the field of pediatrics. The group consisted of 23 healthcare providers with representatives of pediatrics, emergency medicine, trauma surgery, neurosurgery, pediatric intensive care, and pre-hospital care present. Prior to the meeting, a literature review was performed by two committee members and pertinent articles were distributed to the full committee. In addition, the Alaska State Head Trauma Guidelines were reviewed as these included ages 5-17 within the previous guidelines. These new guidelines represent the consensus of the committee.

DEFINITIONS

Pediatric patient:

The purpose of these guidelines is to recommend clinical practice for children ages 0-17 years. Providers may choose to use adult guidelines for adolescents, but this should be according to local protocols.

Acute head injury:

Blunt traumatic brain injury (TBI) is a disruption in the normal function of the brain that can be caused by a bump, blow, or jolt to the head.[6] This includes falls that lead to headstrike, including ground level. An acute injury is one that is evaluated within 24 hours of the traumatic event. These guidelines do not apply to strokes or hemorrhage not associated with trauma. Additionally, these guidelines should apply for blunt head trauma and are not recommended for penetrating head trauma. These guidelines apply to isolated head injury and are not recommended for patients who have signs of multi-trauma injuries.

Glasgow Coma Scale (GCS):

The most commonly accepted assessment tool for documenting neurologic status of the head injured patient. It can be used for pediatric populations with age-appropriate assessment (Figure 1).

PECARN Head CT Rule:

The Pediatric Emergency Care Applied Research Network (PECARN) performed a prospective cohort study of over 42,000 children ages 0-2 and 2-17 who sustained head injury with GCS 14-15.[7] Prediction rules were identified and validated to identify children at very low risk of clinically-important traumatic brain injuries (defined as death, neurosurgery, intubation >24h, hospital admission >2d). Separation of recommendations for children younger than 2 years of age is due to the increased importance of reducing radiation exposure, the minimal ability of

children these ages to communicate, and the difference in trauma mechanisms. The PECARN pediatric head injury imaging guideline is standard practice in the United States and has the highest validation of sensitivity when compared to other pediatric head injury clinical decision rules.[8] These guidelines base CT imaging for pediatric patients with head injury and GCS 14-15 on these recommendations (Figure 2, 6).

Pediatric Cervical Spine Imaging:

When appropriate, the pediatric cervical spine can be cleared clinically. However, pediatric patients with suspicion for cervical spine (c-spine) injuries will require imaging. Choice of imaging modality must balance accuracy and minimizing radiation dosing; particular concerns for radiation exposure to the neck is the location of the thyroid gland. The use of cervical CT scans in children can be minimized without missing clinically significant injuries. If imaging is required, recommendation is to use plain x-ray AP and lateral views of the cervical spine. If there is continued pain or deficits or the patient remains unable to clinically clear due to mental status, MRI imaging may be considered. The above recommendations are in accordance with NEXUS criteria and should be used with caution in children younger than 2 years of age due to small representation in the initial studies[9,10] (Figure 3). In patients undergoing a head CT, local protocols are encouraged to include imaging of C1-C3.[11] Additional plain films will need to be obtained to provide a complete radiographic clearance of the cervical spine. Patients with suspected or confirmed c-spine injury are recommended for spinal motion restriction.[12] Consideration of full spine imaging may be appropriate depending on trauma mechanism; consultation with a specialist may aid in determining need of further imaging.

Spinal cord injury without radiographic abnormalities (SCIWORA) is more common in pediatric patients than adults. Normal c-spine plain film x-rays may be found in up to two-thirds of children who sustain a spinal cord injury. Thus, if spinal cord injury is suspected, normal c-spine plain films do not exclude significant spinal cord injury.[13] If cervical spine or spinal cord injury is suspected, limit spinal motion and obtain appropriate consultation.

Spinal Motion Restriction:

Spinal motion restriction refers to the concept of minimizing unwanted movement of the potentially injured spine. This may include cervical collar placement as well as backboard, scoop stretcher, vacuum splint, or ambulance cot during transfer of patients with suspected spinal injury. In pediatric patients, cervical collar should be applied if the patient has any of the following: complaint of neck pain, torticollis, neurologic deficit, altered mental status (GCS<15), or involvement in a high-risk motor vehicle collision.[12] Time on backboards should be minimized to avoid pressure ulcers; for prolonged transport times vacuum mattress or padding as an adjunct should be considered. Additional padding under the shoulders of young children may be required to avoid excessive cervical spine flexion due to the variation of head size to body ratio.

Clinical Observation:

Neurochecks performed by a health care provider. The patient should remain at the facility for a health care provider to perform these checks. Frequent neurochecks are recommended and consideration of hourly checks is recommended based on local resources. Clinical observation should continue for a minimum of 4 hours from time of injury and continue until the patient returns to GCS 15. Clinical staff should be qualified to deliver care to children. Pediatric GCS score (Figure 1) and pupillary response should be monitored serially.

Risk Factors:

Risk factors are clinical signs, symptoms or history that place the patient at higher risk for clinically significant intracranial injury regardless of GCS.[7]

- **Altered mental status –** Pediatric mental status is age dependent and can be difficult to evaluate. Any child with agitation, slow response, or repetitive questions should be considered high-risk for intracranial injury.
- **Clinical signs of skull fracture –** Clinical signs of a basilar skull fracture include periorbital ecchymosis (raccoon's eyes), retroauricular ecchymosis (Battle's sign), hemotympanum, or cerebrospinal fluid (CSF) leak from the nose (rhinorrhea) or ear (otorrhea). Additionally in pediatric patients, a skull fracture may be palpable.
- **Dangerous mechanism of injury –** High velocity mechanisms may lead to higher force if headstrike occurs and should be evaluated with a higher suspicion of intracranial hemorrhage. These include pedestrian or bicyclist without a helmet struck by a motorized vehicle, ejection from a motor vehicle crash (MVC), death of occupant in vehicle, and falls from greater than 3 feet for ages 0-2 or greater than 5 feet for ages 2-17.
- **Suspected non-accidental trauma –** Clinical suspicion of non-accidental trauma should prompt a more thorough evaluation for trauma. Exam findings may be more severe than the mechanism of injury reported, thus a heightened awareness of potential injury is warranted.

Non-accidental Trauma:

Providers who are caring for injured children must evaluate for signs of non-accidental trauma (NAT). Head injuries are the leading cause of child physical abuse fatality and occurs most commonly in infants.[14] If there is clinical or social suspicion for non-accidental trauma, a thorough work-up will need to be performed to look for injury and head CT imaging is recommended. Local protocols should be followed for additional imaging required beyond CT head imaging, which should include skeletal surveys. Ophthalmologic examination should be considered, including a dilated eye exam to evaluate for retinal hemorrhages. Additionally, children may require local admission or clinical observation if a safe discharge is not identified. It is mandatory to report to the Office of Children's Services (OCS) when there is a reasonable cause to suspect child abuse or neglect.[15] Anyone with concern can initiate the process. Mandated reporters must report suspected abuse or neglect as soon as reasonably possible and no later than within 24 hours (Figure 5).

RECOMMENDATIONS (See attached Algorithm)[16-21]

Patients with GCS 15 with low-risk – Per PECARN guidelines, patients with GCS of 15 and without risk factors can safely avoid CT imaging.[7] The risk of clinically-important TBI injury in patients with GCS 14-15 and no risk factors is less than 0.02% of children younger than 2 years and less than 0.05% of those aged 2-17 years. We recommend against any CT imaging for this patient population. The patient may be discharged with a responsible adult and a head injury patient education sheet (Figure 4).

Patients with GCS 15 with intermediate-risk – Per PECARN guidelines, patients with GCS of 15 but with intermediate-risk factors present may be considered for immediate CT head imaging or for clinical observation.[7] For children younger than 2 years of age, this includes non-frontal scalp hematoma, loss of consciousness greater than 5 seconds, abnormal behavior per parents report, or a severe injury mechanism. For children aged 2-17 years, this includes a history of vomiting, loss of consciousness greater than 5 seconds, severe headache, or a severe injury mechanism. The risk of clinically-important TBI injury in patients with GCS 14-15 and intermediate-risk factors is 0.9% of children aged 0-17 years. The discussion of whether to pursue CT head imaging or clinical observation should involve the parents. Other clinical factors to consider include local resources, physician experience, multiple versus isolated findings, worsening symptoms or signs after clinical observation, and age less than 3 months. In facilities without CT imaging available, poor weather or lack of air-transport may factor into the decision to observe locally or pursue CT imaging.

If clinical observation is chosen, we recommend consideration of clinical observation locally for a minimum of 4 hours post-injury. Children less than 3 months of age may be considered for a longer period of observation due to the difficulty to assess mental status. After observation, if the patient's symptoms are improved, the patient may be discharged with a responsible adult and a head injury patient education sheet (Figure 4). If there has been no improvement, clinical reassessment is needed with consideration of CT imaging or specialty consultation.

If CT imaging is chosen, we recommend that all of these patients undergo a head CT without contrast and evaluation of the cervical spine according to pediatric c-spine imaging protocol. In facilities without CT imaging available, this would require a transfer to a higher care facility. If the head CT imaging is normal, we recommend consideration of clinical observation locally for a minimum of 4 hours post-injury. After observation, the patient may be discharged with a responsible adult and a head injury patient education sheet.

If head CT imaging is abnormal, these patients should be transferred to a trauma center with pediatric and neurosurgical capabilities. Spinal motion restriction should be maintained in transport as indicated. Images should be sent via teleradiology and a neurosurgical consult obtained promptly. Consultation with a pediatric intensivist should be obtained, with the preference of notification prior to arrival at the tertiary center to allow for early recommendations of clinical care.

Patients with GCS 15 with high-risk – Per PECARN guidelines, patients with GCS of 15 but with high-risk factors present, such as altered mental status, agitation, slow response, repetitive

questions, palpable skull fracture, basilar skull fracture, dangerous mechanism, or suspected non-accidental trauma should undergo CT imaging. This is due to a higher rate of clinically-important TBI. The risk of clinically-important TBI injury in this group is 4.4% of children younger than 2 years and 4.3% of those aged 2-17 years.[7] We recommend that all of these patients undergo a head CT without contrast and evaluation of the cervical spine according to pediatric c-spine imaging protocol. In facilities without CT imaging available, this would require a transfer to a higher care facility. If the head CT imaging is normal, we recommend consideration of clinical observation locally for a minimum of 4 hours post-injury. The patient may be discharged with a responsible adult and a head injury patient education sheet when GCS returns to 15 (Figure 4). If the patient is not improved after clinical observation, or there has been deterioration in mental status, a consultation with a pediatric intensivist should be obtained. Discussion with a pediatric intensivist should guide the decision for local admission or transfer to a pediatric trauma center. If transfer is recommended, a pediatric trauma consultation should be obtained.

If head CT imaging is abnormal, these patients should be transferred to a trauma center with pediatric and neurosurgical capabilities. Spinal motion restriction should be maintained in transport as indicated. Images should be sent via teleradiology and a neurosurgical consult obtained promptly. Consultation with a pediatric intensivist should be obtained, with the preference of notification prior to arrival at the tertiary center to allow for early recommendations of clinical care.

Patients with GCS 14 without risk factors – Patients with a GCS of 14 without risk factors may undergo clinical observation for 2 hours or may be triaged immediately to CT scan. This decision may be impacted by local resources and by parental preference. If the patient improves to a GCS of 15, the child may be discharged with a responsible adult and a head injury patient education sheet (Figure 4).

If after 2 hours of clinical observation, the GCS remains at 14, we recommend obtaining a head CT without contrast, spinal motion restriction, and evaluation of the cervical spine according to pediatric c-spine imaging protocol. In facilities without CT imaging available, this would require a transfer to a higher care facility. If the head CT imaging is normal, we recommend consideration of clinical observation locally for a minimum of 4 hours post-injury. The patient may be discharged with a responsible adult and a head injury patient education sheet when GCS returns to 15 (Figure 4).

If the patient is not improved after clinical observation, or there has been deterioration in mental status, a consultation with a pediatric intensivist should be obtained. Discussion with a pediatric intensivist should guide the decision for local admission or transfer to a pediatric trauma center. If transfer is recommended, a pediatric trauma consultation should be obtained.

If head CT imaging is abnormal, these patients should be transferred to a trauma center with pediatric and neurosurgical capabilities. Spinal motion restriction should be maintained in transport. Images should be sent via teleradiology and a neurosurgical consult obtained promptly.

Consultation with a pediatric intensivist should be obtained, with the preference of notification prior to arrival at the tertiary center to allow for early recommendations of clinical care.

Patients with GCS 14 with risk factors – Patients with GCS of 14 but with risk factors present, such as altered mental status, agitation, slow response, repetitive questions, palpable skull fracture, basilar skull fracture, dangerous mechanism, or suspected nonaccidental trauma should increase your suspicion of clinically significant intracranial injury. We recommend that all of these patients undergo a head CT without contrast, spinal motion restriction, and evaluation of the cervical spine according to pediatric c-spine imaging protocol. In facilities without CT imaging available, this would require a transfer to a higher care facility. If the head CT imaging is normal, we recommend consideration of clinical observation locally for a minimum of 4 hours post-injury. The patient may be discharged with a responsible adult and a head injury patient education sheet when GCS returns to 15 (Figure 4). If the patient is not improved after clinical observation, or there has been deterioration in mental status, a consultation with a pediatric intensivist should be obtained. Discussion with a pediatric intensivist should guide the decision for local admission or transfer to a pediatric trauma center. If transfer is recommended, a pediatric trauma consultation should be obtained.

If head CT imaging is abnormal, these patients should be transferred to a trauma center with pediatric and neurosurgical capabilities. Spinal motion restriction should be maintained in transport. Images should be sent via teleradiology and a neurosurgical consult obtained promptly. Consultation with a pediatric intensivist should be obtained, with the preference of notification prior to arrival at the tertiary center to allow for early recommendations of clinical care.

Patients with GCS 9-13 – We recommend that all of these patients undergo a head CT without contrast, spinal motion restriction, and evaluation of the cervical spine according to pediatric c-spine imaging protocol. In facilities without CT imaging available, this would require a transfer to a higher care facility. If the head CT imaging is normal, we recommend consideration of clinical observation locally for a minimum of 4 hours post-injury. The patient may be discharged with a responsible adult and a head injury patient education sheet when GCS returns to 15 (Figure 4). If the patient is not improved after clinical observation, or there has been deterioration in mental status, a consultation with a pediatric intensivist should be obtained. Discussion with a pediatric intensivist should guide the decision for local admission or transfer to a pediatric trauma center. If transfer is recommended, a pediatric trauma consultation should be obtained.

If head CT imaging is abnormal, these patients should be transferred to a trauma center with pediatric and neurosurgical capabilities. Spinal motion restriction should be maintained in transport. Images should be sent via teleradiology and a neurosurgical consult obtained promptly. Consultation with a pediatric intensivist should be obtained, with the preference of notification prior to arrival at the tertiary center to allow for early recommendations of clinical care.

Patients with GCS 3-8 – These patients should initially be optimized with protection of the airway, avoidance of hypoxia and hypotension, maintenance of normocarbia, elevation of the head of bed to greater than thirty degrees if possible, and spinal motion restriction. In addition, a

blood glucose level should be checked and hypoglycemia should be prevented. In Alaska Native children, particular consideration of hypoglycemia in pediatric patients is warranted due to higher prevalence of the Arctic Variant of carnitine palmitoyltransferase 1A (CPT1A). The Arctic Variant of CPT1A can make the infant or child more susceptible to hypoglycemia in the setting of fasting and stress.[22,23]

Patients with GCS 3-8 should then be transferred to a trauma center with pediatric and neurosurgical capabilities. Pediatric airway should be secured with an endotracheal tube, if available we recommend a cuffed tube. Spinal motion restriction should be maintained in transport. A non-contrast CT of the head and c-spine should be obtained if this does not delay transfer. If CT imaging is not available, these patients should be transferred to a pediatric trauma center with neurosurgical capabilities. These severely injured patients do not require primary transfer to a regional facility in order to obtain a CT scan and should be considered for direct transfer to a pediatric trauma center. If images are obtained, these should be sent via teleradiology and a neurosurgical consult obtained promptly. Consultation with a neurosurgeon may include medical optimization of severe head injury that can be initiated prior to or during transport, including management of sodium levels as indicated.

If head CT imaging is obtained and is normal, the patient should then be transferred to a pediatric trauma center. A pediatric trauma consultation should be obtained prior to arrival. Consultation with a pediatric intensivist should be obtained, with the preference of notification prior to arrival at the tertiary center to allow for early recommendations of clinical care.

Other Recommendations – Management of Linear Nondisplaced Skull Fractures:

Children who are found to have isolated linear nondisplaced skull fractures may be grouped with patients who are found to have normal head CT findings.[24-28] Exceptions include open or comminuted fractures, more than one skull fracture, or pneumocephalus. We recommend that children with isolated findings of a single linear nondisplaced skull fracture undergo clinical observation locally for a minimum of 4 hours post-injury. After observation, the patient may be discharged with a responsible adult and a head injury patient education sheet. A rare complication of skull fractures in the young child (less than 3 years of age) is posttraumatic leptomeningeal cysts, also known as growing skull fractures. Routine follow-up x-rays for skull fractures are not recommended. However, young children (less than 3 years of age) with a history of a skull fracture and a scalp mass present within 6 months post-injury should be evaluated clinically and by AP/lateral skull x-rays.[29]

CONCLUSIONS

Our recommendations offer an approach to the evaluation of pediatric head injured patients in Alaska, to range from facilities that do not have CT imaging available to rural facilities without neurosurgical capabilities to urban facilities with specialty care. These recommendations are an attempt to combine a reading of the current literature with the realities of medical practice and resource scarcity in our vast state. It is not meant to replace clinical judgment. There are limits to the applicability of these guidelines including complex social considerations, transport considerations and possible delays in care, and remote medical

treatment facilities with minimal staff. Our hope is that this will offer some guidance to clinicians faced with caring for the pediatric head injured patient in a very challenging environment. In addition, it will help us to utilize our transport and subspecialty resources in a safe, responsible, and efficient manner.

Figure 1: Pediatric Glasgow Coma Scale

	Child	Infant	Score
Eye(s) Opening	Spontaneous	Spontaneous	4
	To speech	To speech	3
	To pain	To pain	2
	No response	No response	1
Verbal Response	Oriented, appropriate	Coos and babbles	5
	Confused, inappropriate	Irritable cries	4
	Inappropriate words	Cries to pain	3
	Inappropriate sounds	Moans to pain	2
	No response	No response	1
Best Motor Response	Obeys commands	Spontaneous, purposeful	6
	Localizes pain	Withdrawal from touch	5
	Withdrawal from pain	Withdrawal from pain	4
	Flexion to pain	Abnormal flexion to pain	3
	Extension to pain	Abnormal extension to pain	2
	No response	No response	1

Figure 2: PECARN Imaging Algorithm[7]

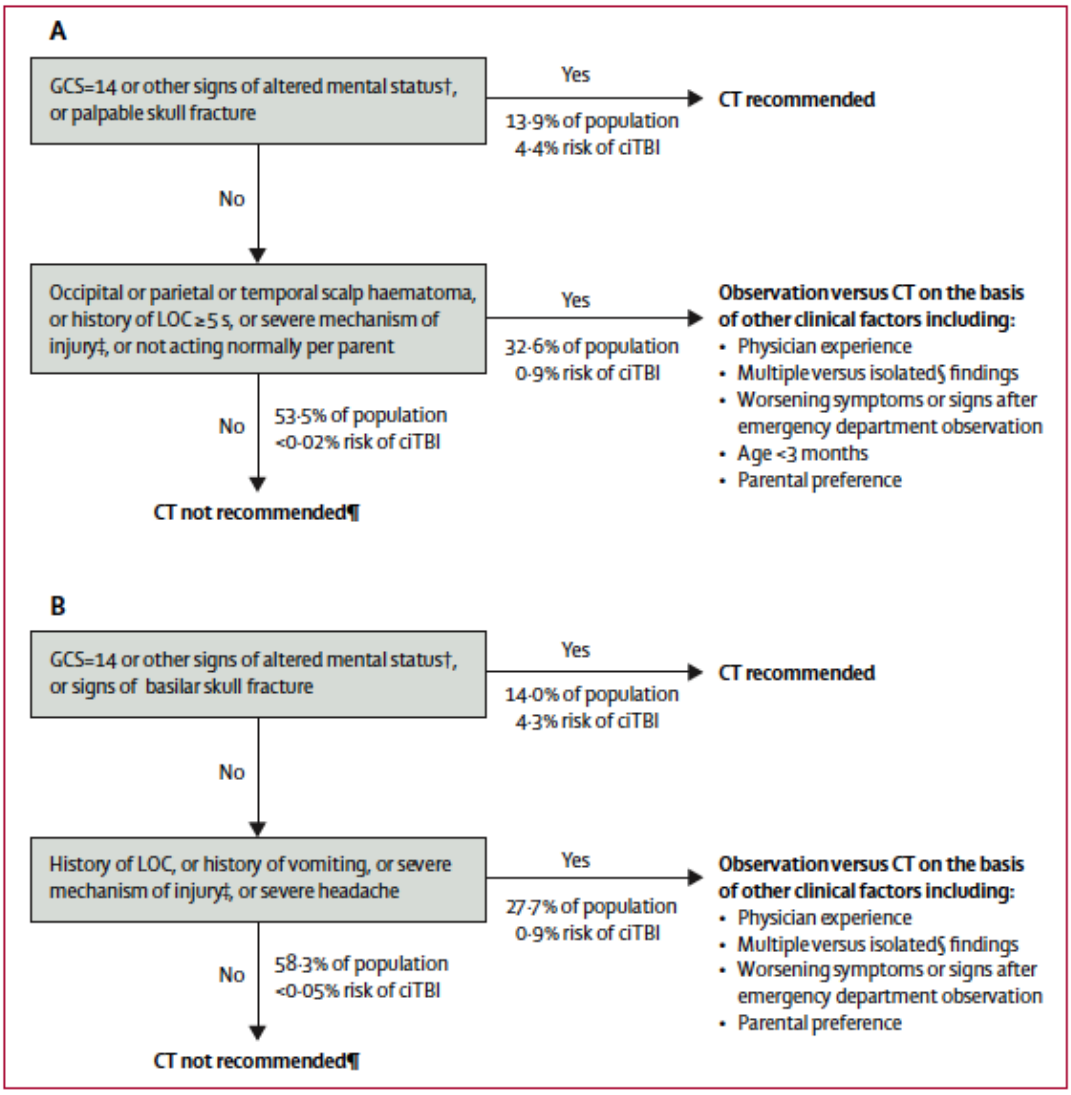


Figure 3*: Suggested CT algorithm for children younger than 2 years (A) and for those aged 2 years and older (B) with GCS scores of 14–15 after head trauma

GCS=Glasgow Coma Scale. ciTBI=clinically-important traumatic brain injury. LOC=loss of consciousness. *Data are from the combined derivation and validation populations. †Other signs of altered mental status: agitation, somnolence, repetitive questioning, or slow response to verbal communication. ‡Severe mechanism of injury: motor vehicle crash with patient ejection, death of another passenger, or rollover; pedestrian or bicyclist without helmet struck by a motorised vehicle; falls of more than 0·9 m (3 feet) (or more than 1·5 m [5 feet] for panel B); or head struck by a high-impact object. §Patients with certain isolated findings (ie, with no other findings suggestive of traumatic brain injury), such as isolated LOC,[39,40] isolated headache,[41] isolated vomiting,[41] and certain types of isolated scalp haematomas in infants older than 3 months,[31,42] have a risk of ciTBI substantially lower than 1%. ¶Risk of ciTBI exceedingly low, generally lower than risk of CT-induced malignancies. Therefore, CT scans are not indicated for most patients in this group.

Figure 3: Pediatric Cervical Spine Imaging Protocol[9]

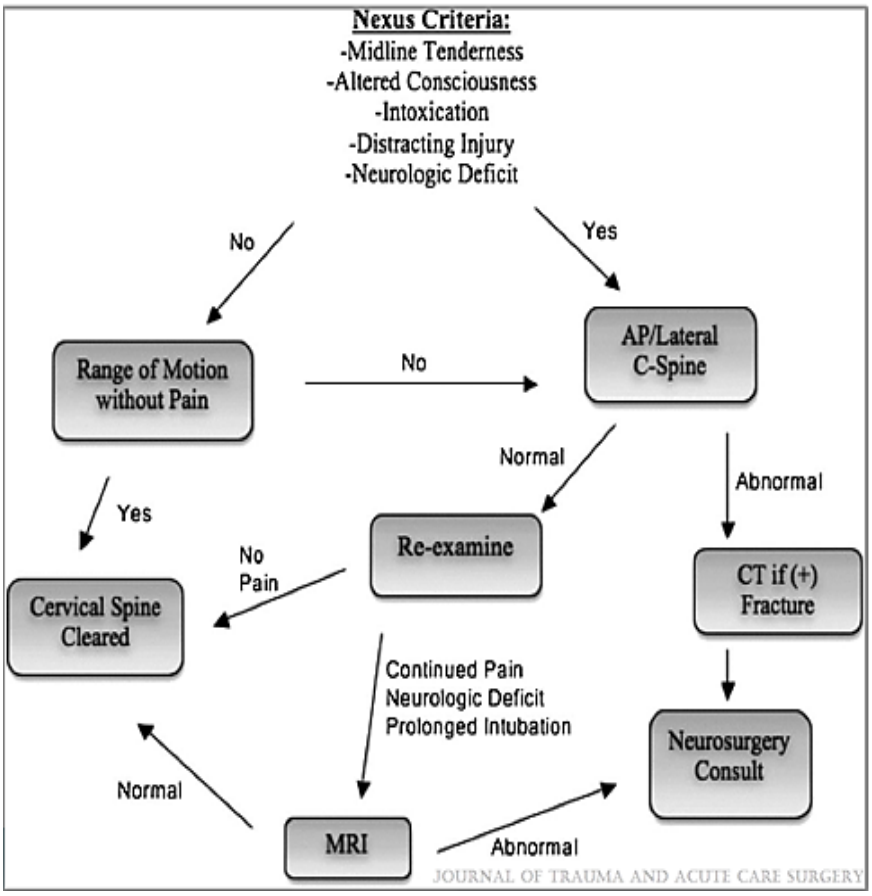


Figure 4: Patient Education Sheet for Traumatic Brain Injury

Facts about Concussion and Brain Injury

About Concussion

A concussion is a type of traumatic brain injury (TBI) caused by a bump, blow, or jolt to the head. Concussions can also occur from a fall or a blow to the body that causes the head and brain to move quickly back and forth. Doctors may describe a concussion as a "mild" brain injury because concussions are usually not life-threatening. Even so, their effects can be serious.

Concussion Signs and Symptoms

Most people with a concussion recover quickly and fully. But for some people, symptoms can last for days, weeks, or longer. In general, recovery may be slower among older adults, young children, and teens. Those who have had a concussion in the past are also at risk of having another one and may find that it takes longer to recover if they have another concussion. Symptoms of concussion usually fall into four categories:

Thinking/Remembering	Difficulty thinking clearly	Feeling slowed down	Difficulty concentrating	Difficulty remembering new information
Physical	Headache	Nausea or vomiting (early on)	Sensitivity to noise or light	Feeling tired, having no energy
	Fuzzy or blurry vision	Dizziness	Balance problems	
Emotional/Mood	Irritability	Sadness	More emotional	Nervousness or anxiety
Sleep	Sleeping more than usual	Sleep less than usual	Trouble falling asleep	

Getting Better

Rest is very important after a concussion because it helps the brain to heal. Ignoring your symptoms and trying to "tough it out" often makes symptoms worse. Be patient because healing takes time. Only when your symptoms have reduced significantly, in consultation with your doctor, should you slowly and gradually return to your daily activities, such as work or school. If your symptoms come back or you get new symptoms as you become more active, this is a sign that you are pushing yourself too hard. Stop these activities and take more time to rest and recover. As the days go by, you can expect to gradually feel better.

Tips to help you get better:

- Get plenty of sleep at night, and rest during the day.
- Avoid activities that are physically demanding (e.g., sports, heavy housecleaning, working-out) or require a lot of concentration (e.g., sustained computer use, video games).
- Ask your doctor when you can safely drive a car, ride a bike, or operate heavy equipment.
- Do not drink alcohol. Alcohol and other drugs may slow your recovery and put you at risk of further injury.

There are many people who can help you and your family as you recover from a concussion. You do not have to do it alone. Keep talking with your doctor, family members, and loved ones about how you are feeling, both physically and emotionally. If you do not think you are getting better, tell your doctor.

For more information and resources, please visit CDC on the Web at: www.cdc.gov/Concussion.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention

CDC

CS202043

Figure 5: Reporting Guidelines for Non-Accidental Trauma in Children

Triggers corroborative of Abusive Head Injury that warrant consultation and mandate report to Office of Children's Services (OCS):

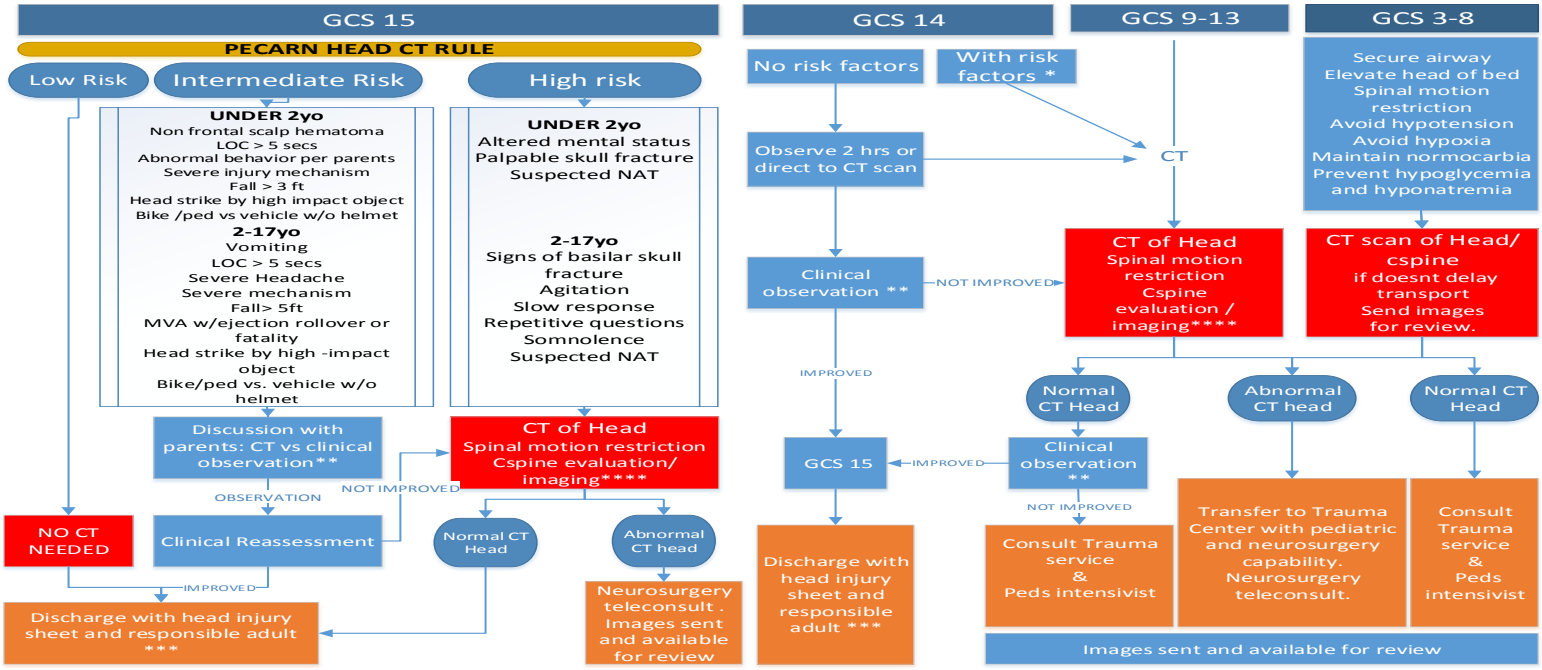
1. Unexplained injuries
2. Changing histories
3. History unexplained/unlikely due to child's current level of development
4. Child sicker than history indicates
5. Delay in seeking care
6. Bruising on non-mobile children
    a. Less than 6 months of age
    b. Special needs children
7. Bruises on:
    a. Fatty body parts (thighs, buttocks, cheeks, posterior calves)
    b. Areas usually covered (bathing suit areas, back, abdomen)
    c. Ears, lips, neck
        i. Studies have shown that orofacial trauma is exceedingly rare in children who undergo mask ventilation, intubation or other resuscitative therapies.
8. Rib fractures, old fractures
9. Injuries to neck, phrenulae, tongue
10. Other injuries as found by complete physical exam, e. g.:
    a. Evolving bruising noted after resuscitation
    b. Patterned bruises

Alaska Child Abuse Hotline: 1-800-478-4444

Consultation with Child Advocacy Center:
http://alaska.nationalchildrensalliance.org/find-a-child-advocacy-center-in-alaska/

Consultation with Pediatric Intensivist:

Algorithm: Alaska Pediatric Head Blunt Injury Guidelines



*** Risk factors**

Altered mental status

Palpable skull fracture

Suspected nonaccidental trauma

Basilar skull fracture

Agitation, slow response, repetitive questions

Dangerous mechanism – under 2yo fall > 3 ft. / 2-18yo fall > 5 ft.;

-MVA w/ejection rollover or fatality; Head strike by high -impact object; Bike or pedestrian vs. vehicle w/o helmet

****Clinical observation**

Repeat examination performed by a health care provider. Frequent neuro examinations are recommended and consider at least Q 1 hr neuro checks for 4 hrs from injury.

***** Head Injury sheet**

(see attachment)

******Cspine imaging**- pediatric c-spine protocol. (see attachment): Pediatric patients have a significant incidence of cervical spine injury despite negative spine imaging or CT scan. Spinal motion restriction should be continued in neurologically abnormal patients until spinal column or cord injury has been excluded.

NEUROSURGERY REQUESTS THAT THE CT IMAGES ARE SENT AND ARE AVAILABLE FOR REVIEW AT TIME OF TELECONSULTATION.

Pediatric Head Trauma Guideline Task Force

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