HEAD TRUAMA

- Presented by: Dr Meshkini Ali
- Prof. Neurosurgery Dep.
- TBZMED

HEAD TRUAMA

The primary goal of treatment for patients with suspected traumatic brain injury is to prevent secondary brain injury.

HEAD TRUAMA

Objectives

By the end of this interactive discussion, you will be able to:

- ✓ Recognize the GCS score that corresponds to a severe head injury and indicates a comatose patient.
- ✓ Identify the different types of intracranial bleeding seen on CT that are associated with traumatic brain injury.
- ✓ Discuss the role of supplemental oxygen and systolic blood pressure maintenance in limiting secondary brain injury.
- ✓ Describe the management of intracranial hypertension associated with the mass effect of blood or brain swelling.
- ✓ Discuss the indications for early, rapid transfer to a center equipped to manage a patient with brain injury.

HEAD TRUAMA

Case Scenario

M: 23-year-old male, fell from bicycle, hitting head on curb; no helmet

I: 10 cm laceration to the L temporal-parietal region

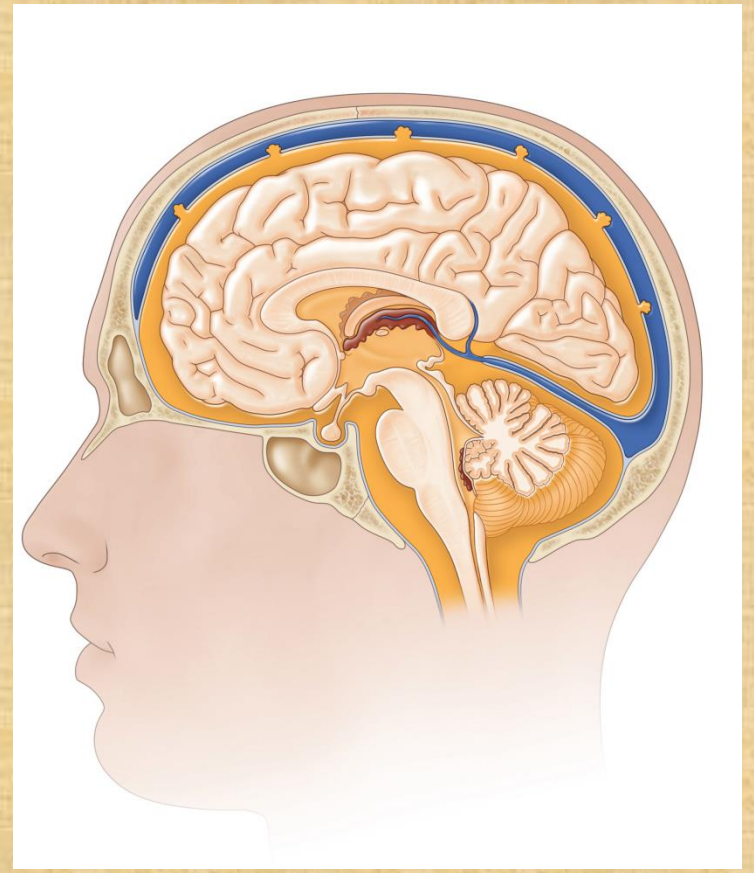
S: Initially able to say his name. HR 115; BP 100/60; O_2 sat 88%; GCS 12 (E3V3M6)

Two hours after transport to local hospital, patient has sonorous respirations; HR 120; BP 100/70; GCS 6 (E2V1M3)

T: IV cannulas in situ, O_2 via nasal prongs, 200mLs crystalloid infused

Anatomy and Physiology

What are the unique features of brain anatomy and physiology, and how do they affect patterns of brain injury?

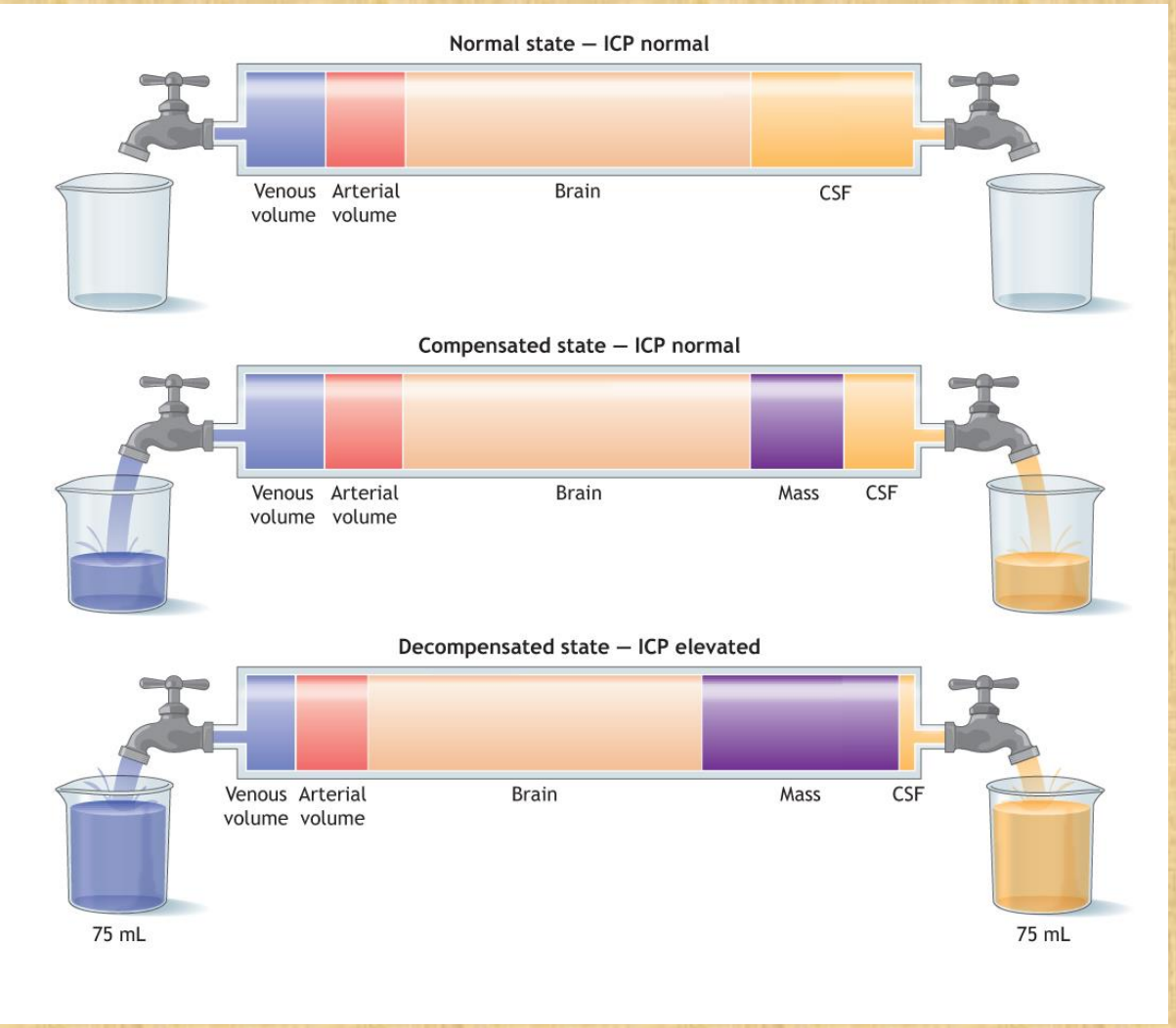


Anatomy and Physiology

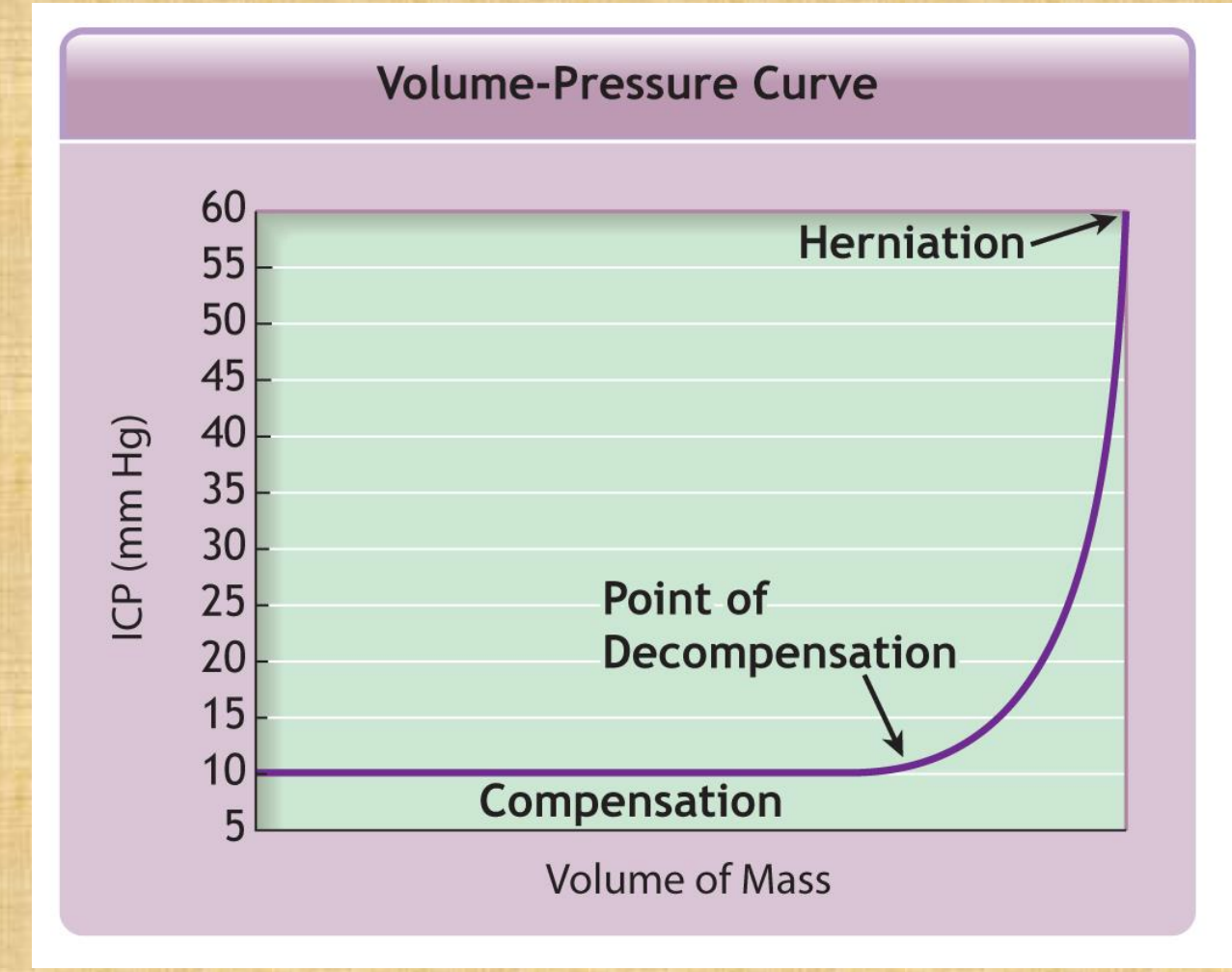
What are the unique features of brain anatomy and physiology, and how do they affect patterns of brain injury?

- **Rigid, nonexpansile skull filled with brain, CSF, and blood**
- **Cerebral blood flow (CBF) usually autoregulated**
- **Autoregulatory compensation disrupted by brain injury**
- **Mass effect of intracranial hemorrhage**

Monro-Kellie Doctrine



Volume-Pressure Curve



Intracranial Pressure (ICP)

10 mm Hg = Normal

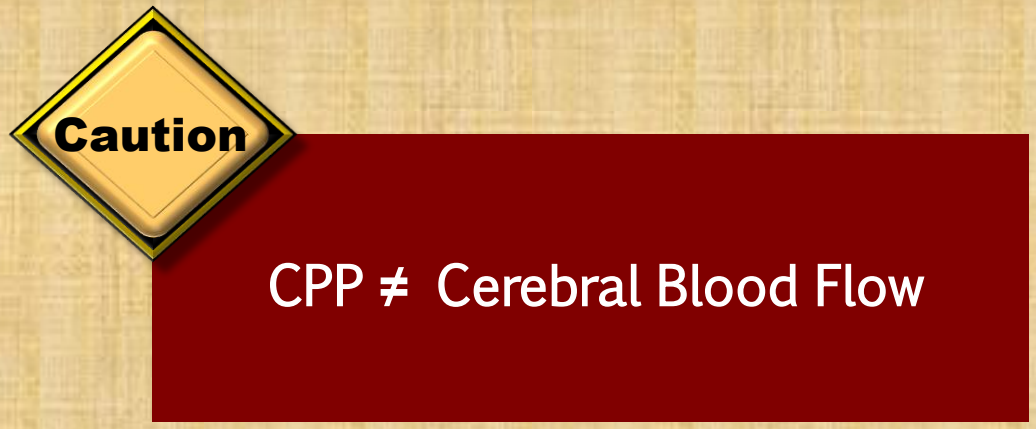
>20 mm Hg = Abnormal

>40 mm Hg = Severe

- **Sustained increased ICP leads to decreased brain function and poor outcome**
- **Hypotension and low saturation adversely affect outcome**

Autoregulation

- If autoregulation is intact, CBF is maintained constant between a mean BP of 50 to 150 mm Hg.
- In moderate or severe brain injury, autoregulation is impaired so CBF varies with mean BP.
- The injured brain is more vulnerable to episodes of hypotension, causing secondary brain injury.



Classifications of Head Injury

By Morphology – Skull Fractures

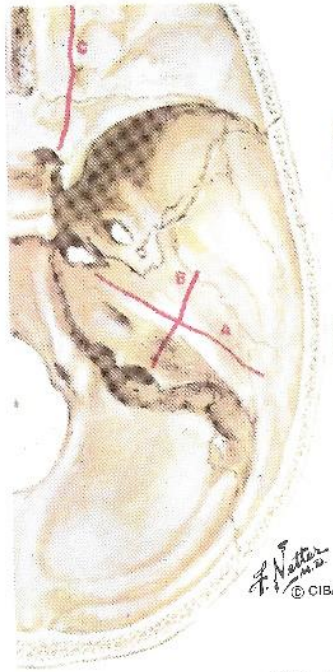
Vault

- Depressed or nondepressed
- Open / closed

Basilar

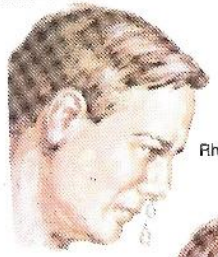
- With or without CSF leak
- With or without cranial nerve palsy

Basilar Skull Fractures



Longitudinal (**A**) and transverse (**B**) fractures of petrous pyramid of temporal bone, and anterior basal skull fracture (**C**)

"Panda bear" or "raccoon" sign due to leakage of blood from anterior fossa into periorbital tissues. Absence of conjunctival injection differentiates fracture from direct eye trauma



Rhinorrhea

Otorrhea or ear hemorrhage

Battle's sign: postauricular hematoma

elective cranioplasty later. The wound is copiously

Classifications of Head Injury

By Morphology – Brain Injuries

Focal

- Epidural (extradural)
- Subdural
- Intracerebral

Diffuse

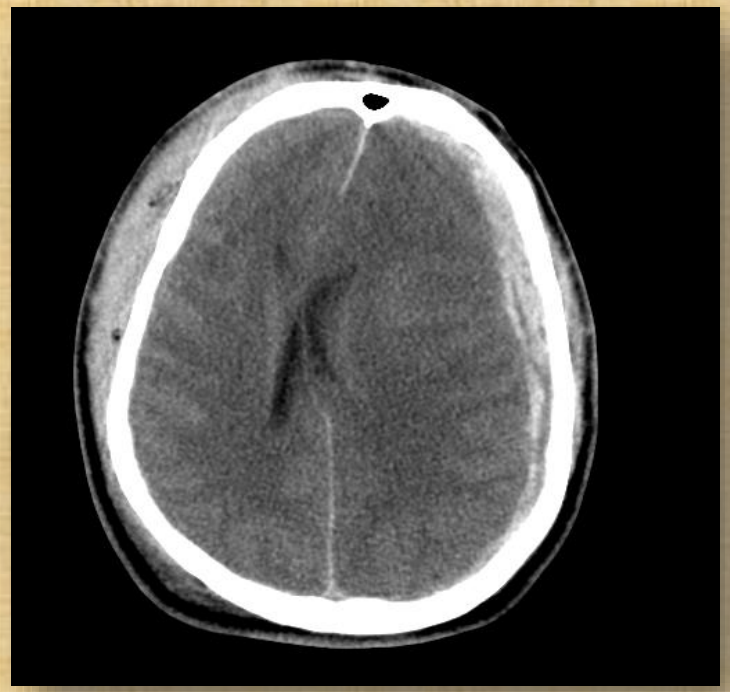
- Concussion
- Multiple contusions
- Hypoxic / ischemic injury

Epidural Hematoma

- **Associated with skull fracture**
- **Classic: middle meningeal artery tear**
- **Lenticular / biconvex**
- **Lucid interval**
- **Can be rapidly fatal**
- **Early evacuation essential**

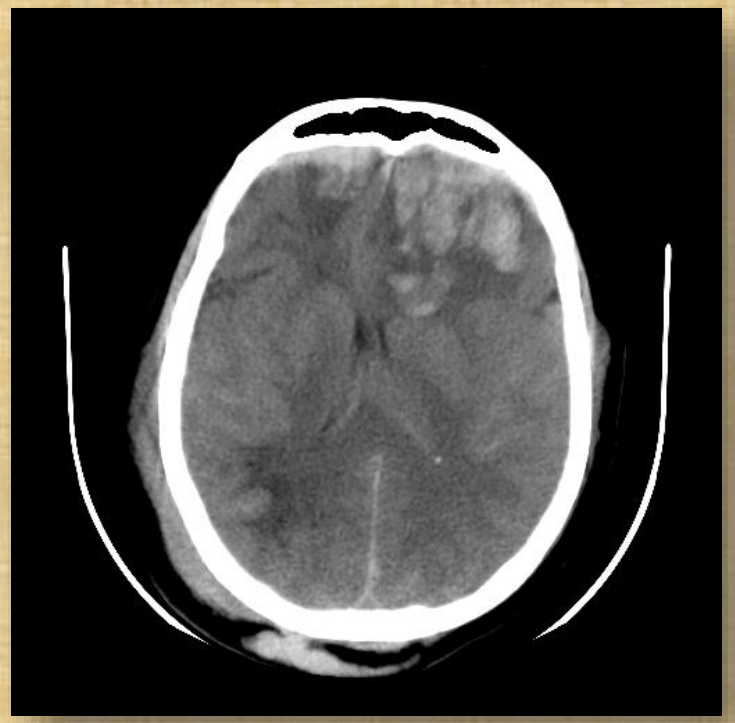
Subdural Hematoma

- **Venous tear / brain laceration**
- **Covers cerebral surface**
- **Morbidity / mortality due to underlying brain injury**
- **Rapid surgical evacuation recommended, especially if > 5 mm shift of midline**



Intracerebral Hematoma / Contusion

- **Coup / contra coup injuries**
- **Most common: frontal / temporal lobes**
- **CT changes usually progressive**
- **Most conscious patients: no operation**



Large Frontal Contusion with Shift

Diffuse Brain Injury

Normal CT

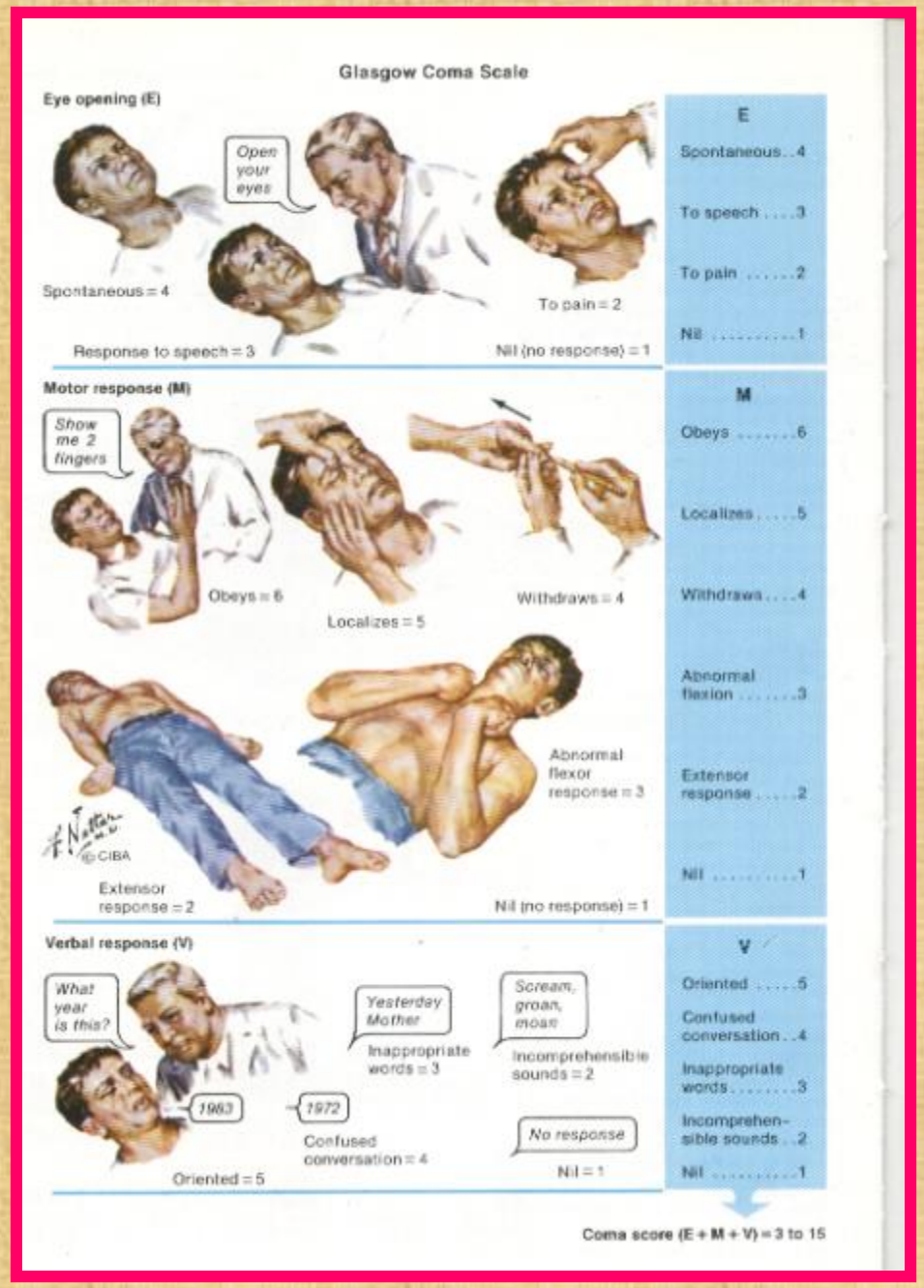
Diffuse Injury

Range from mild concussion to severe ischemic insult

Classifications of Head Injury

By Severity of Injury Based on GCS Score

- Mild
- Moderate
- Severe


Glasgow Coma Scale
Eye opening (E)
Open your eyes
Spontaneous = 4
To pain = 2
Response to speech = 3
Nil (no response) = 1
E
Spontaneous . . 4
To speech 3
To pain 2
Nil 1
Motor response (M)
Show me 2 fingers
Obeys = 6
Localizes = 5
Withdraws = 4
Abnormal flexor response = 3
Extensor response = 2
Nil (no response) = 1
M
Obeys 6
Localizes 5
Withdraws 4
Abnormal flexion 3
Extensor response 2
Nil 1
Verbal response (V)
What year is this?
1983
Oriented = 5
Yesterday Mother
Inappropriate words = 3
1972
Confused conversation = 4
Scream, groan, moan
Incomprehensible sounds = 2
No response
Nil = 1
V
Oriented 5
Confused conversation . . 4
Inappropriate words 3
Incomprehensible sounds . . 2
Nil 1
Coma score (E + M + V) = 3 to 15

Mild Brain Injury

- **GCS score = 13 – 15**
- **History**
- **Exclude systemic injuries**
- **Neurologic exam**
- **Radiographic investigation as indicated**
- **Alcohol / drug screens as indicated**

Observe or discharge based on findings

Moderate Brain Injury

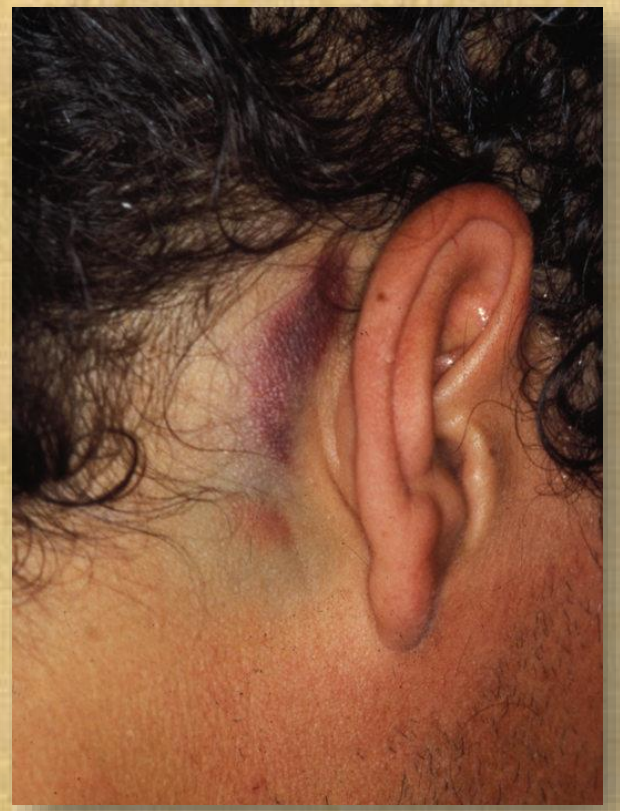
- **GCS score = 9 – 12**
- **Initial evaluation same as for mild injury**
- **CT scan for all**
- **Admit and observe**
- **Frequent neurologic exams**
- **Repeat CT scan**
- **Deterioration: Manage as severe head injury**

Severe Brain Injury

- GCS score = 3 – 8
- Evaluate and resuscitate
- Intubate for airway protection
- Neurologic exam prior to intubation
- Focused neurologic exam
- Frequent reevaluation
- Identify associated injuries

Indications for CT Scan

- **GCS score still < 15 two hours after injury**
- **Neurologic deficit**
- **Open skull fracture**
- **Sign of basal skull fracture**
- **Vomiting (> 2 episodes)**
- **Extremes of age**
- **Retrograde amnesia**
- **Severe headache**



Management

What is the optimal treatment for patients with brain injuries?

Management

What is the optimal treatment for patients with brain injuries?

Priorities

- **ABCDE**
- **Minimize secondary brain injury**
- **Administer oxygen**
- **Maintain adequate ventilation**
- **Maintain blood pressure (systolic > 90 mm Hg)**

Management

What is a focused neurological examination?

Management

What is a focused neurological examination?

- **GCS score**
- **Pupils**
- **Lateralizing signs**

Consult neurosurgeon early

Management

Medical

- Controlled ventilation
- Goal: $PaCO_2$ at 35 mm Hg
- Intravenous fluids
  - Euvolemia
  - Isotonic
- Consult with neurosurgeon

Management

Medical

- Mannitol
  - Use only with signs of tentorial herniation
  - Avoid in patients with hypovolemia
  - Dose 1.0 gram / kg IV bolus
- Hypertonic saline
- Anticonvulsants
- Sedation
- Paralytics

Neurological examination before prolonged sedation/paralysis

Management

Surgical

- **Scalp Wounds**
  - **Possible site of major blood loss**
  - **Direct pressure to control bleeding**
  - **Occasional temporary closure**

Management

Surgical

- **Penetrating Trauma**
  - **ABCs**
  - **X-ray / CT scan**
  - **Early neurosurgical consult**
  - **Prophylactic antibiotics**
  - **Do not remove penetrating object or probe the wound.**

Management

Surgical

- **Intracranial Mass Lesion**
  - **Can be life-threatening if expanding rapidly**
  - ***Immediate* neurosurgical consult**
  - **Hyperventilation / medical therapy**
  - **Damage control craniotomy: transfer to neurosurgeon (rural / austere areas)**

HEAD TRUAMA

Discussion Question

1. What are the initial priorities in the management of this patient?

Case Details	
M	23-year-old male, fell from bicycle, hitting head on curb; no helmet
I	10 cm laceration to the L temporal-parietal region
S	Initially able to say his name. HR 115; BP 100/60; O_2 sat 88%; GCS 12 (E3V3M6) Two hours after transport to local hospital, patient has sonorous respirations; HR 120; BP 100/70; GCS 6 (E2V1M3)
T	IV cannulas in situ, O2 via nasal prongs, 200mLs crystalloid infused

HEAD TRUAMA

Discussion Question

2. What are the signs that the patient's injury is progressing?

Case Details	
M	23-year-old male, fell from bicycle, hitting head on curb; no helmet
I	10 cm laceration to the L temporal-parietal region
S	Initially able to say his name. HR 115; BP 100/60; O_2 sat 88%; GCS 12 (E3V3M6) Two hours after transport to local hospital, patient has sonorous respirations; HR 120; BP 100/70; GCS 6 (E2V1M3)
T	IV cannulas in situ, O2 via nasal prongs, 200mLs crystalloid infused

HEAD TRUAMA

Case Scenario Progression

- Patient intubated
- Given 1 L normal saline
- Vital signs: HR 100; BP 100/70; O_2 Sat 94%

HEAD TRUAMA

Discussion Question

1. How do you monitor this patient's neurological status

- Patient intubated
- Given 1 L normal saline
- Vital signs: HR 100; BP 100/70; O_2 Sat 94%

HEAD TRUAMA

Discussion Question

2. What other injuries and physical exam findings may suggest cranial and intracranial injury?

- Patient intubated
- Given 1 L normal saline
- Vital signs: HR 100; BP 100/70; O_2 Sat 94%

HEAD TRUAMA

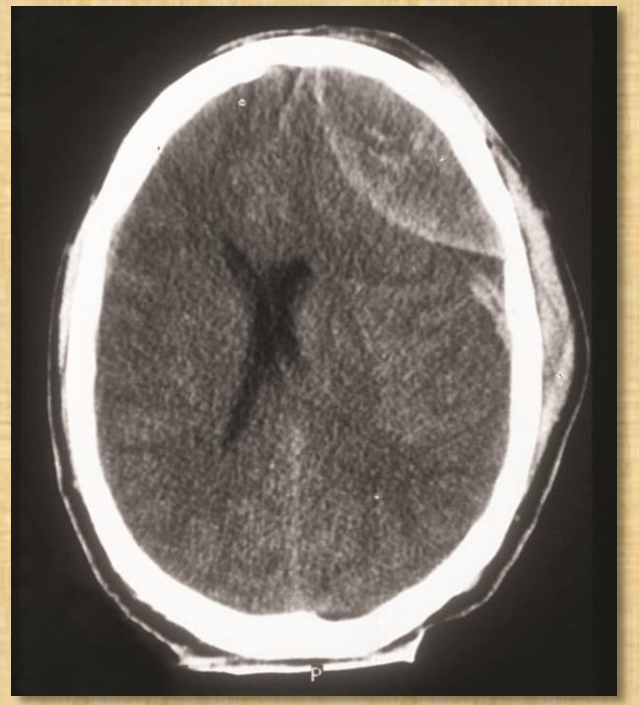
Case Scenario Progression

- Head, c-spine and abdominal CTs performed.
- Head CT: temporal bone fracture, epidural hematoma, 1 cm of midline shift
- C-spine normal

HEAD TRUAMA

Discussion Questions

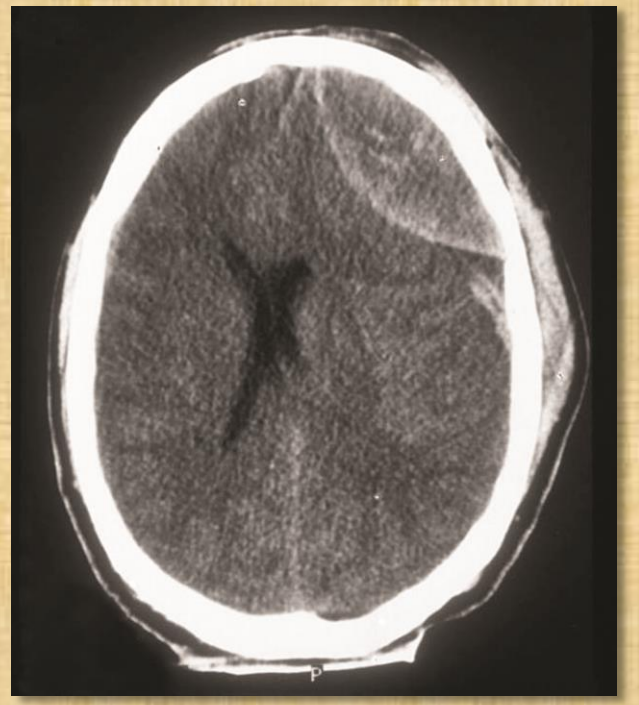
1. What types of intracranial hemorrhage can be identified on CT scan?



HEAD TRUAMA

Discussion Questions

2. What CT scan findings are indicative of severe head injury that may require intervention?



- Head, c-spine and abdominal CTs performed.
- Head CT: temporal bone fracture, epidural hematoma, 1 cm of midline shift
- C-spine normal

HEAD TRUAMA

Case Scenario Progression

- Thoracoabdominal CT scan normal
- Initial management includes:
  - elevating the head of bed
  - sedation with short-acting medications
  - frequent neurological examinations

HEAD TRUAMA

Discussion Question:

1. What are the initial management options for this patient with severe brain injury and how do these differ from mild and moderate brain injury?

- Thoracoabdominal CT scan normal
- Initial management includes:
- elevating the head of bed
- sedation with short-acting medications
- frequent neurological examinations

HEAD TRUAMA

Discussion Question:

2. What are the indications for transferring a patient with a head injury to a center with a higher level of care?

- Thoracoabdominal CT scan normal
- Initial management includes:
- elevating the head of bed
- sedation with short-acting medications
- frequent neurological examinations

HEAD TRUAMA

Case Scenario Progression

- ✓ Neuro exam shows progression to extensor posturing.
- ✓ Repeat CT scan shows new subdural hematoma with associated mass effect and midline shift.
- ✓ Herniation appears imminent without treatment.
- ✓ Patient requires a higher level of care and rapid transfer to neurosurgeon

HEAD TRUAMA

Discussion Question:

1. What are the initial treatment options that may protect the brain from ongoing swelling?

- Neuro exam shows progression to extensor posturing.
- Repeat CT scan shows new subdural hematoma with associated mass effect and midline shift.
- Herniation appears imminent without treatment.
- Patient requires a higher level of care and rapid transfer to neurosurgeon.

HEAD TRUAMA

Case Scenario Conclusion

- Neurosurgeon recommends 0.5 g/kg mannitol and adjusting $PaCO_2$ to 30 to 35 mm Hg.
- Patient is immediately transported for emergency craniotomy.
- Patient underwent successful evacuation of his intracranial hematoma.
- He was discharged to a rehabilitation center for ongoing therapy.

Brain Death

How do I diagnose brain death?

Brain Death

How do I diagnose brain death?

- GCS score = 3
- Nonreactive pupils
- Absent brainstem reflexes (e.g., oculocephalic, corneal, and Doll's eyes, and no gag reflex)
- No spontaneous ventilatory effort on formal apnea testing

Organ Donation

- **Organ procurement organization referral for all patients with head injury and GCS < 5**
- **Consider organ donation for all patients with brain death**

HEAD TRUAMA

Any Questions?

HEAD TRUAMA

Review Objectives

By the end of this interactive discussion, you will be able to:

- Recognize the GCS score that corresponds to a severe head injury and indicates a comatose patient.
- Identify the different types of intracranial bleeding seen on CT that are associated with traumatic brain injury.
- Discuss the role of supplemental oxygen and systolic blood pressure maintenance in limiting secondary brain injury.
- Describe the management of intracranial hypertension associated with the mass effect of blood or brain swelling.
- Discuss the indications for early, rapid transfer to a center equipped to manage a patient with brain injury.

HEAD TRUAMA

Key Learning Points

- GCS score is an objective, reproducible measurement of brain injury severity.
- GCS of 8 or less is considered severe and indicative of a comatose patient.
- Consider a CT scan of the head for any trauma patient with suspected traumatic brain injury.
- Initial management of intracranial hypertension includes:
  - elevation of the head of bed
  - sedation
  - selective administration of mannitol and hypertonic saline

HEAD TRUAMA

Key Learning Points

- Minimize secondary brain injury by:
  - adequate oxygenation (supplemental oxygen)
  - ensuring brain perfusion: SBP > 100 mm Hg (age 50-69) or > 110 mm Hg (15 – 49 and older than 70)

- If no neurosurgical capability, consider early, rapid transfer

Thanks for your kind attention