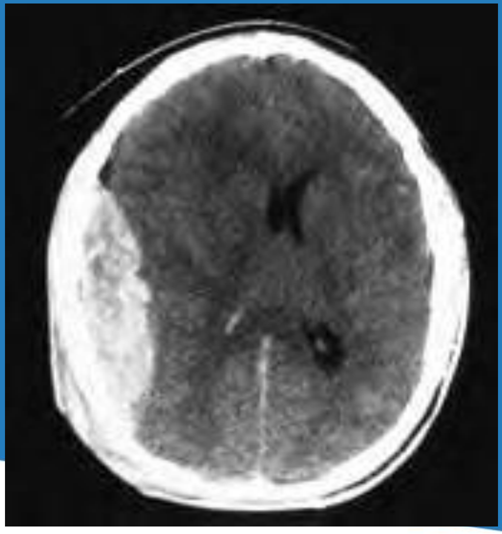
The Prehospital Management of Head Trauma



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Epidemiology

Approximately 500,000 cases of head injury occur in the U.S. each year

- 10% die prior to reaching a hospital
- 100,000 patients suffer a resultant disability from their head injury

Epidemiology

Patients with head injury that reach the hospital:

- Mild 80%
- Moderate 10%
- Severe 10%

Introduction

Adequate oxygenation and maintenance of sufficient blood pressure to perfuse the brain is paramount !!

- Avoid secondary brain damage

Anatomy

Scalp

- **S**kin
- **C**onnective tissue
- **A**poneurosis (galea)
- **L**oose areolar tissue
- **P**ericranium

****Can be a source of significant blood loss**

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Anatomy

Skull

- Cranial vault
- Base

Anatomy

Meninges

- Epidural space
- Dura: tough, fibrous membrane that adheres firmly to the internal surface of the skull
  - Subdural space
- Arachnoid: thin, transparent layer
  - Subarachnoid space: CSF
- Pia: firmly attached to the surface of the brain

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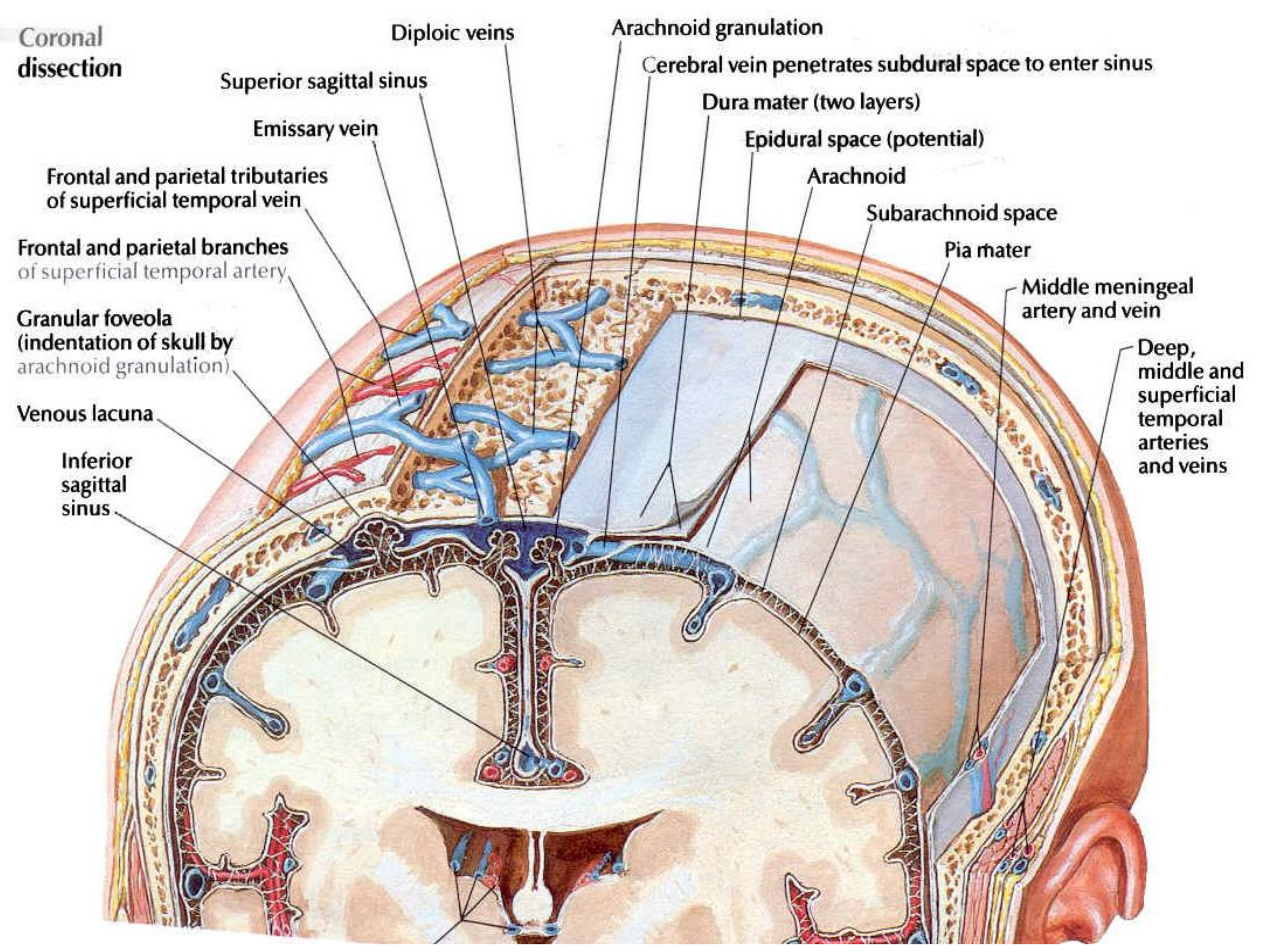
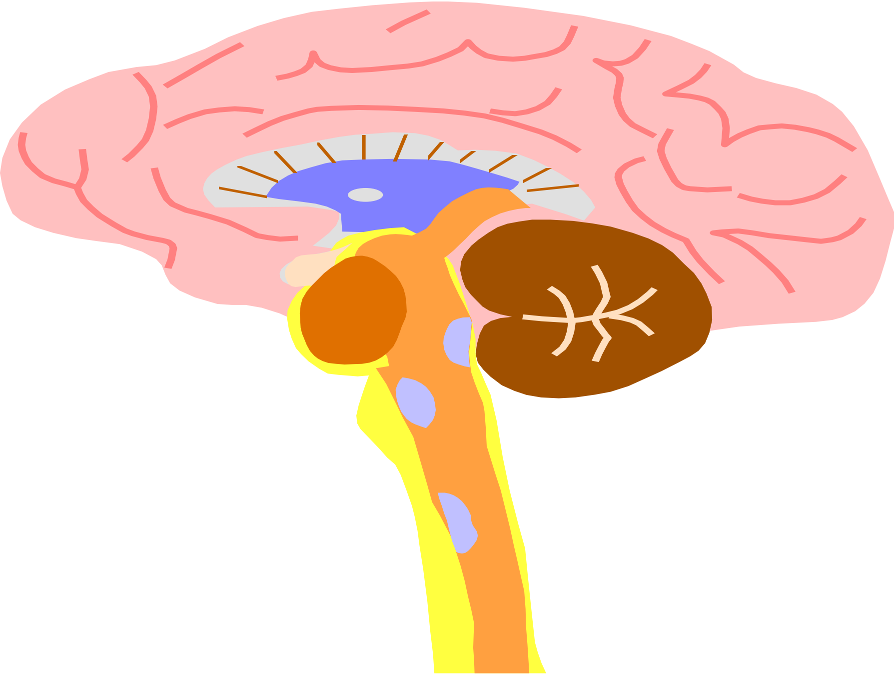


Coronal
dissection
Diploic veins
Arachnoid granulation
Cerebral vein penetrates subdural space to enter sinus
Superior sagittal sinus
Dura mater (two layers)
Emissary vein
Epidural space (potential)
Frontal and parietal tributaries of superficial temporal vein
Arachnoid
Subarachnoid space
Frontal and parietal branches of superficial temporal artery
Pia mater
Middle meningeal artery and vein
Granular foveola (indentation of skull by arachnoid granulation)
Deep, middle and superficial temporal arteries and veins
Venous lacuna
Inferior sagittal sinus

Anatomy

Brain

- Cerebrum
- Cerebellum
- Brainstem



Anatomy

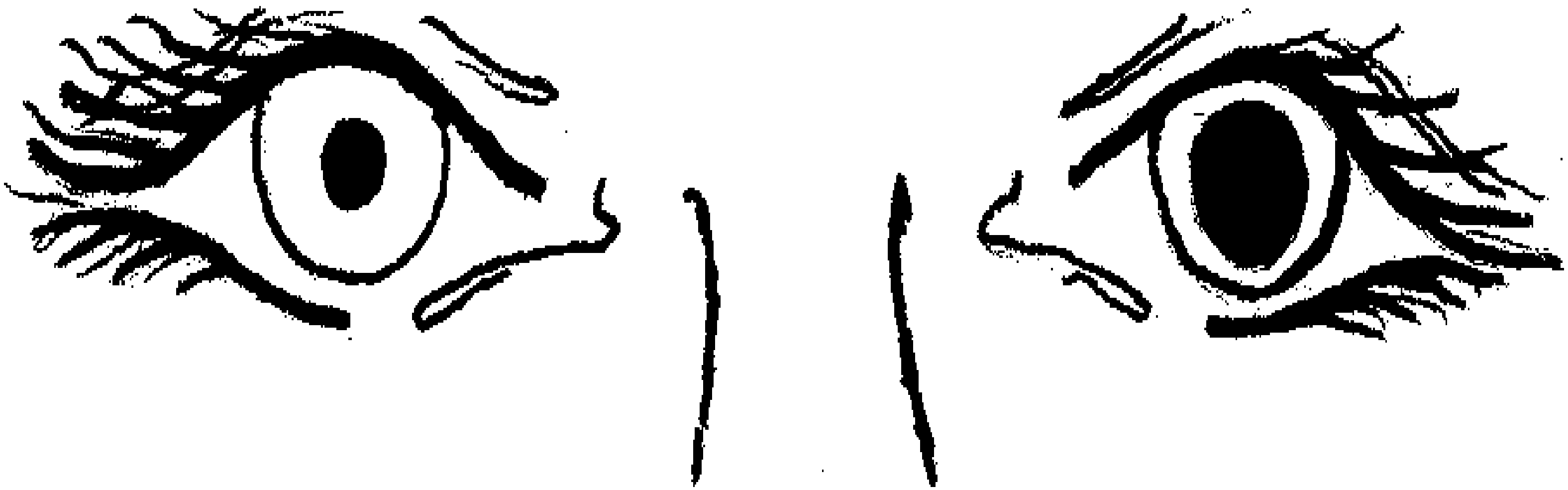
Cerebrospinal fluid (CSF)

- Produced by the choroid plexus at a rate of 30 ml/hour
- Blood in the CSF can impair absorption and result in increased intracranial pressure (ICP)

Anatomy

Tentorium

- Divides the brain into compartments
- Cranial Nerve III runs along the edge and may become compressed during downward brain herniation
    - Blown pupil



Physiology

Intracranial pressure

- Elevated ICP not only indicates a problem, but contributes to the problem
- Normal ICP = 10 mm Hg
  - > 20 mm Hg = abnormal
  - > 40 mm Hg = severe
- The higher the ICP after head injury, the worse the outcome

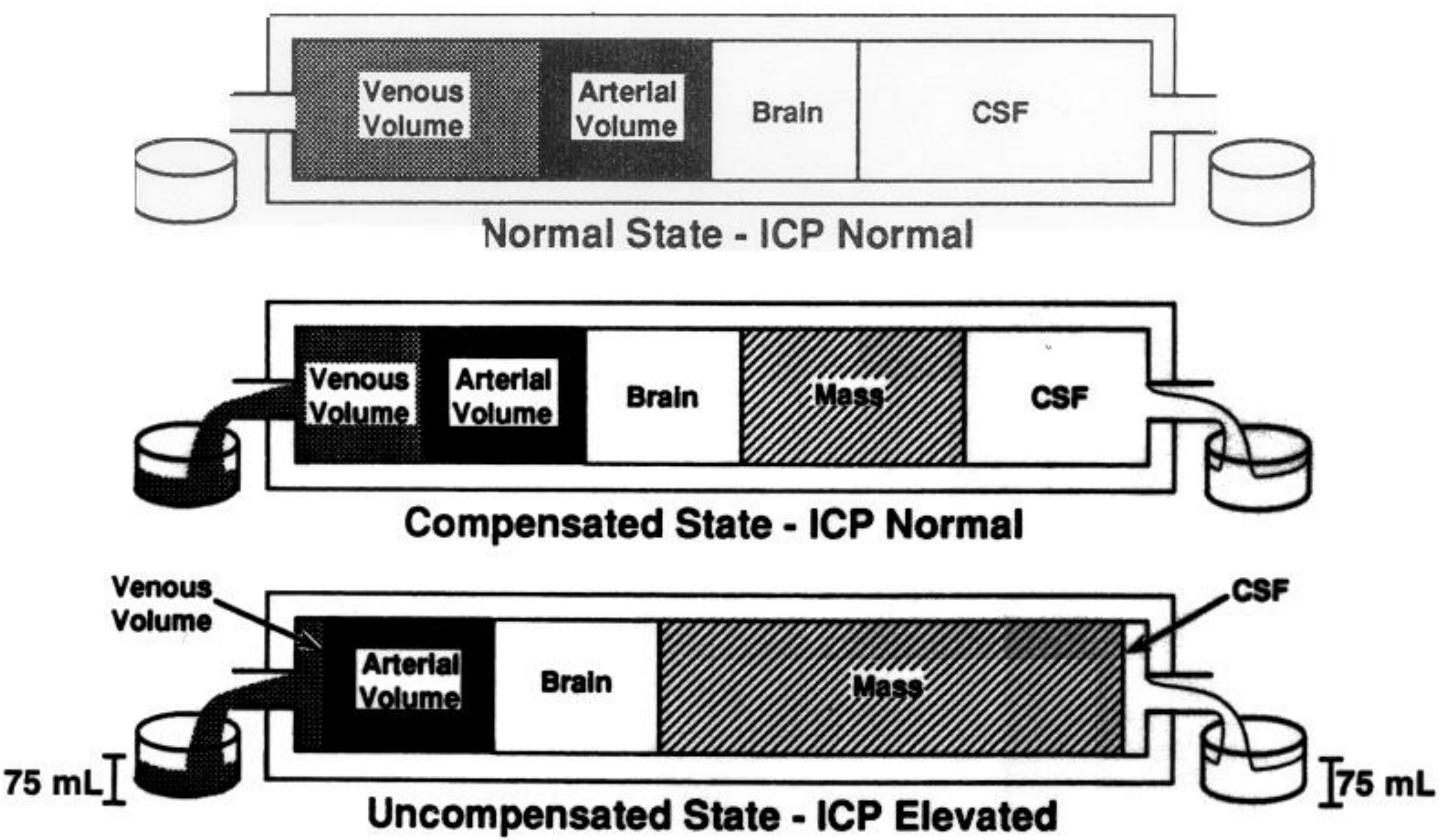
Physiology

Monro-Kellie Doctrine:

- The total volume of intracranial contents must remain constant

MONRO-KELLIE DOCTRINE

INTRACRANIAL COMPENSATION FOR EXPANDING MASS



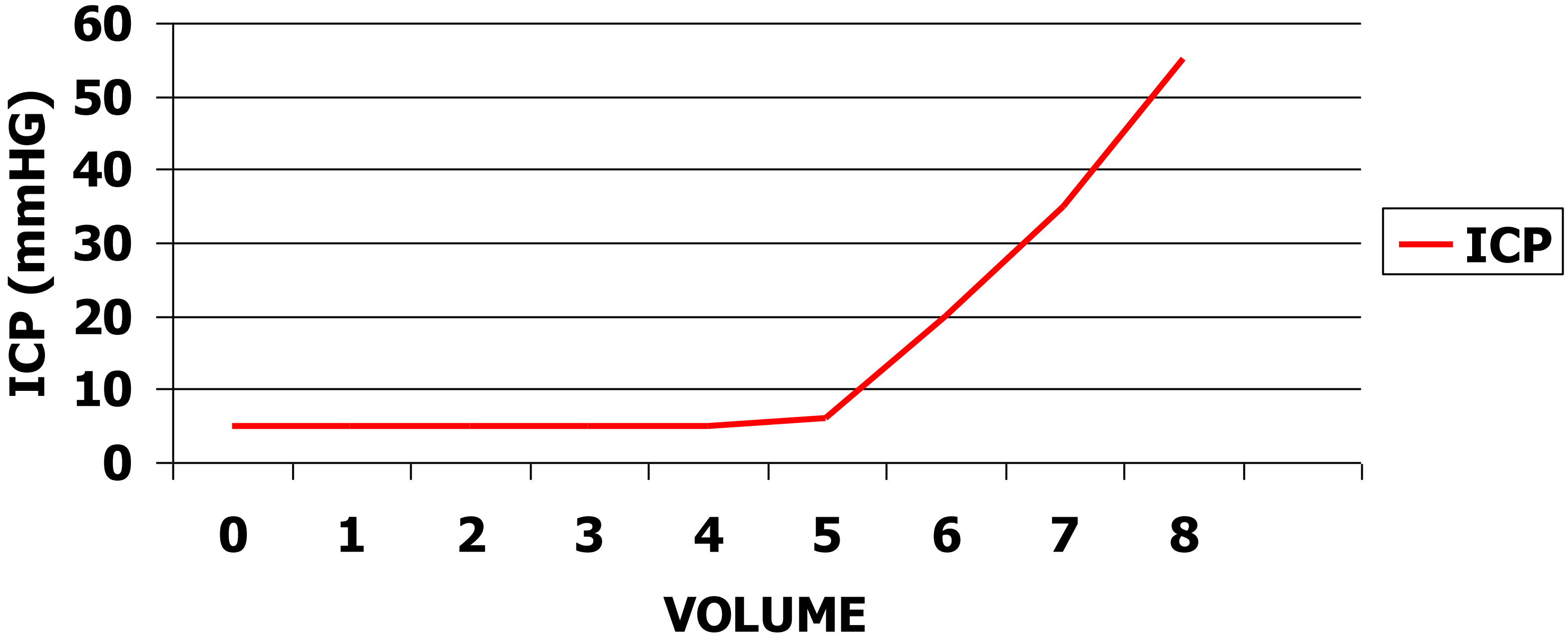
Pathophysiology

Blood

Brain

CSF

Monro-Kellie Doctrine



Cerebral Perfusion Pressure

CPP = MAP – ICP

Perfusion pressures < 70 mm Hg are associated with poor outcome

Once compensatory mechanisms are exhaustive and there is an exponential increase in ICP, brain perfusion is compromised

- Hematomas should be evacuated early
- Adequate systemic blood pressure must be maintained

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Classification

Mechanism of injury

- Blunt
  - High velocity
  - Low velocity

Classification

Severity of injury

- Mild: GCS 14-15
- Moderate: GCS 9-13
- Severe: GCS 8 or below

Glasgow Coma Scale

Eye Opening	
Spontaneous	4
To speech	3
To pain	2
None	1
Best Motor Response	
Obeys commands	6
Localizes pain	5
Normal flexion (Withdrawl)	4
Abnormal flexion (Decorticate)	3
Extension (Decerebrate)	2
None (Flaccid)	1
Verbal Response	
Oriented	5
Confused conversation	4
Inappropriate words	3
Incomprehensible sounds	2
None	1

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Classification

Morphology

- Skull fractures
  - Vault
    - Linear vs stellate
    - Depressed vs nondepressed
    - Open vs closed
  - Basilar
    - With or without CSF leak
    - With or without CN VII palsy

Classification

Morphology

- Intracranial lesions
  - Focal
    - Epidural
    - Subdural
    - Intracerebral
  - Diffuse
    - Mild concussion
    - Classic concussion
    - Diffuse axonal injury

Skull Fractures

A linear vault fracture increases the likelihood of intracranial hematoma by about 20x in a conscious patient, and by 400x in a comatose patient

- Fragments depressed more than the thickness of the skull require surgical elevation

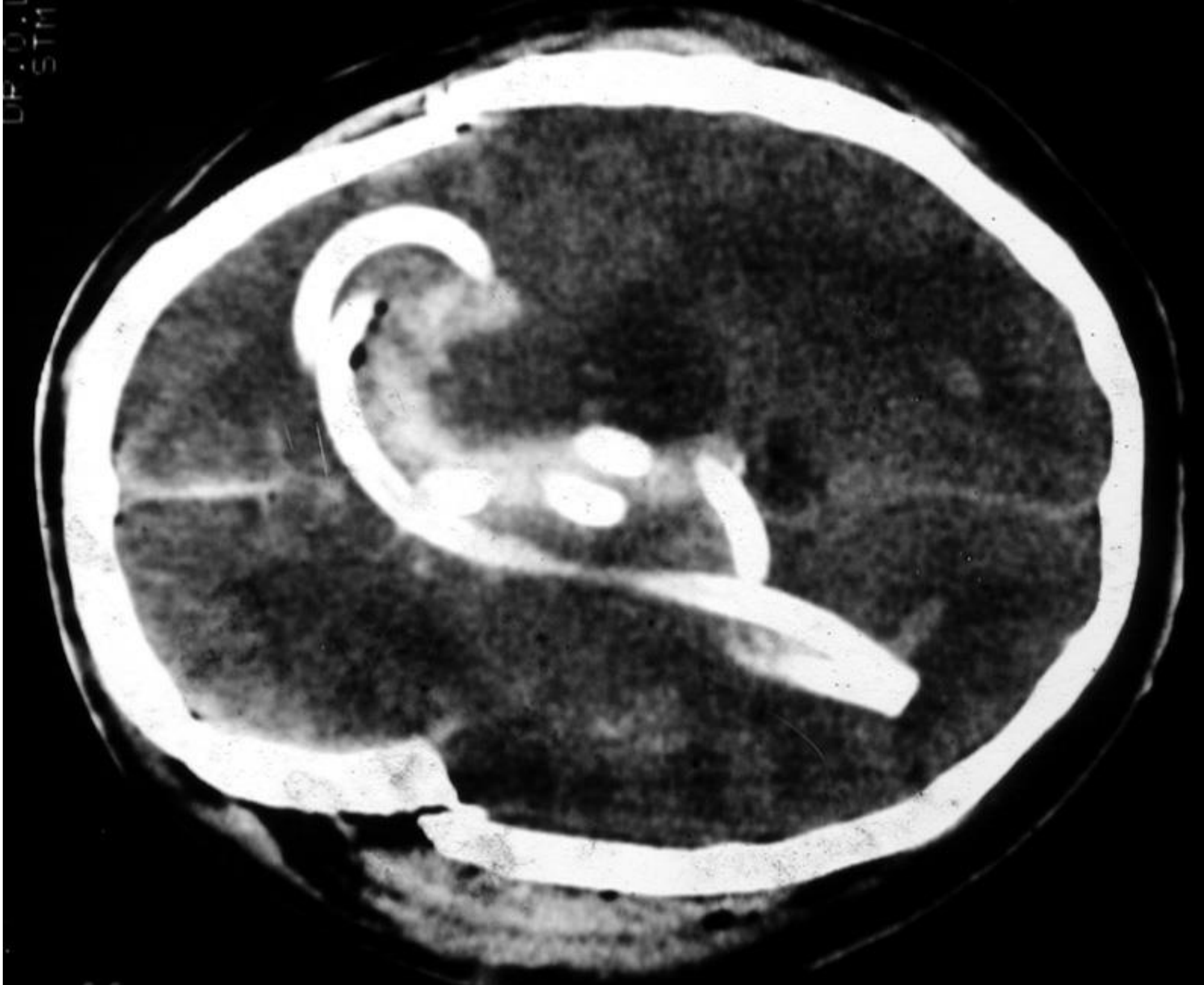
Open fractures require early repair and antibiotic prophylaxis

Skull Fractures

Signs of basilar skull fracture:

- Raccoon eyes
- Battle’s sign
- Hemotympanum
- CSF leaks
- CN VII palsy

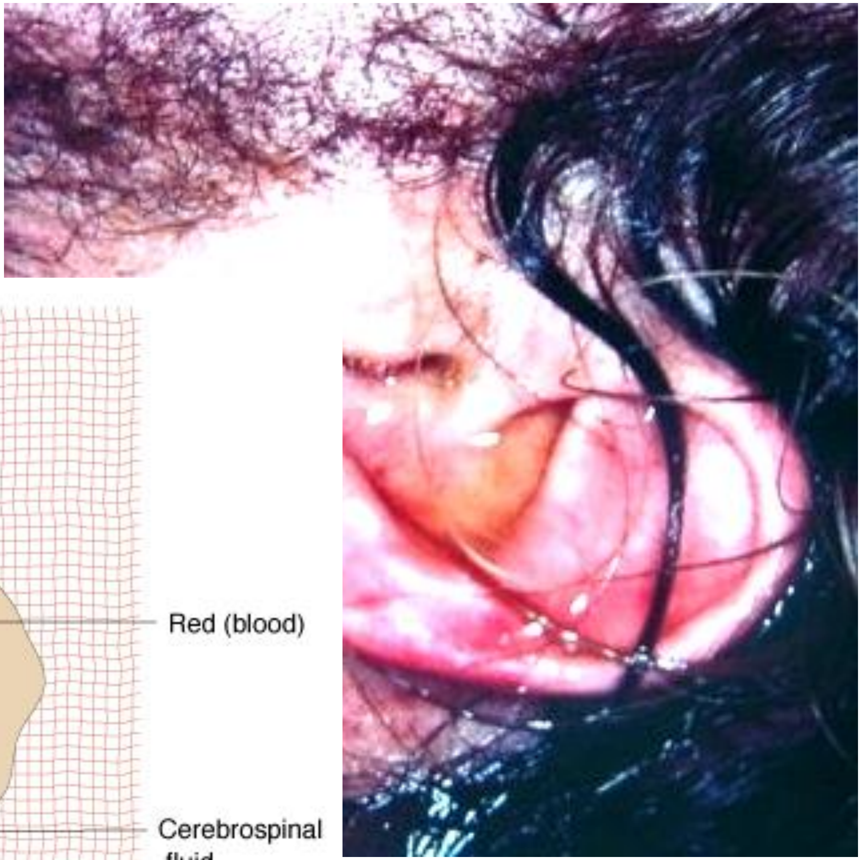
**Avoid passing anything through the nares in these patients

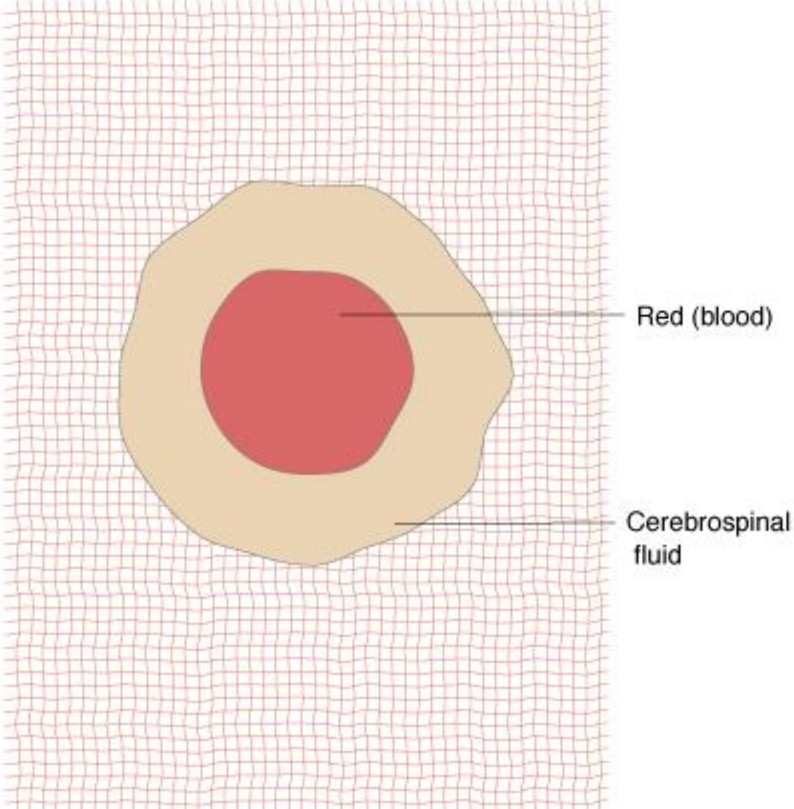


Raccoon Eyes

Battle's Sign

CSF Leak

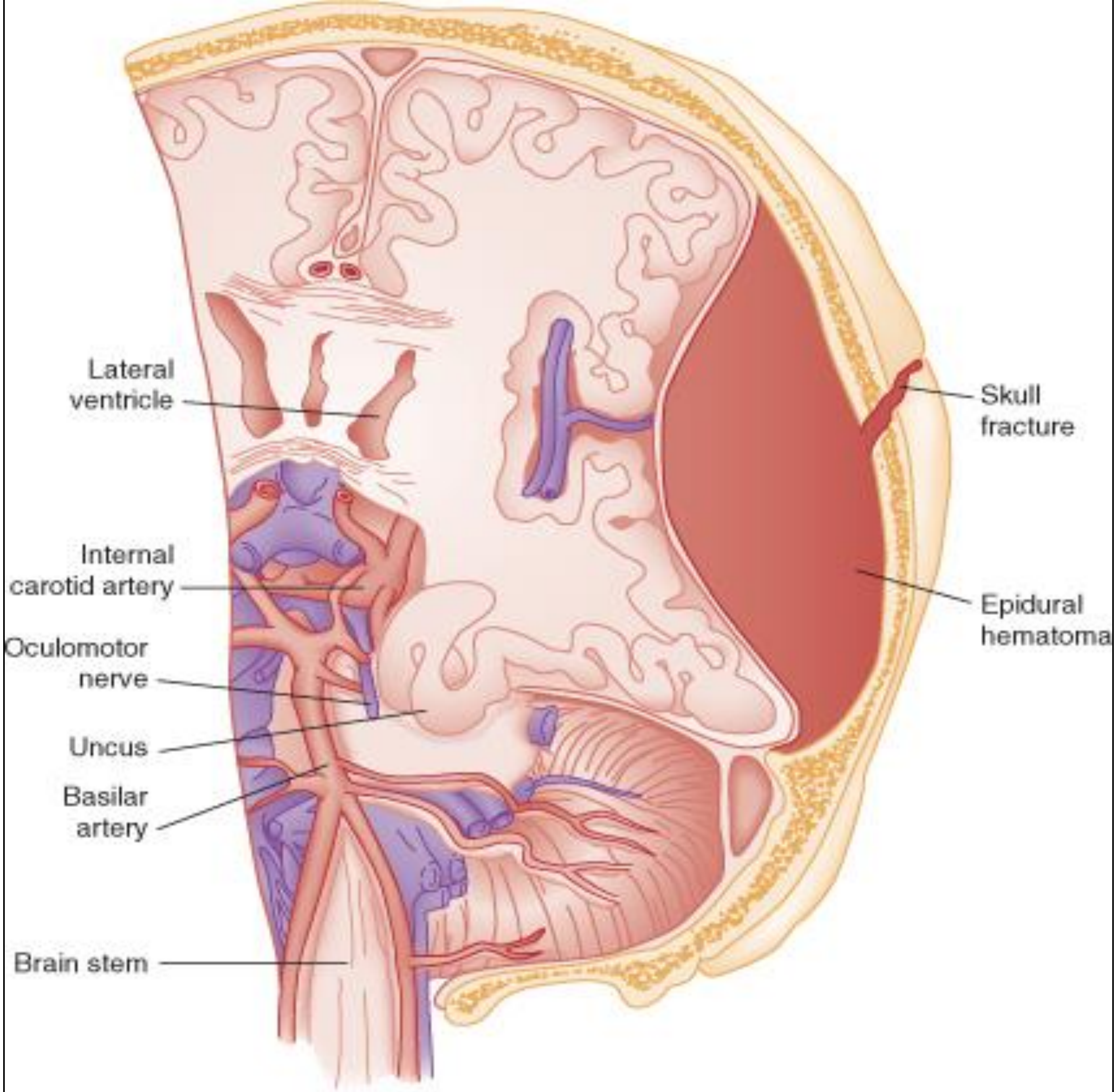




Intracranial Lesions

Epidural hematoma

- Located outside the dura but within the skull
- Typically biconvex or lenticular in shape
- Most often located in the temporal or temporoparietal region
- Usually arterial in origin
  - Middle meningeal artery


Lateral ventricle
Internal carotid artery
Oculomotor nerve
Uncus
Basilar artery
Brain stem
Skull fracture
Epidural hematoma

Epidural Hematoma

Relatively uncommon

- 0.5% of all head-injured patients
- 9% of those that are comatose

Outcome is directly related to the neuro status before surgery

Classic “lucid interval”

Subdural Hematoma

Much more common than epidural hematomas

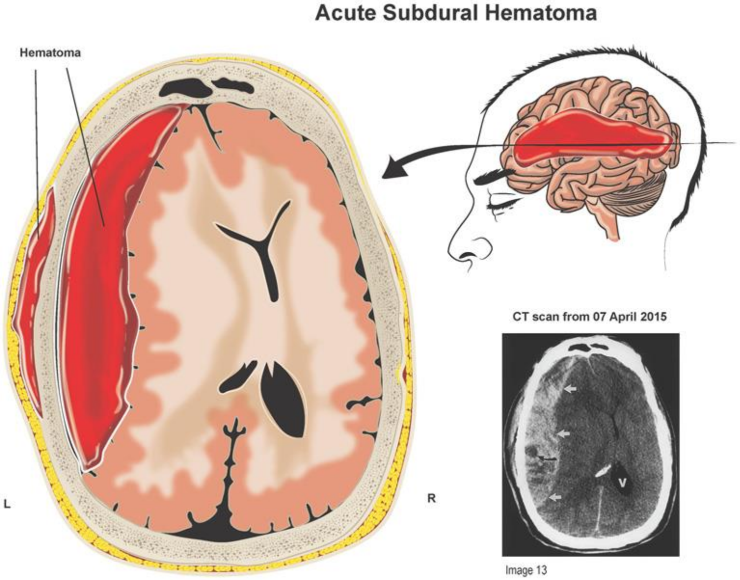
- 30% of severe head injuries

Most frequently due to tearing of a bridging vein between the cerebral cortex and a draining venous sinus

Subdural Hematoma

Cover the entire surface of the hemisphere

Underlying brain damage is usually more severe and the prognosis is much worse than epidural hematomas



Cerebral Contusions/Intracerebral Hematomas

Pure cerebral contusions are common

Most occur in the frontal and temporal lobes

Distinction between contusions and hematomas remains ill-defined

Contusions can coalesce to form hematomas

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Mild Concussion

Consciousness is preserved but there is a noticeable degree of temporary neurologic dysfunction

Mildest form: confusion without amnesia

Slightly greater injury: confusion with both retrograde and antegrade amnesia

Classic Cerebral Concussion

Positive LOC with amnesia

- Length of amnesia is a good measure of the severity of injury
- Transient with return to full consciousness by six hours

Can develop post-concussion syndrome

- Memory difficulties, dizziness, nausea, and depression

Diffuse Axonal Injury

Prolonged post-traumatic coma that is not due to a mass lesion or ischemic results

Patient often demonstrates posturing

Remain severely disabled if they survive

Can exhibit autonomic dysfunction:

- Hypertension, hyperpyrexia, etc.

Management of Mild Head Injury

GCS 14-15

80% of patients with head injury

Awake, but may be amnestic with brief loss of consciousness

- Define LOC
- Was it true LOC?
- Important to differentiate

Management of Mild Head Injury

Clinical signs of basilar skull fracture should be sought out

Monitor and transport

Management of Moderate Head Injury

GCS 9-13

Can follow simple commands, but usually confused

May have focal neurologic deficits

10 to 20% lapse into coma

Managed like severely head injured patients, but are not routinely intubated

Management of Severe Head Injury

GCS 3-8

Unable to follow simple commands

Prompt diagnosis and treatment is required

ALS resources should be requested, if not already dispatched

Goal: prevent secondary damage to an already injured brain

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Management of Severe Head Injury

Primary Survey

- Cardiopulmonary stabilization must be achieved rapidly
  - Hypotension with severe head injury results in double the mortality compared to patients with no hypotension (60% vs. 27%)
  - The presence of hypoxia increases the mortality to 75%

Primary Survey

Airway and Breathing

- Manage the airway to your certification level
- Early intubation (*if RSA Credentialed)
- Hyperventilation may be used cautiously
  - PCO_2 30-35

Circulation

- Hypotension is usually not due to brain injury itself until later stages of herniation occur
- Volume replacement with IVF

Primary Survey

Circulation

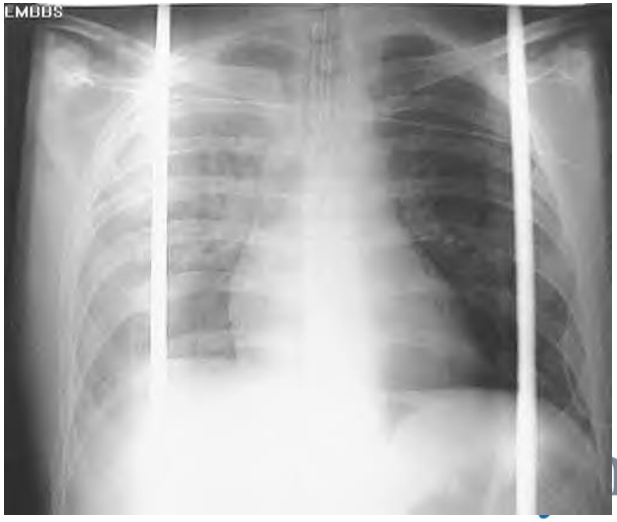
- Hypotension is usually not due to brain injury itself until later stages of herniation occur
- Maintain normovolemia
- Avoid fluid overload
- Avoid hypotonic fluids and fluids that contain glucose

Secondary Survey

Once the primary survey is completed

Look for other injuries

- 50% of patients have additional major systemic injuries



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Neurologic Examination

Rapid and directed neurological examination

- GCS based on best response
- Pupillary light response
- Prior to sedation

Frequent serial examinations should occur

Role of TXA

Use TXA as part of the treatment regimen in hemorrhagic shock

Note: TXA is not currently indicated in isolated head trauma without associated hemorrhagic shock

Summary

- Manage the primary survey, especially in comatose patients
- Treat hypoxia and shock aggressively and look for its cause
- Avoid hypovolemia and overhydration
- Frequently reassess the patient's neurologic status

Questions??

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Sources

Emergency Care in the Streets by Nancy Caroline, Seventh Edition.

Advanced Trauma Life Support Course Manual by the American College of Surgeons Committee on Trauma, Tenth Edition.

Emergency Medicine: A Comprehensive Study Guide by Tintinalli, et al. Eighth Edition.

Emergency Medicine: Concepts and Clinical Practice by Rosen, et al. Ninth Edition.

Images from google.com

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