

Clinical Questions: among pediatric patients (age <=18 years) with head injury/TBI, what characteristics or degree of injury warrants treatment in a designated level 1/pediatric trauma center (i.e. center with pediatric neurosurgical capability)? Conversely, which injuries can be treated in a local community hospital/level 2/3/non-trauma center?

Approach: A systematic literature search was performed with the assistance of a certified medical librarian. 71 guideline/systematic review articles were reviewed. Based on the quality of the guidelines [1] and relevance to the clinical question, 4 guidelines were selected [2-5].

Summary of guideline findings:

Lumba-Brown [2]:

- PECARN criteria [6] are well-validated for ruling out important intracranial injury -> if there are no indications for CT scan by the PECARN rule, transfer to a tertiary care center is likely not indicated (suspected child abuse is an exception).
- Persistent vomiting, loss of consciousness (LOC), seizures, skull fracture are risk factors for important intracranial injury requiring intervention -> these should prompt transfer to tertiary care.

SIGN [3]: Transfer to center with neurosurgical capability if:

- Persisting coma (GCS score 8 or less) after resuscitation
- Confusion persisting more than 4 hours
- Deterioration in level of consciousness after admission (decrease in 1 point on motor/verbal, or 2 points on eye opening GCS subscales)
- Focal neurologic signs
- Seizure without full recovery
- Depressed skull fracture
- Definite/suspected penetrating injury
- CSF leak or other sign of basilar skull fracture

Astrand [4]:

- Classifies injuries into the following:
 - **Moderate** (GCS 9-13)
 - **Mild, high risk** – GCS 14-15, with focal neuro deficit, seizures, clinical signs of skull base fracture or depressed skull fracture
 - **Mild, medium risk** – GCS 14, or GCS 15 with LOC >1 min, or on anticoagulation medications/coagulation disorder
 - **Mild, low-risk** – GCS 15 and amnesia to the event, severe headache, abnormal behavior per guardian, more than 2 episodes of emesis, brief LOC, patient with a ventricular shunt, or large temporal/parietal scalp hematoma/irritability (if <2 yrs old)
 - **Minimal risk** – GCS 15 and none of previous risk factors
- **Moderate** and **Mild, high risk** get immediate head CT and neurosurgical consultation (i.e. transfer to higher level of care if no neurosurgeon available)
- **Mild, medium risk** get observation for at least 12 hours +/- head CT

- **Mild, low risk** gets observation for at least 6 hours, or head CT if there are multiple risk factors
- **Minimal risk** gets discharge with appropriate guardian instructions (i.e. does not need higher level of care)
- Even if **Minimal risk**, consider transfer to higher level of care if suspected child abuse, bulging fontanelle, or high-velocity injury mechanism

New Zealand Guidelines [5]:

- General guideline covering both adults and children
- Involve neurosurgeon (i.e. transfer to higher level of care if no neurosurgeon available) if :
 - Severe TBI (GCS 8 or less)
 - Deterioration in GCS (GCS decrease by 2 or more) or new neuro deficit
 - Significant focal neuro deficit
 - Surgically significant lesion on imaging: intracranial bleed with midline shift, open/depressed skull fracture, diffuse brain swelling/cerebral edema
 - CSF leak
 - Penetrating brain injury
 - Seizure without full recovery
- Admit to hospital (i.e. transfer to higher level of care if unable to admit) if :
 - Any of the above
 - Significant abnormalities on imaging
 - GCS less than 15 after imaging
 - Early post-traumatic seizure
 - Skull fracture
 - Major force of injury
 - Continuing signs of concern (vomiting, severe headaches, amnesia to event)
 - Other concerns: abuse, intoxication, other injuries, extremes of age
 - No caregiver available for discharge
- Guidelines for transfer to higher level of care
 - Designated consultants at sending and receiving facility for handoff
 - Local guidelines regarding transfer should be written and followed
 - Resuscitate/stabilize before transport
 - Intubate/ventilate if GCS 8 or less
 - Experienced staff to transport (recommend doctor with at least 2 years experience to accompany, pediatric-trained staff for children)
 - Transfer team must be able to communicate with sending and receiving facility during transfer
 - Provide resources for education, training, and audit

Sources:

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2. Lumba-Brown A, Yeates KO, Sarmiento K, et al. Diagnosis and Management of Mild Traumatic Brain Injury in Children: A Systematic Review. JAMA Pediatr. 2018;172(11):e182847. doi:10.1001/jamapediatrics.2018.2847

3. SIGN. SIGN 110: Early Management of Patients with a head injury. A national clinical guideline Edinburgh: Scottish Intercollegiate Guidelines Network, 2009. <https://www.sign.ac.uk/sign-110-early-management-of-patients-with-a-head-injury>
4. Astrand R, Rosenlund C, UndeÅn J. Scandinavian guidelines for initial management of minor and moderate head trauma in children. BMC Medicine. 2016; 14(1):33. <https://doi.org/10.1186/s12916-016-0574-x> PMID: 26888597
5. NZG Group. Traumatic Brain Injury: Diagnosis, Acute Management and Rehabilitation. Wellington: New Zealand Guidelines Group, 2006. <https://www.moh.govt.nz/NoteBook/nbbooks.nsf/0/B8738C3605889A6ACC257A6D00809243?opendocument>
6. Kuppermann N, Holmes JF, Dayan PS, et al. Identification of children at very low risk of clinically-important brain injuries after head trauma: a prospective cohort study. Lancet 2009; 374: 1160–70. DOI:10.1016/S0140-6736(09)61558-0