

Traumatic Brain Injury

Introduction:

Traumatic brain injury is a global problem that leads to morbidity and mortality particularly among young people, Includes any injury or trauma to the scalp, skull, or brain. A serious form of head injury is traumatic brain injury. Statistics regarding the occurrence of head injuries are incomplete because many victims die at the injury scene or because the condition is considered minor and health care services are not sought.

Definition:

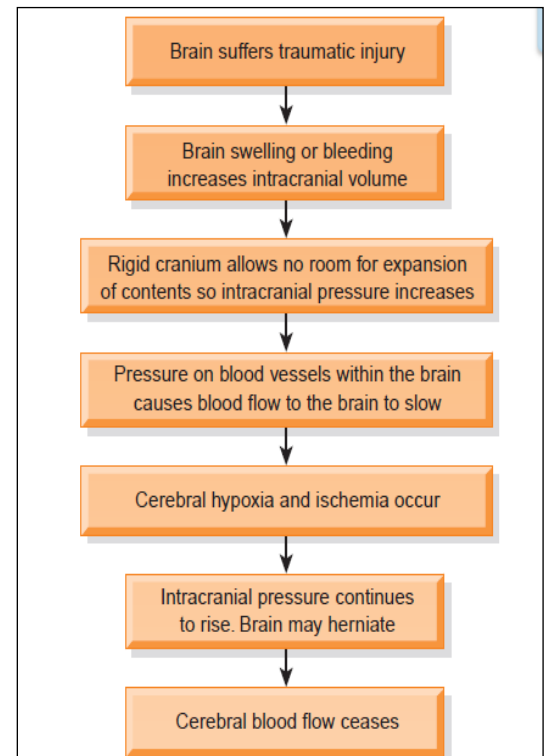
- **Traumatic brain injury** (TBI) is a nondegenerative, noncongenital insult to the brain from an external mechanical force, possibly leading to permanent or temporary impairment of cognitive, physical, and psychosocial functions, with an associated diminished or altered state of consciousness.
- **Traumatic brain injury** refers to trauma to the scalp and skull that may or may not include injury to the brain.

Damage to the brain from traumatic injury takes two forms:

- 1- **Primary injury** is the initial damage to the brain that results from the traumatic event. This may include contusions, lacerations, and torn blood vessels due to impact, acceleration/ deceleration, or foreign object penetration.
- 2- **Secondary injury** evolves over the ensuing hours and days after the initial injury and results from inadequate delivery of nutrients and oxygen to the cell.

Pathophysiology

Trauma → intracranial hemorrhage and hematoma → brain swelling → intracranial volume and ICP → displacement or herniation of the brain. Pressure on cerebral blood vessels → ↓ blood flow to brain → ↓ O₂ to brain → cerebral hypoxia → cerebral ischemia, infarction, and irreversible brain damage → brain death.



Etiology of head injury:-

1- Blunt

- Motor vehicle collision
- Pedestrian event
- Fall
- Assault
- Sports injury

2- Penetrating

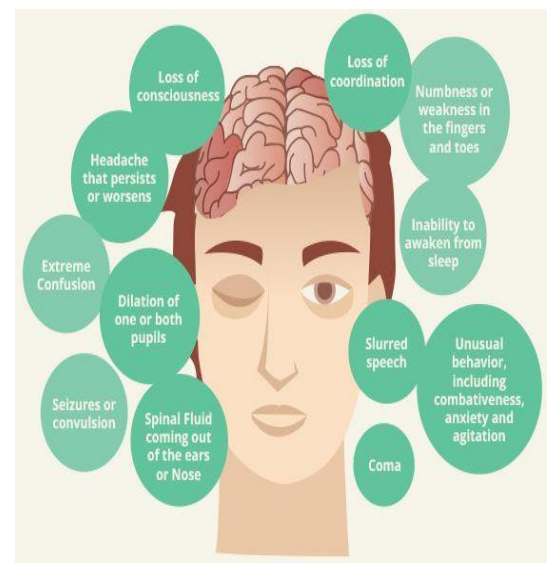
- Gunshot wound
- Arrow



Clinical Presentation

- Persistent, localized pain; headache.
- Loss of consciousness, confusion, drowsiness, personality change, Restlessness.

- Sudden onset of neurological deficits.
- Bruising over mastoid (Battle's sign).
- Nausea and vomiting.
- CSF otorrhea (ears) or rhinorrhea (nose).
- Halo sign: Blood stain surrounded by a yellowish stain on bed linens or head dressing that may indicate CSF leak.
- Abnormal pupillary response.
- Altered or absent gag reflex.
- Absent corneal reflex.
- Change in vital signs: altered respiratory pattern, widened pulse pressure, bradycardia, or tachycardia.
- Seizures.



Assessing the Severity of traumatic brain injury

- **Glasgow Coma Scale (GCS):** A 3- to 15-point scale used to assess a patient's level of consciousness and neurologic functioning, scoring is based on best motor response, best verbal response, and eye opening (eg, eyes open to pain, open to command)
- **Duration of loss of consciousness:** Classified as mild (mental status change or loss of consciousness [LOC] < 30

min), moderate (mental status change or LOC 30 min to 6 hr), or severe (mental status change or LOC >6 hr)

- **Posttraumatic amnesia (PTA):** The time elapsed from injury to the moment when patients can demonstrate continuous memory of what is happening around them.

Severity of Traumatic Brain Injury^[8]			
	GCS	PTA	LOC
Mild	13-15	<1 day	0-30 mins
Moderate	9-12	>1 to < 7 days	>30 mins to < 24 hrs
Severe	< 9	> 7 days	> 24 hrs

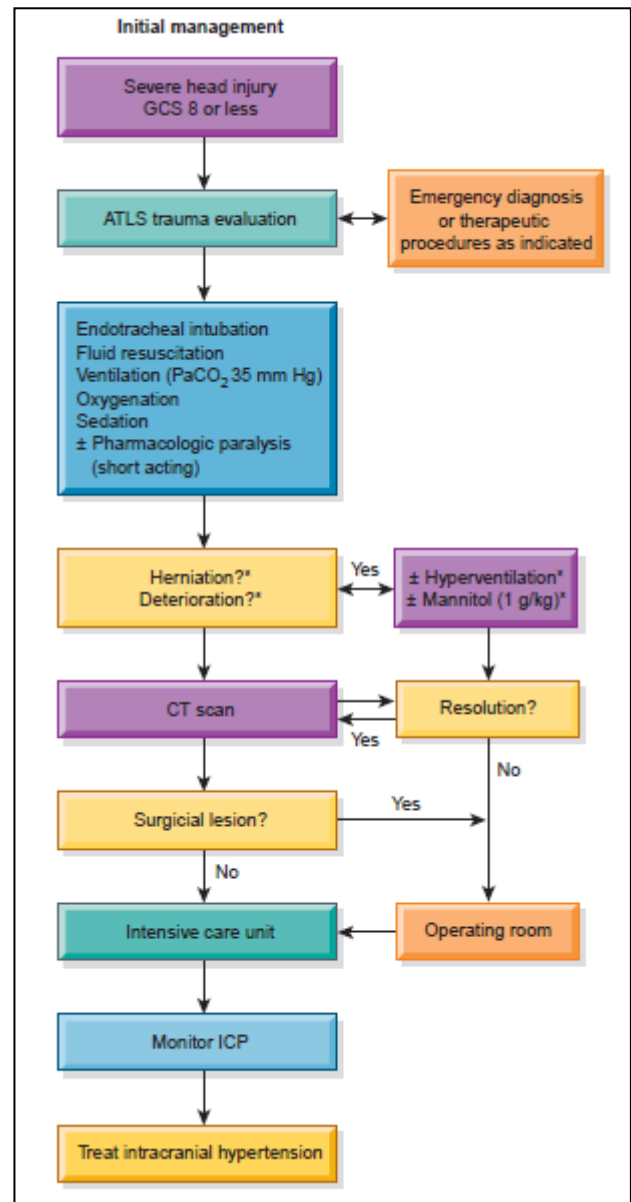
Severity	Description
Mild	GCS score 13–15 May have lost consciousness or exhibited amnesia for 5–60 min No abnormality on CT scan and length of hospital stay <48 h
Moderate	GCS score 9–12 Loss of consciousness or amnesia for 1–24 h May have abnormality on CT scan
Severe	GCS score 3–8 Loss of consciousness or amnesia for more than 24 h May have a cerebral contusion, laceration, or intracranial hematoma

Diagnostic Tests

- 1- Check for cerebrospinal fluid leak.
- 2- X-ray, CT of the head, MRI, or PET to assess hematoma, swelling, and injury.
- 3- Cerebral angiography.
- 4- CBC, chemistry panel, and blood coagulation studies.
- 5- Urinalysis for specific gravity.

Management

- 1- Stabilize cardiac and respiratory function to ensure adequate cerebral perfusion. Maintain optimum ABGs or O₂ saturation. Assess oxygenation and respiratory status.
- 2- Assess and monitor neurological status and ICP; calculate CPP to maintain >70 mm Hg.
- 3- Perform frequent neurological checks, including Glasgow Coma Scale.
- 4- Provide light sedation as necessary to ↓ agitation. Administer analgesics for pain. Induce barbiturate coma if necessary.
- 5- Administer hypertonic saline and osmotic diuretics as needed.
- 6- Monitor and control for elevations in ICP.
- 7- Induce therapeutic hypothermia.
- 8- Prepare patient for craniotomy to lessen the pressure in the brain if necessary.
- 9- Assess for vision and hearing impairment and sensory function.



- 10- Assess for hypothermia and hyperthermia. Control fever.
- 11- Institute seizure precautions. Minimize stimuli and excessive suctioning.
- 12- Monitor ECG for cardiac arrhythmias. Institute deep vein thrombosis.
- 13- (DVT) precautions.
- 14- Assess fluid and electrolyte balance. Control hemorrhage and hypovolemia.
- 15- Administer stool softeners to prevent Valsalva maneuver.
- 16- Keep head and neck in neutral alignment; no twisting or flexing of neck.
- 17- Keep head of bed elevated.
- 18- Maintain adequate nutrition orally or enterally. Assess and maintain skin integrity.
- 19- Provide DVT and peptic ulcer prophylaxis.

Complication:

- 1- Altered consciousness
- 2- Cerebrospinal fluid may build up in the spaces in the brain (cerebral ventricles) ----. Increase ICP and Hydrocephalus
- 3- Electrolyte imbalance.
- 4- Posttraumatic seizure disorder
- 5- Infection: Patient who on mechanical ventilation high risk for ventilator associated pneumonia catheter bloodstream, urinary tract infection, Meningitis.
- 6- Neurological deficits: cognitive, motor sensory, speech

Nursing care for patient with head injuries

A-nursing assessment:

- Airway: assess for vomitus, bleeding, and foreign objects. Ensure cervical spine immobilization.

- Breathing: assess for abnormally slow or shallow respirations. An elevated carbon dioxide partial pressure can worsen cerebral edema.
- Circulation: assess pulse and bleeding.
- Disability: assess the patient's neurologic status.

B-Nursing diagnosis:

- Altered Cerebral Tissue Perfusion related to increased ICP.
- Ineffective Breathing Pattern related to ↑ICP or brain stem injury.
- Altered Nutrition: Less Than Body Requirements related to compromised neurologic function and stress of injury.
- Altered Thought Processes related to physiology of injury.
- Risk for Injury related to altered thought processes.
- Ineffective Family Coping related to unpredictability of outcome.

Nursing Interventions

1- Maintaining Adequate Cerebral Perfusion.

- Maintain a patent airway.
- Monitor ICP, as ordered.
- Monitor cerebral oxygenation, temperature, or neurochemicals, as ordered. Provide oxygen therapy to maintain PaO₂ above 100 and carbon dioxide within normal range.
- Maintain SBP above 90 to enhance cerebral perfusion, and administer treatment for arrhythmias if patient is symptomatic. Evaluate for additional source of blood loss if patient is tachycardia and hypotensive.
- Monitor LOC, cranial nerve function, and motor and sensory function as per GCS or neurologic flow sheet, identify

emerging trends in neurologic function, and communicate findings to medical staff.

- Monitor response to pharmacologic therapy, including antiepileptic drugs (AED) levels, as directed.
- Monitor laboratory data, CSF cultures, and Gram stains, if applicable, and institute prompt antibiotic therapy as directed.
- Monitor coagulation panel and replace clotting factors at room temperature as directed.
- Assess dressings and drainage tubes after surgery for patency, security, and characteristics of drainage.
- Institute measures to minimize increased ICP, ischemic changes, cerebral edema, seizures, or neurovascular compromise, such as careful positioning, to avoid flexing head, reducing hip flexion (can reduce venous drainage, causing congestion), and spreading out care evenly over 24-hour period.

2- Maintaining Respiration

- Monitor respiratory rate, depth, and pattern of respirations; report any abnormal pattern, such as Cheyne- Stokes respiration's or apnea.
- Assist with intubation and ventilator assistance, if needed.
- Obtain frequent ABG values to maintain PaO₂ greater than 100 mm Hg and PaCO₂ 35 to 45 mm Hg.
- The use of positive end-expiratory pressure (PEEP) in the care of critically ill patients after TBI remains controversial. PEEP (5 to 10 cm) is felt to be physiological and not detrimental; however, excessive PEEP can create increases

in intrathoracic pressure, diminish venous drainage, reduce mean arterial pressure (MAP), and increase ICP.

- Turn patient every 2 hours, and assist with coughing and deep breathing.
- Suction patient as needed; however, hyperventilate the patient before suctioning to prevent hypoxia..

3- Meeting Nutritional Needs

- Begin nutritional support as soon as possible after a head injury; provide 140% of energy requirements (100% in paralyzed patient), with 15% in the form of protein.
- Administer H₂-blocking agents to prevent gastric ulceration and hemorrhage from gastric acid hyper secretion.
- Enteric feedings can be initiated once bowel sounds have returned; continuous or intermittent
- Elevate the head of the bed after feedings
- Check residuals to prevent aspiration, Monitor for diarrhea
- Oral feeding—started when adequate swallowing mechanism is demonstrated
- Consult with dietitian to provide the increased calories and nitrogen requirement resulting from the metabolic changes of brain injury.
- Monitor glucose levels frequently, utilizing finger stick samples and glucometer. Insulin (I.V. drip/sliding scale) may be required to regulate serum glucose levels within a normal range to avoid hyperglycemia, which elevates lactate levels and worsens the effects of secondary brain injury.
- Consult speech therapist for bedside or radiographic swallow study before initiation of oral foods. Recognize that any patient with coma is at risk for swallowing difficulties.

Assessment of swallowing function decreases risk of aspiration. Speech therapy is essential for retraining and developing adaptive techniques.

4- Promoting Cognitive Function

- Periodically, assess the patient's LOC, and compare to baseline.
- Be aware of the patient's cognitive alteration, and adjust interaction and environment accordingly.
- Provide meaningful stimulation using all senses—visual, olfactory, gustatory, acoustic, and tactile.
- Observe the patient for fatigue or restlessness from overstimulation.
- Involve the family in sensory stimulation program to maximize its effectiveness.
- Decrease environmental stimuli when the patient is in agitated state.
- Reorient to surroundings using repetition, verbal and visual cues, and memory aids; routinely orient the patient after awakening.
- Use pictures of family members, clock, calendar as outlined by occupational and speech therapist.
- Encourage the family to provide items from home to increase sense of identity and security.
- Anticipate the need for additional help with toileting, eating, performing ADLs due to cognitive impairment.
- Break down ADLs into simple steps that patient can progressively take part in.
- Structure the environment and care activities to minimize distraction and provide consistency.

- Identify and maintain usual patterns of behavior—sleep, medication use, elimination, food intake, and self-care routine.
- Refer the patient for cognitive retraining, if appropriate.

5- Preventing Injury

- Instruct the family regarding the behavioral phases of recovery from brain injury, such as restlessness and combativeness.
- Investigate for physical sources of restlessness, such as uncomfortable position, signs of UTI, or pressure ulcer development.
- Reassure the patient and family during periods of agitation and irrational behavior.
- Pad side rails, and wrap hands in mitts if patient is agitated. Maintain constant vigilance, and avoid restraints if possible.
- Keep environmental stimuli to a minimum to avoid confusion and agitation.
- Provide adequate light if patient is hallucinating.
- Avoid sedatives to avoid medication-induced confusion and altered states of cognition