Head Injury: Classifications, Diagnosis and Treatment

Head injury refers to trauma to the scalp, skull, or brain that may result in temporary or permanent neurological dysfunction. It encompasses a wide spectrum of pathologies, from superficial scalp injuries to life-threatening intracranial hemorrhages.

Etiology

Common causes include:

- **Motor Vehicle Accidents** : leading cause in all age groups.
- **Falls** : especially in children and elderly.
- **Assaults**
- **Sports-related injuries**
- **Penetrating trauma** (e.g. gunshot wounds, stab wounds)

Epidemiology :

- Male to female ratio: ~2:1
- More common in individuals < 35 years

Classification of Head Injury

A. By Severity (Glasgow Coma Scale - GCS)

GCS Score	Severity
13–15	Mild
9–12	Moderate
?8	Severe

B. By Anatomical Layers Involved (Mnemonic: SCALP)

1. **S** kin
2. **C** onnective tissue (dense) – vascular layer
3. **A** poneurosis (Galea aponeurotica)
4. **L** oose areolar tissue – site of hematoma accumulation
5. **P** ericranium – periosteum of the skull

C. By Pathology

- **Primary injury** : Occurs at the time of trauma
- **Secondary injury** : Occurs later due to complications like hypoxia, edema, or hematomas

Skull Fractures

1. Closed (Simple) Fractures

- **Linear** : Most common; often associated with epidural hematomas
- **Comminuted** : Multiple fragments
- **Ping-pong fracture** : Seen in infants; greenstick-like
- **Depressed** : Bone is pushed inward; risk of dural tear
- **Basilar** : Involving base of skull; may lead to CSF rhinorrhea/otorrhea

2. Open (Compound) Fractures

- Communication with the external environment
- Risk of infection and CSF leak

Brain Injuries

A. Primary Injuries

- **Concussion** : Transient loss of neurological function
- **Contusion** : Bruising of brain tissue
- **Laceration** : Tearing of brain parenchyma
- **Diffuse Axonal Injury (DAI)** :
  - Result of shearing forces during acceleration/deceleration
  - Common in high-speed trauma
  - Poor prognosis; presents with coma or persistent vegetative state

B. Penetrating Injury

- Direct mechanical disruption from sharp objects
- Commonly involves skull base in children

C. Compression Injury

- Crush injuries leading to multiple linear fractures and cranial nerve involvement

Secondary Brain Injury

A. Intracranial Hematomas

1. Epidural Hematoma

- **Location** : Between skull and dura mater
- **Cause** : Middle meningeal artery rupture (often temporal bone fracture)
- **Imaging** : Biconvex (lentiform) shape on CT
- **Clinical** : "Lucid interval" followed by rapid deterioration
- **Treatment** : Emergency craniotomy or burr hole evacuation

2. **Subdural Hematoma**

- **Location** : Between dura and arachnoid mater
- **Cause** : Tearing of bridging veins
- **Types** :
  - **Acute** : Rapid onset; high mortality
  - **Chronic** : Slow accumulation; common in elderly, alcoholics
- **Imaging** : Crescent-shaped hematoma
- **Treatment** : Burr hole drainage or craniotomy

Clinical Presentation

- Altered mental status, confusion, loss of consciousness
- Headache, vomiting, seizures
- Focal neurological deficits (e.g., hemiparesis, cranial nerve palsies)
- Signs of raised ICP (e.g., papilledema, Cushing triad: hypertension, bradycardia, irregular respirations)

Diagnostic Evaluation

- **Imaging** : Non-contrast head CT is first-line
- **Neurological exam** : Regular GCS scoring
- **Monitoring** : ICP monitoring in severe head injury

Management

- **Initial** : ABCs (Airway, Breathing, Circulation)
- **Supportive** : Oxygen, fluid management, seizure prophylaxis
- **Definitive** : Surgical evacuation of hematomas, repair of skull fractures
- **Rehabilitation** : Multidisciplinary approach for physical, cognitive recovery

Complications

- Post-traumatic seizures
- Hydrocephalus
- Infections (meningitis, brain abscess)
- Chronic traumatic encephalopathy (CTE)
- Persistent vegetative state or death