Trauma Clinical Guideline

Initial Management of Traumatic Brain Injury

The Trauma Medical Directors and Program Managers Workgroup is an open forum for designated trauma services in Washington State to share ideas and concerns about providing trauma care. The workgroup meets regularly to encourage communication among services, and to share best practices and information to improve quality of care. On occasion, at the request of the Emergency Medical Services and Trauma Care Steering Committee, the group discusses the value of specific clinical management guidelines for trauma care.

The Washington State Department of Health distributes this guideline on behalf of the Emergency Medical Services and Trauma Care Steering Committee to assist trauma care services with developing their trauma patient care guidelines. Toward this goal the workgroup has categorized the type of guideline, the sponsoring organization, how it was developed, and whether it has been tested or validated. The intent of this information is to assist physicians in evaluating the content of this guideline and its potential benefits for their practice or any particular patient.

The Department of Health does not mandate the use of this guideline. The department recognizes the varying resources of different services, and approaches that work for one trauma service may not be suitable for others. The decision to use this guideline depends on the independent medical judgment of the physician. We recommend trauma services and physicians who choose to use this guideline consult with the department regularly for any updates to its content. The department appreciates receiving any information regarding practitioners’ experience with this guideline. Please direct comments to 360-236-2874.

This is a trauma assessment and management guideline. It was adapted from professional literature. The workgroup reviewed the guideline, sought input from trauma care physicians throughout Washington State, and used that input to make changes. Both the Emergency Medical Services and Trauma Care Steering Committee and the Department of Health Office of Community Health Systems endorsed the guideline. This guideline has not been tested or validated.
The problem
Traumatic brain injury (TBI) is a frequent event. It occurs in more than 1.7 million people annually, resulting in more than 1 million emergency room visits. TBI has significant public health and socioeconomic effects, resulting in more than 50,000 deaths per year and billions in healthcare costs. In children, TBI is the leading cause of death in patients less than 18 years of age and results in more than 60,000 admissions. The majority of TBI’s occur from blunt injuries sustained in falls, motor vehicle crashes (MVC), sports and recreational injuries.

Assessment
The assessment of any trauma patient should follow a systematic approach (primary and secondary survey) such as that discussed in the advanced trauma life support (ATLS) course. This process will ensure immediate life-threatening injuries are discovered and treated first, and will help limit the potential for missed injuries.

The initial or early signs of TBI may be subtle and relate to small increases in intracranial pressure. They include:

- headache
- nausea
- altered level of consciousness (LOC)
- Glasgow coma scale (GCS) < 15

If left untreated, intracranial pressure may increase and result in herniation of the brain. Assessment findings with brain herniation may include:

- unilateral or bilateral pupil dilatation
- GCS < 8
- Cushing’s triad (widened pulse pressure, bradycardia, irregular respirations)
- absence of deep tendon and plantar responses
- Abnormal posturing (decorticate and decerebrate)

Initial documentation of the GCS is a vital step in the assessment process. The initial GCS will serve as a baseline on which future neurological assessments will be based. The brief neurological assessment in the primary survey should include not only the GCS but also the LOC, pupillary size and response to light, posturing, and vital signs review. The neurological assessment in the secondary and tertiary surveys should be in more detail.

Early consideration should be given to the patients past medical history. Patients prescribed any type of anticoagulant are at increased risk for intracerebral bleeding. In these cases, providers should immediately consider reversal of anticoagulation. The Head Injury in the Anticoagulated Patient guideline should be referenced.

Diagnostics
The patient with TBI should be closely monitored with trending of vital signs to include GCS and LOC. Assessing the vital signs over time will help identify the initial onset of increased ICP developing as Cushing’s triad (widened pulse pressure, bradycardia, and irregular respirations).

If the patient has been prescribed anticoagulant medications, an immediate coagulation study and computed tomography (CT) should be performed. Prediction rules have been developed to help determine if a TBI may exist and also to help assist in the decision making to obtain a CT. If the patient
meets one of the followed prediction criteria, a TBI may exist for which a CT is warranted for definitive diagnosis. If hemodynamically unstable, patients should be resuscitated before receiving a CT.

**Prediction Rules (recommend CT)**

- GCS ≤ 14
- Altered mental status
- Skull fracture
- Loss of consciousness
- Vomiting
- Severe mechanism of injury (patient ejected from vehicle, death of another vehicle passenger, vehicle rollover, or fall greater than twice the height of the patient)
- Severe headache

**Interventions**

The goals of treatment for the patient with a TBI should be directed toward preventing a secondary injury. Secondary injury results from hypotension, hypoxemia, hypercarbia, cerebral edema, increased intracranial pressure (ICP), decreased cerebral perfusion pressure (CPP), and cerebral ischemia. All of these can cause further injury to the brain, compounding the initial injury. Interventions should be directed to prevent secondary injury.

The patient’s airway and oxygenation should be assessed immediately upon arrival. Oxygen therapy should be started and the need for intubation should be anticipated. Appropriate ventilation can be guided by monitoring the expiratory carbon dioxide (CO2) levels via capnography (35-45 mm Hg). Capnography values should be used with caution and correlated with blood gas results in hypovolemic/shock patients.

The systolic blood pressure (SBP) should be monitored closely to avoid hypotension. The patient should receive controlled crystalloid intravenous (IV) solutions with caution to prevent circulatory overload. Patients with simultaneous hemorrhage should receive blood products.

The patient’s core temperature should also be monitored closely to prevent hypothermia. It may be necessary to implement warming measures such as warm blankets, increasing ambient air temperature, or applying an external warming device.

To help facilitate the flow of blood out of the head and prevent any increase in ICP the head of bed should be elevated to 30 degrees (low semi-fowlers position). If there is a suspected spine injury use caution and consider the reverse Trendelenburg position.

In some cases any agitation to the patient or pain can increase ICP. Consideration should be made to administering sedative and/or pain medications.

Patients suspected of having a TBI with significant neurological injury should be consulted to neurosurgery immediately. If neurosurgical services are unavailable the patient should be transferred to a higher level designated trauma service with neurosurgical capabilities.

**Advanced interventions**

If impending brain herniation is occurring based on the signs and symptoms above, it may be necessary to administer hypertonic saline (23.4 percent) or an osmotic diuretic such as Mannitol. These medications
will help reduce interstitial fluid, thus limiting the effect of increasing ICP. These medications should not be used in patients with hypotension or hemorrhage. Hypertonic saline should be given via central line. These interventions should be considered with neurosurgical consultation and preparation for transport to definitive care.

**Pediatrics**

Children are at risk for head injury because of some anatomical and physiological differences. Over the past decade the use of computed tomography (CT) has become the standard diagnostic tool when evaluating children with TBI. In recent years it has been discovered the overuse of CT has placed young patients at risk for malignancies. As a result, current clinical recommendations suggest limiting the use of CT when clinical prediction rules are available. These prediction rules have been studied and were published by the Pediatric Emergency Care Applied Research Network (PECARN). When followed, these prediction rules result in a near 100 percent accuracy rate for identifying children with low-risk TBI, which would not require CT. If the patient has any of the signs or symptoms in the prediction rules, a CT is recommended.

**Prediction Rules (recommend CT)**

- Less than two years of age:
  - GCS less than or equal to 14; signs of altered mental status
  - Palpable skull fracture
  - Occipital, parietal, or temporal scalp hematoma
  - Loss of consciousness
  - Severe mechanism of injury (patient ejected from vehicle, death of another vehicle passenger, vehicle rollover, bike crash with no helmet, fall greater than three feet (pedestrian), or struck in the head by high-impact object)
  - Somnolence
  - Vomiting

- Over two years of age:
  - GCS less than or equal to 14; signs of altered mental status
  - Signs of basilar skull fracture
  - Loss of consciousness
  - Vomiting
  - Severe mechanism of injury (patient ejected from vehicle, death of another vehicle passenger, vehicle rollover, bike crash with no helmet, fall greater than three feet (pedestrian), or struck in the head by high-impact object)
  - Severe headache
  - Somnolence

Patients at low risk for TBI with no other injuries can be safely discharged home to the care of a responsible family member or guardian. In some cases, patients do not meet the prediction rules for TBI or the need for CT, but the provider is uncomfortable not having definitive diagnostic imaging. In those cases, the patient should be admitted for observation. Patients where there is a concern for non-accidental trauma (NAT), social issues, difficulty assessing mental status, or isolated skull fractures should be considered for admission.
References


Adult Initial Management of Traumatic Brain Injury

Primary Survey

Suspected TBI

Unstable

Anticoagulated

Head Injury Anticoagulated Guideline

Neurosurgical Consult

Impending Herniation

Operating Room

Resuscitate

When Stable

Transfer If No Surgical Services

Predictors of TBI
- GCS ≤ 14; altered mental status
- Skull fracture
- Scalp hematoma
- LOC
- Vomiting
- Severe mechanism of injury
- Severe headache

Predictors of TBI
- GCS ≤ 14; altered mental status
- Skull fracture
- Scalp hematoma
- LOC
- Vomiting
- Severe mechanism of injury
- Severe headache

Multiple injuries
- Minor Symptoms
- Nausea
- Normal Exam

No Other Injuries

Yes Predictors

No Predictors

Consider CT vs Observation/Admission

Worsening Condition

Positive (+)
- Neurosurgical Consult
- Observation/Admission

Negative (-)
- Observation/Admission

Discharge

* Severe mechanism of injury - patient ejected from vehicle, death of another vehicle passenger, vehicle rollover, or fall greater than three feet.
Ped (≤ 14) Initial Management of Traumatic Brain Injury

Primary Survey

Suspected TBI

Unstable

Neurosurgical Consult

Impending Herniation

Prevent Secondary Injury

Operating Room

Resuscitate

When Stable

Transfer If No Surgical Services

Predictors of TBI
- GCS ≤ 14
- Altered mental status per parent
- Agitation
- Delayed response to verbal stimuli
- LOC
- NAT
- Skull fracture
- Scalp hematoma
- *Severe mechanism of injury
- Severe headache
- Somnolence
- Vomiting

Predictors of TBI

No Predictors

Multiple injuries
Nausea
NAT
Social concerns

No Other Injuries

Observation/Admission

Worsening Condition

Positive (+)

Neurosurgical Consult

Negative (-)

Observation/Admission

Discharge

Impending herniation
- Unilateral or bilateral pupil dilation
- Lateralizing motor signs
- Cushing’s triad (widened pulse pressure, bradycardia, irregular respirations)
- Posturing (decerebrate and decorticate)

Prevent Secondary Injury
- Establish airway and ventilation
- Supplementary oxygen
- Maintain normal BP
- Maintain normothermia
- Elevate HOB 30°
- Consider osmotic diuretic or hypertonic saline

* Severe mechanism of injury - patient ejected from vehicle, death of another vehicle passenger, vehicle rollover, bike crash with no helmet, head strike with high impact object, or fall greater than three feet.