BREATH MASTERY HUB

Traumatic Brain Injury (TBI)

Presenter: MASHAEL NASSER MATABI

BSc in Respiratory Therapy

PGY-D2 in Critical Respiratory Care

BREATH MASTERY HUB

Learning Objectives

- Define and classify TBI.
- Understand TBI pathophysiology.
- Identify clinical signs and complications.
- Explain ICP and CPP concepts.
- Describe basic medical and ventilatory management.

BREATH MASTERY HUB

What is TBI?

- Traumatic Brain Injury = disruption of normal brain function.
- Caused by an external mechanical force.
- May result in temporary or permanent impairment.
- Ranges from mild concussion to severe brain damage.

BREATH MASTERY HUB

Common Causes of TBI

- Motor vehicle collisions.
- Fall down.
- Sports injuries.
- Assaults.
- Penetrating injuries (gunshot, stabbing).

BREATH MASTERY HUB

Classification of TBI

- TBI can be classified by:

1. Severity.
2. Mechanism of injury.
3. Pathology.

BREATH MASTERY HUB

Severity Classification (GCS)

- Mild: GCS 13–15
- Moderate: GCS 9–12
- Severe: GCS ≤ 8
- **GCS assessed using:**

1. Eye opening
2. Verbal response
3. Motor response

BREATH MASTERY HUB

GLASGOW COMA SCALE (GCS)

EYE OPENING (E)
4 = Spontaneous
3 = To Speech
2 = To Pain
1 = No Response

VERBAL RESPONSE (V)
5 = Oriented (aware, jagah, vyaktri ke baare mein sahi jawab dena)
4 = Confused
3 = Inapproprate Words
2 = Incomprehensible Sounds
1 = No Response

MOTOR RESPONSE (M)
6 = Obeys Commands
5 = Localizes Pain
4 = Withdraws to Pain
3 = Flexion to Pain (decorticate posture)
2 = Extension to Pain (decerebrate posture)
1 = No Response

THE NURSING MIND

TOTAL SCORE
Maximum = 15

Minimum = 3 (sabhi 1-1)
Maximum = 15 (normal, fully alert)

INTERPRETATION
13–15 = Mild injury / Normal
"GCS ≤ 8, intubate"

The Nursing Mind

BREATH MASTERY HUB

Mechanism of Injury

- **Closed head injury** (No skull penetration).
- **Penetrating head injury** (Skull and dura breached).

BREATH
MASTERY HUB

Primary vs Secondary Brain Injury

- **Primary injury** Occurs at time of trauma , Irreversible.
- **Secondary injury** Occurs hours to days later , Potentially preventable.

BREATH MASTERY HUB

Primary Brain Injury

- Cerebral contusion
- Laceration
- Hemorrhage
- Diffuse axonal injury

BREATH MASTERY HUB

Secondary Brain Injury

- Hypoxia.
- Hypercapnia.
- Hypotension.
- Cerebral edema.
- Increased ICP.
- Excitotoxicity.
- Brain Herniation.

BREATH MASTERY HUB

Why Secondary Injury Matters

- Main cause of poor neurological outcome.
- Target of ICU management.
- RT plays a key role in prevention.

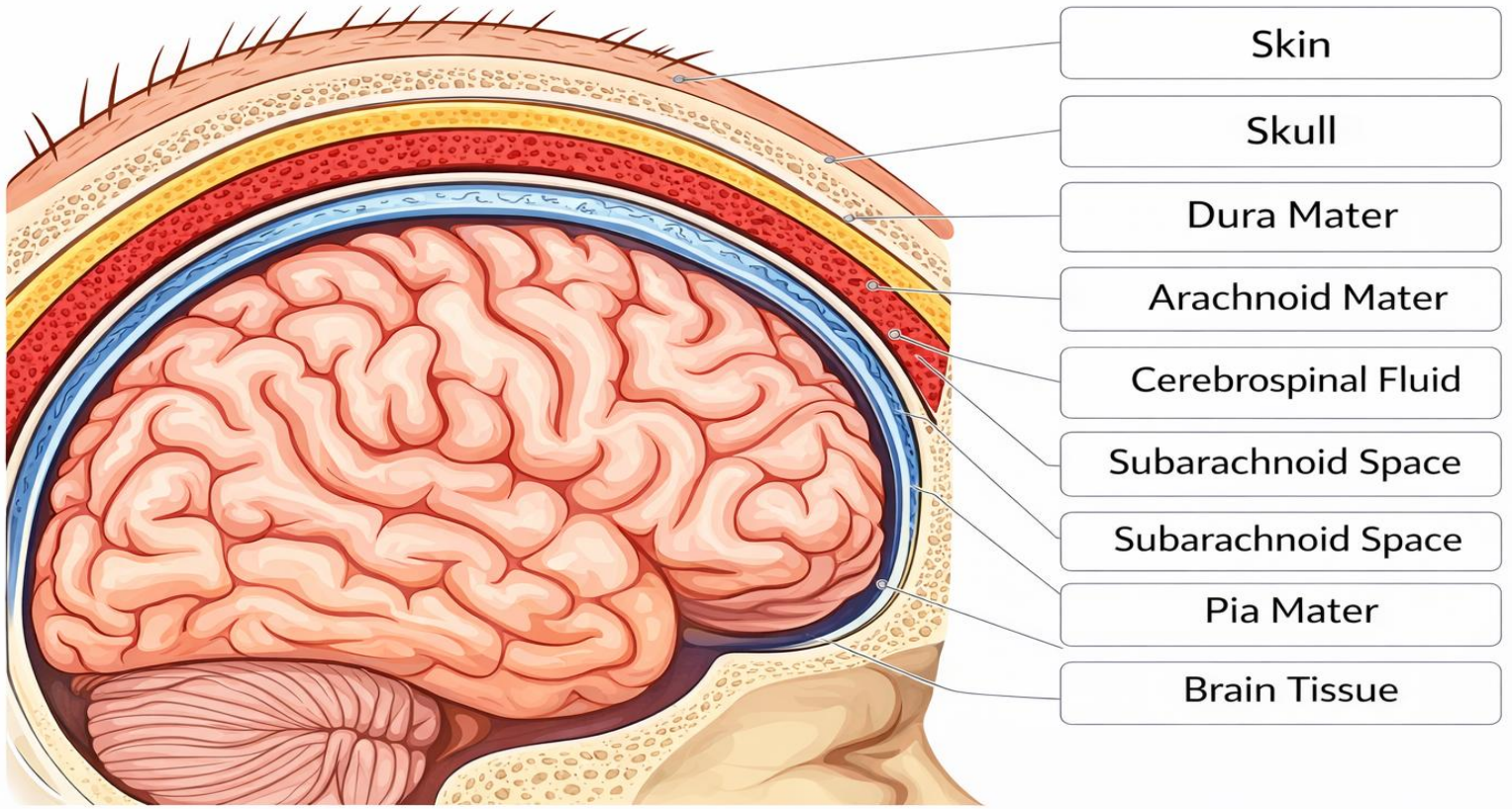
BREATH MASTERY HUB

Types of TBI

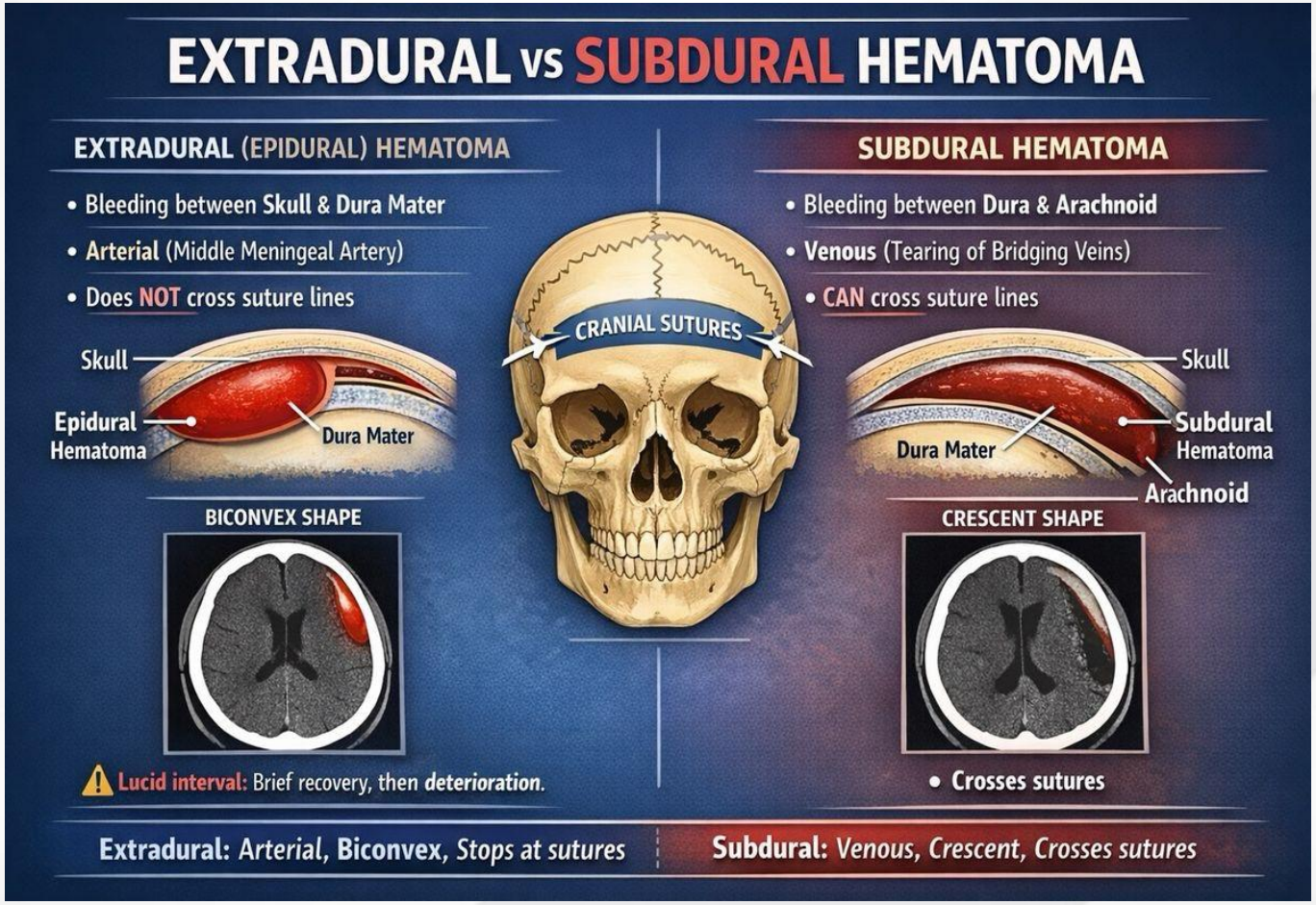
- Concussion
- Cerebral contusion
- Diffuse Axonal Injury (DAI)
- Epidural hematoma
- Subdural hematoma
- Intracerebral hemorrhage
- Subarachnoid hemorrhage

BREATH
MASTERY HUB

Layers of the Brain



BREATH MASTERY HUB



BREATH MASTERY HUB

Clinical Presentation

- Altered level of consciousness
- Headache
- Vomiting
- Seizures
- Pupillary changes
- Abnormal posturing

BREATH MASTERY HUB

Cushing’s Triad

- **Signs of increased ICP:**

1. Hypertension.
2. Bradycardia.
3. Irregular respirations.

BREATH MASTERY HUB

CT Scan Findings

- Hematomas.
- Midline shift.
- Cerebral edema.
- Skull fractures.

BREATH
MASTERY HUB

BREAK FOR 5MIN..

BREATH MASTERY HUB

Intracranial Pressure (ICP):

- **Intracranial pressure (ICP)** is the pressure exerted by the contents inside the skull on the brain tissue.
- **Normal ICP: 5–15 mmHg.**
- **Increased ICP: >20 mmHg.**
- Causes:

1. Edema.
2. Hemorrhage.
3. Hypercapnia.

BREATH MASTERY HUB

ICP Monitoring:

- **Indications:**

1. Severe TBI (GCS ≤8) and an abnormal CT scan.

- **to prevent and treat elevated ICP:**

1. Head of bed elevation to 30 degrees.
2. Optimization of venous drainage: keeping the neck in neutral position, loosening neck braces if too tight.
3. Monitoring central venous pressure and avoiding excessive hypervolemia.

BREATH MASTERY HUB

Cerebral Perfusion Pressure (CPP)

- The Formula: CPP = MAP – ICP.
- Target CPP: 60–70 mmHg.
- MAP: > 80mmHg.
- **Goal:** Ensure the heart can push blood into the swollen brain.
- Low CPP → cerebral ischemia.

BREATH MASTERY HUB

Medical Management Goals

- Prevent secondary brain injury.
- **Maintain:**

1. Adequate oxygenation.
2. Normocapnia.
3. Normotension.
4. Control ICP.

BREATH MASTERY HUB

How Suctioning Increases ICP:

- Hypoxemia → cerebral vasodilation → ↑ ICP.
- Hypercapnia → ↑ cerebral blood volume → ↑ ICP.
- Coughing / gag reflex → sudden spike in ICP.

BREATH MASTERY HUB

Oxygenation & Ventilation

- Target PaO_2: >60 mmHg.
- High PEEP → ↑ intrathoracic pressure
- May ↓ venous drainage from brain
- Use lowest effective PEEP
- Target $PaCO_2$: 35–40 mmHg.
- Avoid routine hyperventilation

BREATH MASTERY HUB

Hyperventilation in TBI

- ↓ $PaCO_2$ → cerebral vasoconstriction
- Temporary ↓ ICP
- Risk: cerebral ischemia
- Used only in acute herniation

BREATH MASTERY HUB

Sedation & Analgesia

- **Goal:** To prevent the patient from "fighting" the ventilator (asynchronous breathing) & metabolic demand.
- **Reason:**
- Coughing or straining against the endotracheal tube increases intrathoracic pressure, which directly blocks venous drainage from the brain and raises ICP.
- **Common agents:**
- (Propofol and Fentanyl)

BREATH MASTERY HUB

Osmotic Therapy:

- The intravascular injection of hyperosmolar agents (mannitol, hypertonic saline) creates an osmolar gradient, drawing water across the blood-brain barrier This leads to a decrease in interstitial volume and a decrease in ICP.

BREATH MASTERY HUB

Surgical Management

- Hematoma evacuation
- Decompressive craniectomy
- Indicated when medical therapy fails

BREATH MASTERY HUB

Complications of TBI

- Brain herniation
- Neurogenic pulmonary edema
- VAP
- Electrolyte disorders (DI, SIADH)

BREATH MASTERY HUB

Key Take-Home Messages

- Secondary brain injury is preventable
- Airway & ventilation are critical
- Maintain oxygenation, CO_2, and CPP
- RT has a vital role in TBI care

BREATH
MASTERY HUB

Thank you..
Any question?