Head Trauma

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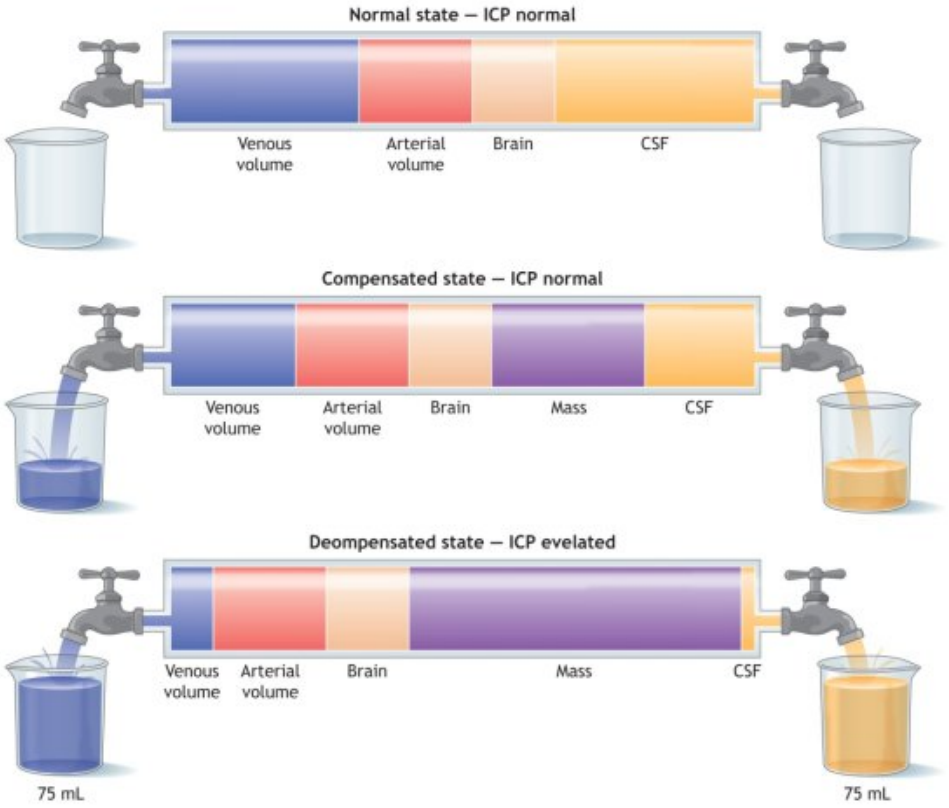
Objectives

1. Anatomy & Physiology
2. The importance of limiting 2ry brain injury
3. Classification of HI
4. Management of HI
5. Brain Death

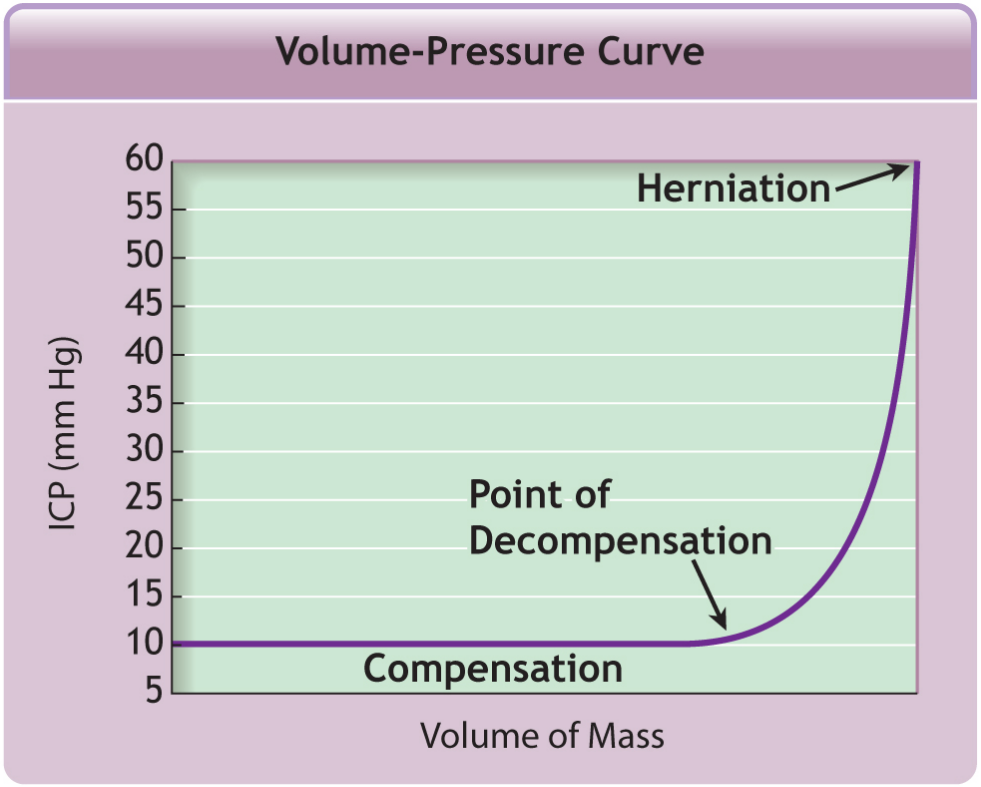
Anatomy & Physiology

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

Monro-Kellie Doctrine



Volume-Pressure Curve



Intrcranial Pressure

Sustained increased ICP leads to decreased brain function and poor outcome

10 mm Hg	Normal
> 20 mm Hg	Abnormal
> 40 mm Hg	Severe

Cerebral Perfusion Pressure (CPP)

	MAP	–	ICP	=	CPP
Normal	90		10		80
Cushing's Response	100		20		80
Hypotension	50		20		30



CPP ≠ Cerebral Blood Flow

Mean Arterial Pressure (MAP)

- MAP = Diastolic + 1/3 Pulse pressure
- Pulse pressure = Systolic - Diastolic

Autoregulation (MAP & CBF)

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

Classification of HI

Types:

Blunt

Penetrating (more risk of infection & siezures)

Classification of HI

By Morphology (The Cranium: Skull fractures):

A. Vault

1. Linear (nondepressed)/ Depressed
2. Closed (simple)/ Open (compound)

B. Basilar

1. With/without CSF leak (Rhinorrhoea, Otorrhoea)
2. With/ without cranial nerve palsy (1st,7th,8th)

Classification of HI

Linear skull fractures: X-rays

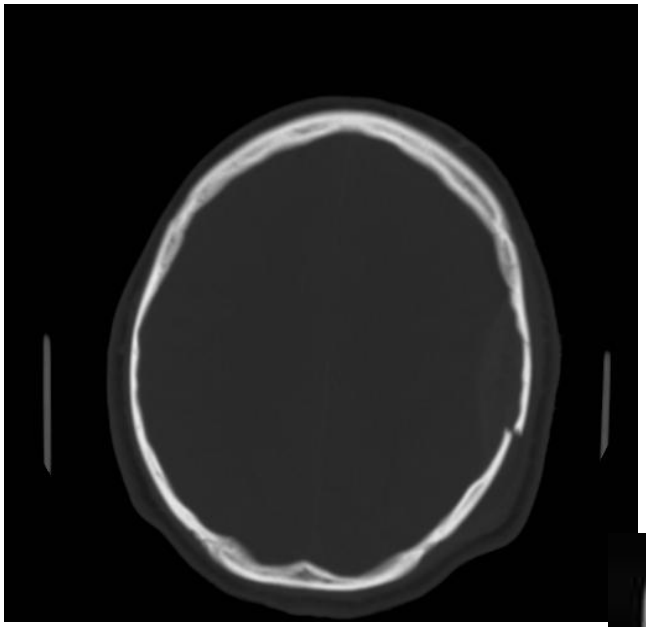


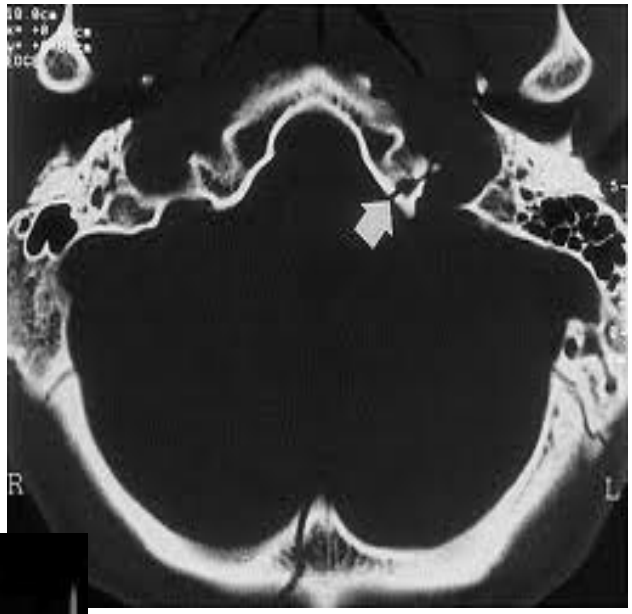


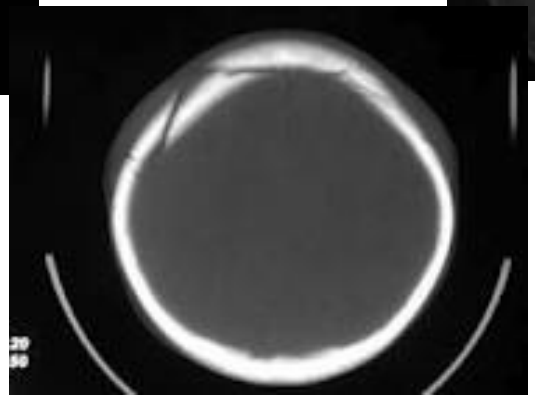


Classification of HI

Linear skull fractures: CT Bone window

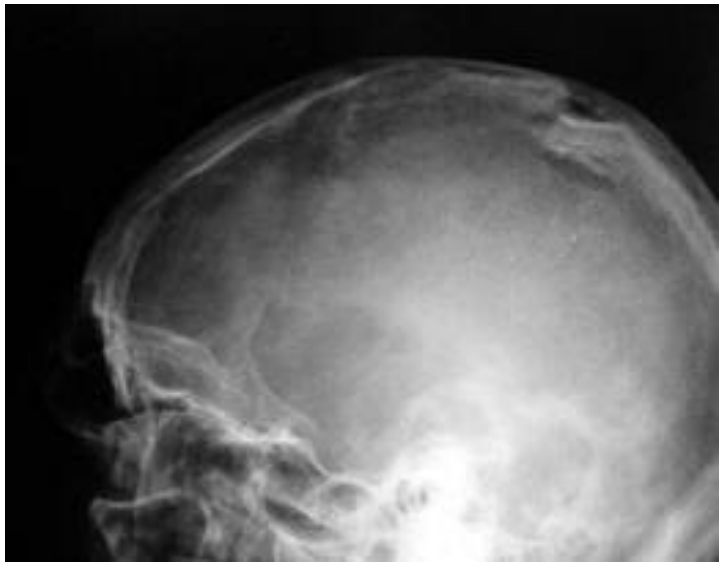


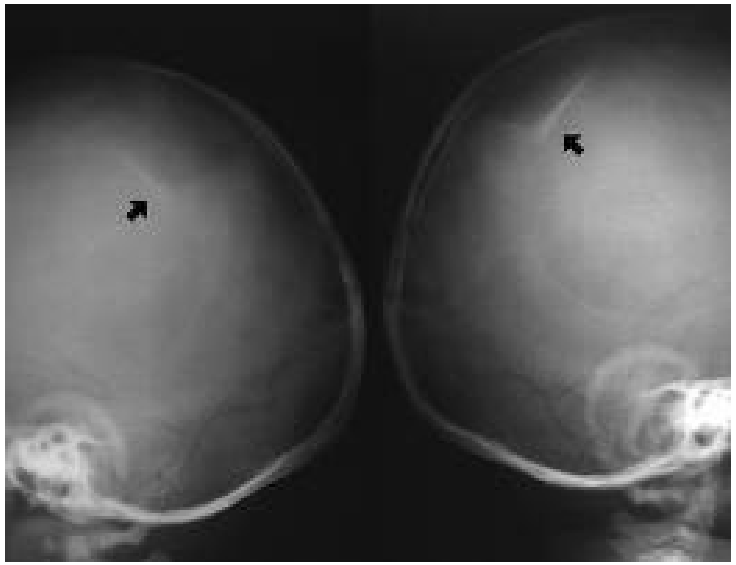




Classification of HI

Depressed skull fractures: X-rays

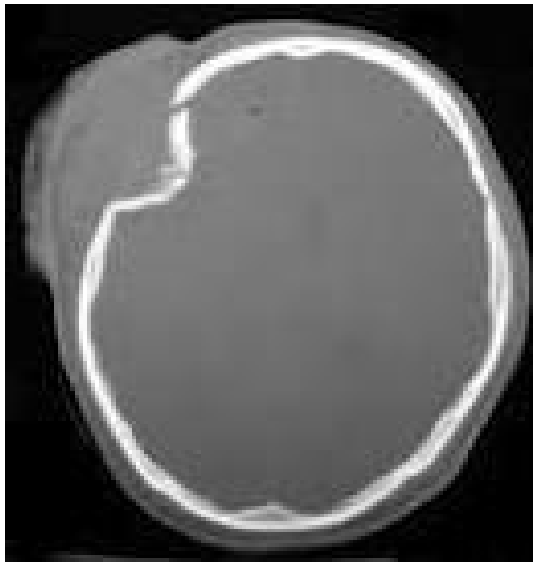




Classification of HI

Depressed skull fractures: CT







Depressed Skull # (Indications for surgery)

Any one of the next:

- Depression > 1 cm/ or full bone thickness
- Gross wound contamination
- Significant intracranial hematoma
- Gross cosmetic deformity
- Frontal sinus involvement
- Dural penetration (clinical or radiological)

Depressed Skull

Nonsurgical management may be considered if:

- All the following are present (No indication):
  - No depression > 1 cm/ or full bone thickness
  - No gross wound contamination
  - No significant intracranial hematoma
  - No gross cosmetic deformity
  - No frontal sinus involvement
  - No dural penetration (clinical or radiological)

Signs of skull base fracture

- Raccoon eyes
- Battle sign
- CSF leak: rhinorrhea or otorrhea
- Cranial nerve palsy











Classification of HI

By Morphology (Intracranial injuries):

A. Focal

1. Epidural hematoma
2. Subdural Hematoma/air
3. Intracerebral contusion/ hematoma

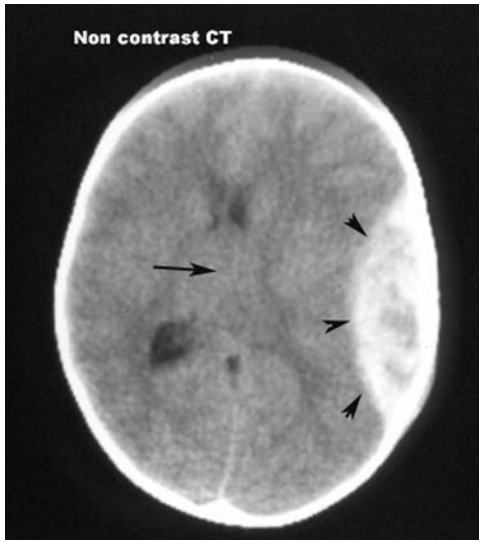
B. Diffuse

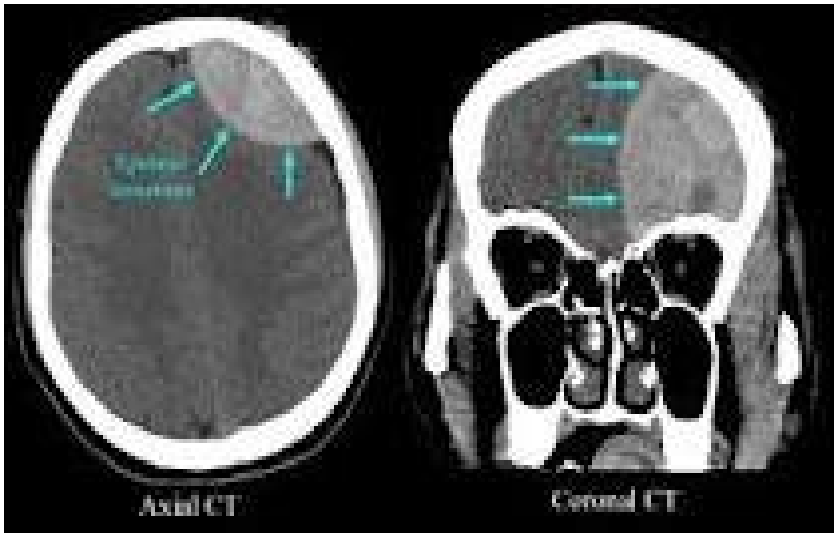
1. Concussion / Diffuse axonal injury
2. Multiple contusions
3. Hypoxic / ischemic injury

Epidural Hematoma

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

EDH - CT





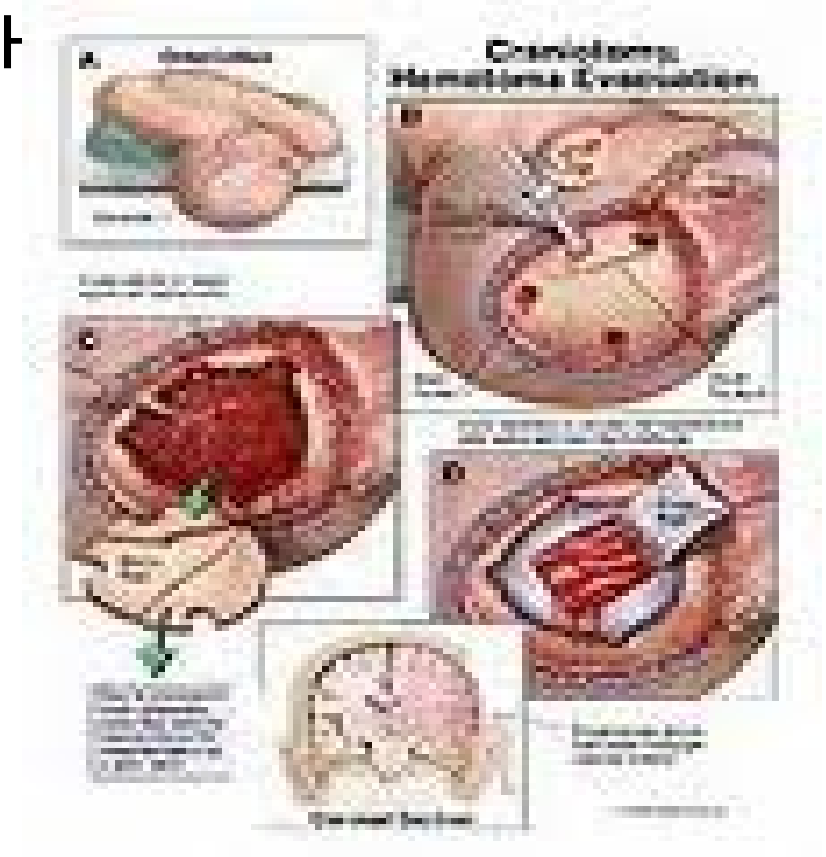
Epidural Hematoma

Temporal EDH

Uncal herniation

EDH – Indications for surgery

- Volume > 30 cm3, regardless of GCS
  - Craniotomy for EDH



EDH – Conservative management (Serial CT & close neuroobservation)

If all the following are present:

- Volume < 30 cm3
- Thickness < 15 mm
- Midline shift < 5 mm
- GCS > 8
- No focal neurodeficit

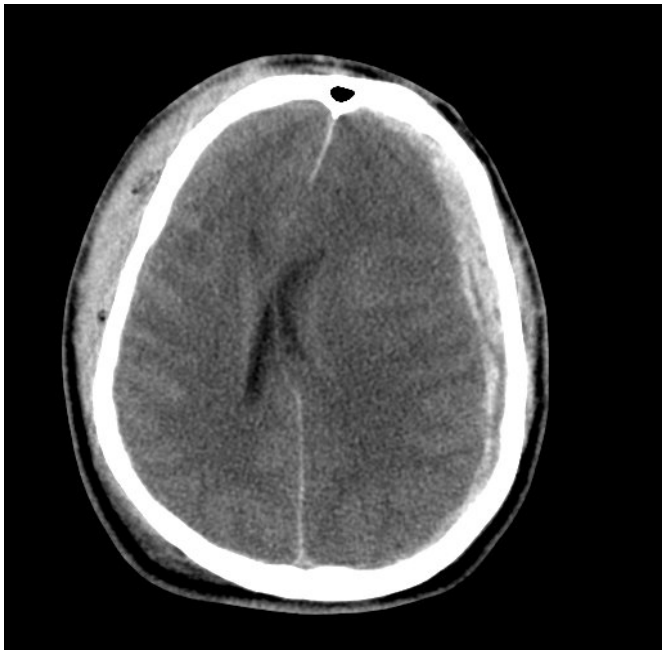
Subdural Hematoma

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

Subdural Hematoma

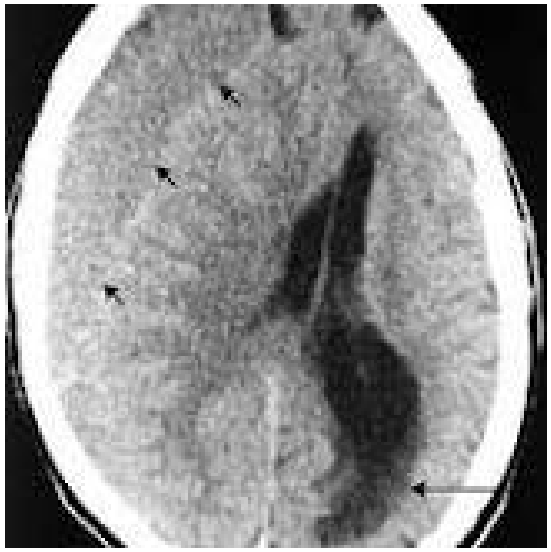
Acute

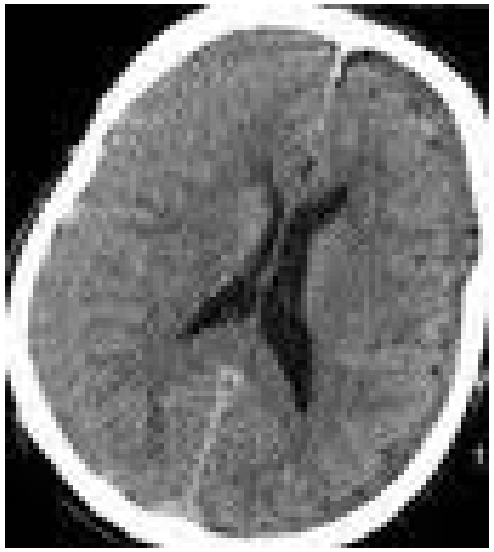




Subdural Hematoma

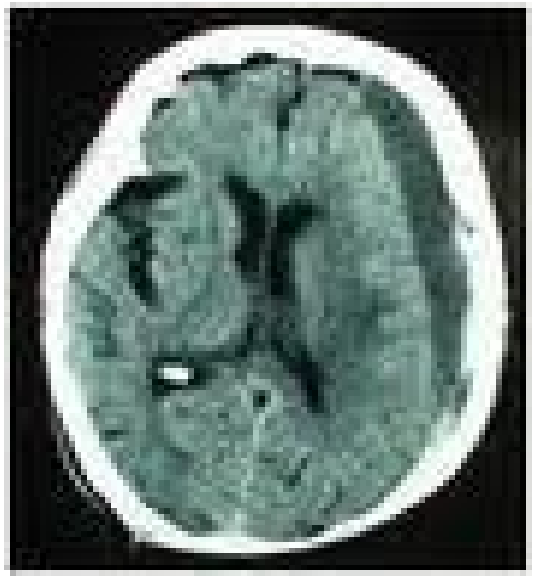
Subacute

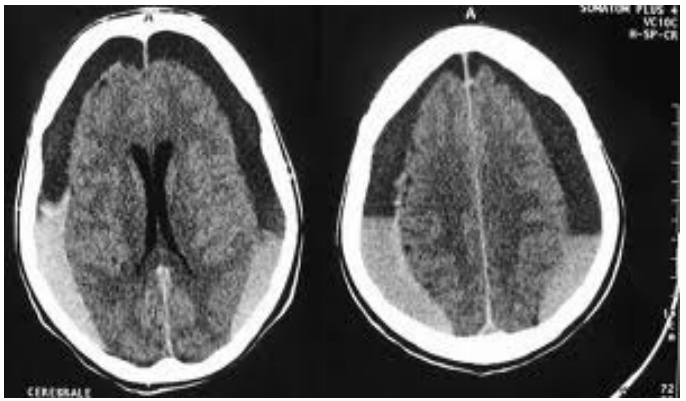




Subdural Hematoma

Chronic



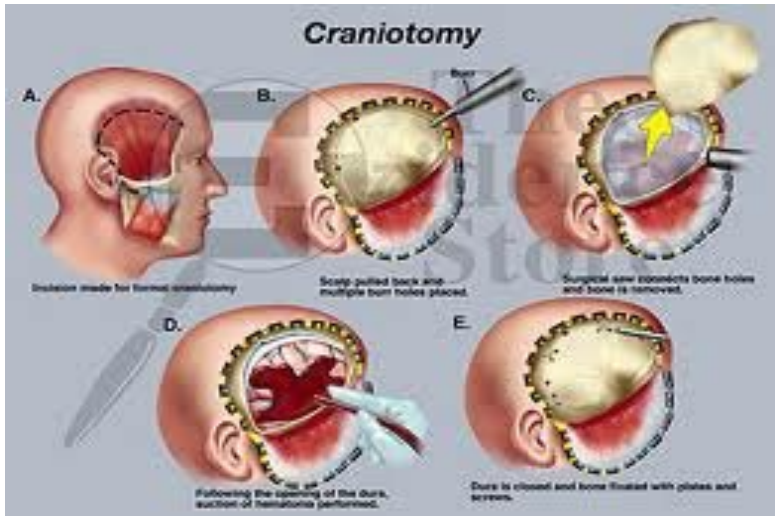


ASDH – Indications for surgery

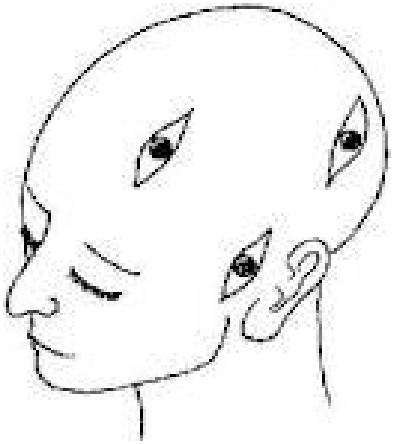
- Thickness > 10 mm, regardless of GCS
- Midline shift > 5 mm, regardless of GCS
- If thickness < 10 mm & shift < 5 mm, then operate if any of the following is present:
  - GCS drops by ≥ 2 points
  - Anisocoria
  - ICP > 20 mmHg

SDH – Surgical treatment

Craniotomy for ASDH



Burr hole for subacute & chronic SDH

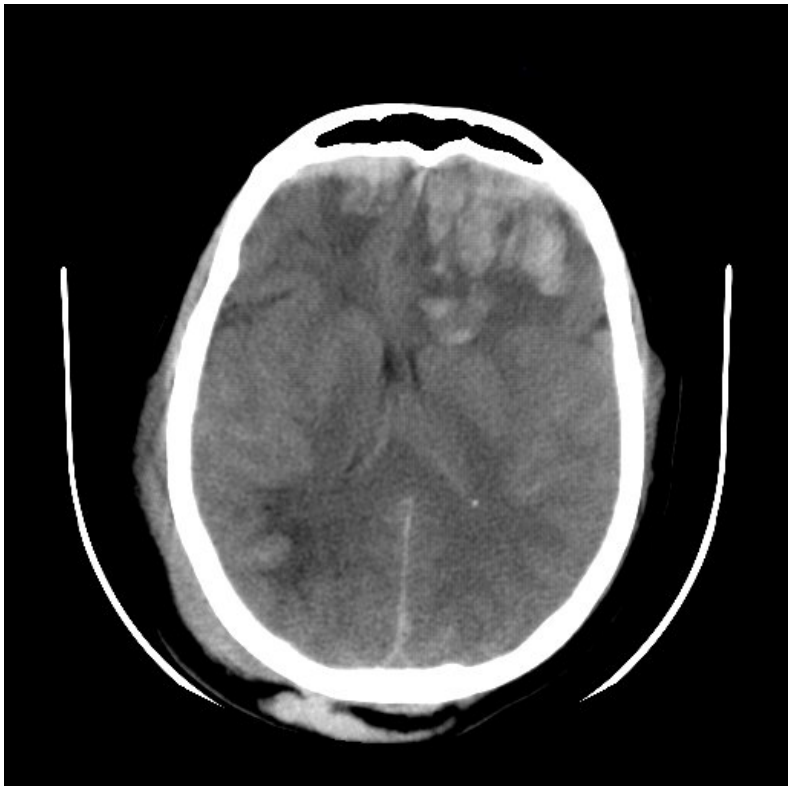


Intracerebral Hematoma / Contusion

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

Intracerebral Hematoma / Contusion

Large frontal contusion with mass effect



Diffuse Brain Injury

Range from mild concussion to severe ischemic insult



Normal CT



Diffuse Injury

Classification of HI

By Severity of Injury Based on GCS Score:

Mild (13-15)

Moderate (9-12)

Severe (3-8)

Glasgow Coma Scale - GCS

Points	Best Eye	Best Verbal	Best Motor
6	-	-	Obeys
5	-	Oriented	Localizes
4	Spont.	Confused	Withdraws
3	To speech	Inappropriate	Flex/Decort.
2	To pain	Incomprehens.	Ext/Decerebr.
1	None	None	None

Pediatric Glasgow Coma Scale

P – GCS (< 2 yrs)

Points	Best Eye	Best Verbal	Best Motor
6	-	-	Normal spont. movement
5	-	Coos, Babbles	Withdraws to touch
4	Spont.	Irritable cries	Withdraws to pain
3	To speech	Cries to pain	Abnormal Flex
2	To pain	Moans to pain	Abnormal Ext.
1	None	None	None

Mild HI

- GCS score = 13 – 15
- Take detailed history
- Perform neurologic exam
- Exclude systemic injuries
- Alcohol / drug screens as indicated
- Liberal use of head CT
- Observe or discharge based on the findings

Moderate HI

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

Severe HI

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

Indications for CT scan

High risk

- GCS score still < 15 two hours after injury
- Neurologic deficit
- Open skull fracture
- Sign of basal skull fracture
- Extremes of age

Indications for CT scan

Moderate risk

- “Dangerous mechanism”
- Retrograde amnesia > 30 minutes in duration
- Severe headache
- Vomiting > 2 episodes

Management

Priorities

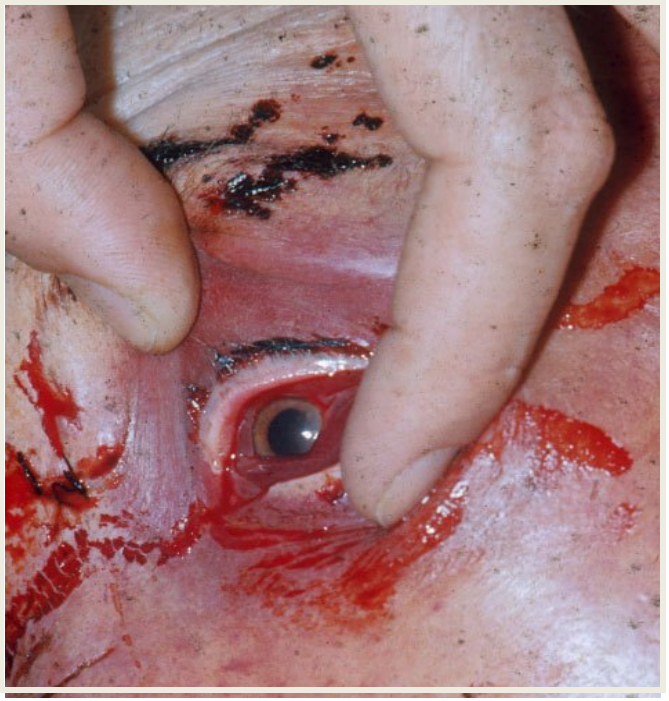
1. **ABCDE**
2. **Minimize secondary brain injury:**
   - Administer oxygen
   - Maintain adequate ventilation
   - Maintain blood pressure (systolic > 90 mm Hg)

Management

Focused Neurological Exam

- GCS score
- Pupils
- Lateralizing signs

Consult Neurosurgeon!



Guidelines for prehospital management of traumatic brain injury, 2d edition

Prehospital Emergency Care

- January / March 2007
- Supplement to Volume 12 / Number 1

Management

Medical treatment:

- Controlled ventilation (Goal: Paco2 at 35 mm Hg)
- Intravenous fluids (Euvolemia, Isotonic)
- Mannitol (Use with signs of tentorial herniation.
  Dose: 0.25 to 1.0 g / kg IV bolus)
- Anticonvalsants, sedation, paralytics

NB! Perform & document neurological examination before prolonged sedation

Guidelines for the Management of Severe Traumatic Brain Injury 3rd Edition

A Joint Project of the

Brain Trauma Foundation Website: www.braintrauma.org

Improving the Outcome of Brain Trauma Patients Worldwide

and

American Association of Neurological Surgeons (AANS)

Congress of Neurological Surgeons (CNS)

AANS/CNS Joint Section on Neurotrauma and Critical Care

Journal of Neurotrauma, Volume 24, Supplement 1, 2007

Brain Trauma FOUNDATION

Guidelines for the Management of Severe Traumatic Brain Injury
4th Edition

Guidelines for the Management of Severe Traumatic Brain Injury, Fourth Edition FREE

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Guidelines for the acute medical management of severe traumatic brain injury in infants, children, and adolescents

Pediatr Crit Care Med 2003 Vol. 4, No. 3 (Suppl.)

Management

Surgical treatment:

Scalp Wounds

Possible site of major blood loss

Direct pressure to control bleeding

Occasional temporary closure

Management

Surgical treatment:

Intracranial mass lesions

Can be life-threatening if expanding rapidly

Immediate neurosurgical consult

Hyperventilation/ mannitol (with signs of tentorial herniation)

Guidelines for the Surgical Management of Traumatic Brain Injury

Neurosurgery

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Summary

- Ensure adequate oxygenation
- Maintain Paco2 near / at 35 mm Hg
- Maintain mean BP > 90 mm Hg
- Frequent neurologic assessment
- Liberal use of CT
- Early neurosurgical consult

Thanks



Any Questions?