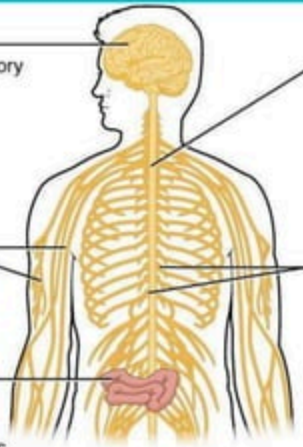

Neurophysiology

Brain (CNS)
Perception and processing of sensory stimuli (somatic/autonomic)
Execution of voluntary motor responses (somatic)
Regulation of homeostatic mechanisms (autonomic)

Nerves (PNS)
Fibers of sensory and motor neurons (somatic/autonomic)

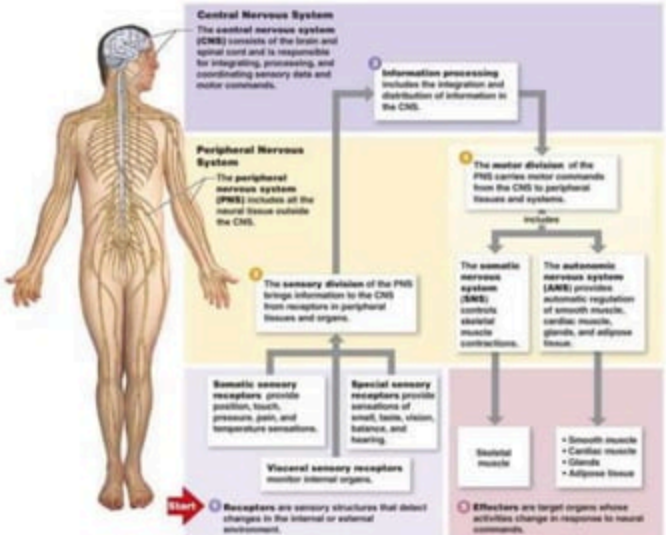
Digestive tract (ENS)
The enteric nervous system (ENS), located in the digestive tract, is responsible for autonomous functions and can operate independently of the brain and spinal cord.



Spinal cord (CNS)
Initiation of reflexes from ventral horn (somatic) and lateral horn (autonomic) gray matter
Pathways for sensory and motor functions between periphery and brain (somatic/autonomic)

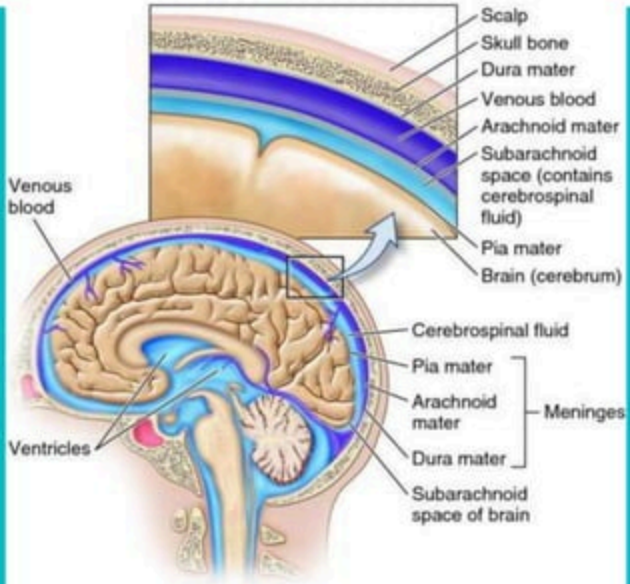
Ganglia (PNS)
Reception of sensory stimuli by dorsal root and cranial ganglia (somatic/autonomic)
Relay of visceral motor responses by autonomic ganglia (autonomic)

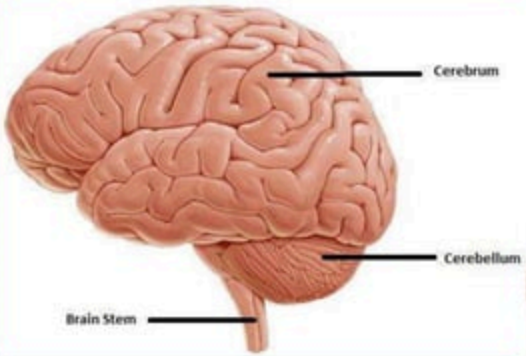
Nervous System

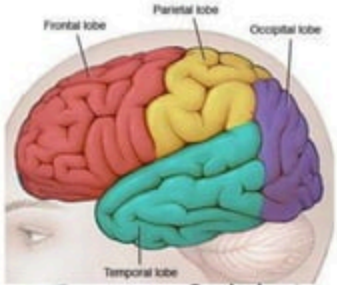


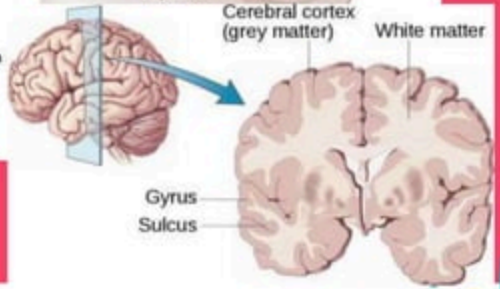
Overview

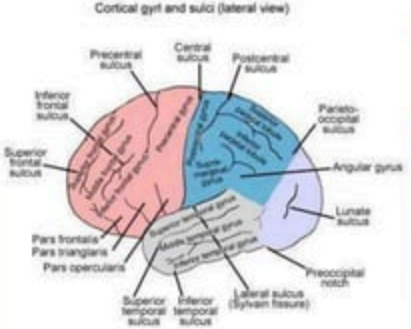
1. Neuroanatomy
2. Cerebral circulation
3. CSF circulation
4. Monroe-Kellie Doctrine
5. Cerebral blood flow
6. Cerebral perfusion pressure
7.

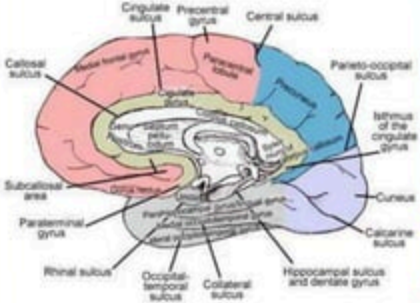

Scalp
Skull bone
Dura mater
Venous blood
Arachnoid mater
Subarachnoid space (contains cerebrospinal fluid)
Pia mater
Brain (cerebrum)
Venous blood
Cerebrospinal fluid
Pia mater
Arachnoid mater
Meninges
Dura mater
Ventricles
Subarachnoid space of brain

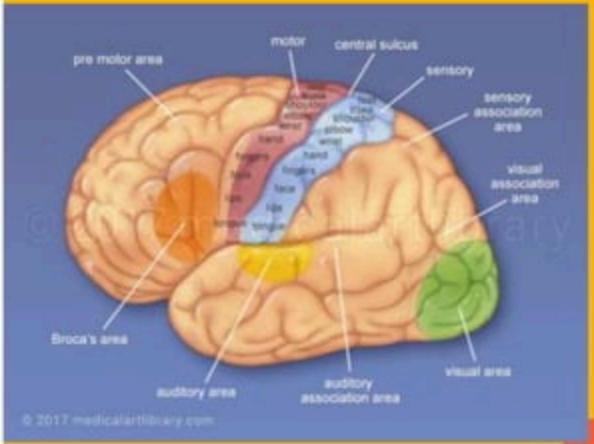

Cerebrum
Cerebellum
Brain Stem

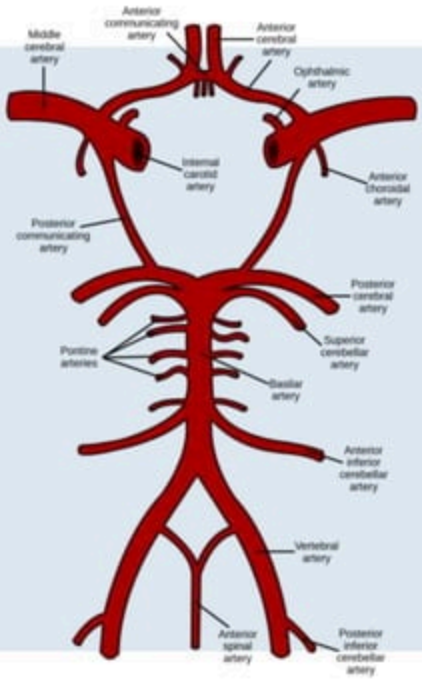

Frontal lobe
Parietal lobe
Occipital lobe
Temporal lobe


Cerebral cortex
(grey matter)
White matter
Gyrus
Sulcus

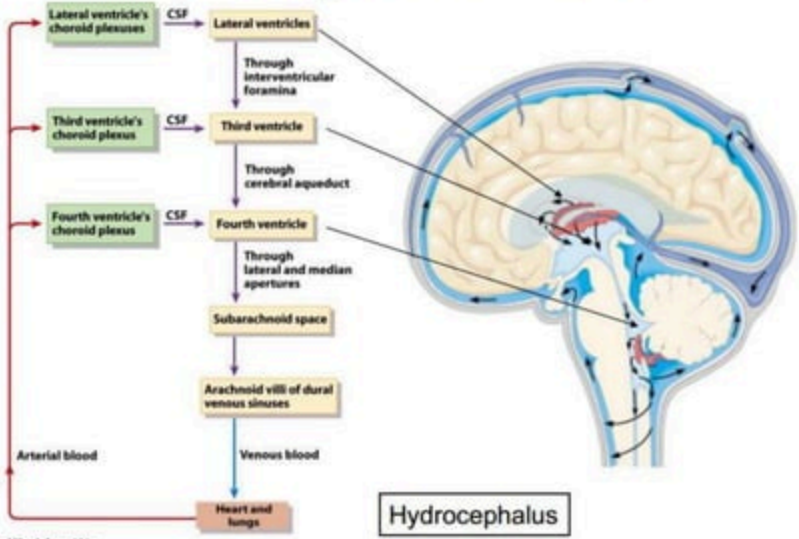

Cortical gyri and sulci (lateral view)
Precentral sulcus
Central sulcus
Postcentral sulcus
Inferior frontal sulcus
Parieto-occipital sulcus
Superior frontal sulcus
Angular gyrus
Lunate sulcus
Pars frontalis
Pars triangularis
Pars opercularis
Preoccipital notch
Superior temporal sulcus
Inferior temporal sulcus
Lateral sulcus (Sylvan fissure)


Cingulate sulcus
Precentral gyrus
Central sulcus
Callosal sulcus
Parieto-occipital sulcus
Isthmus of the cingulate gyrus
Subcallosal area
Cuneus
Paraterminal gyrus
Calcarine sulcus
Rhinal sulcus
Occipito-temporal sulcus
Collateral sulcus
Hippocampal sulcus and dentate gyrus
Cortical gyri and sulci (medial view)


pre motor area
motor
central sulcus
sensory
sensory association area
visual association area
Broca's area
auditory area
auditory association area
visual area
© 2017 medicalartlibrary.com


Anterior communicating artery
Middle cerebral artery
Anterior cerebral artery
Ophthalmic artery
Internal carotid artery
Anterior choroidal artery
Posterior communicating artery
Posterior cerebral artery
Superior cerebellar artery
Pontine arteries
Basilar artery
Anterior inferior cerebellar artery
Vertebral artery
Anterior spinal artery
Posterior inferior cerebellar artery

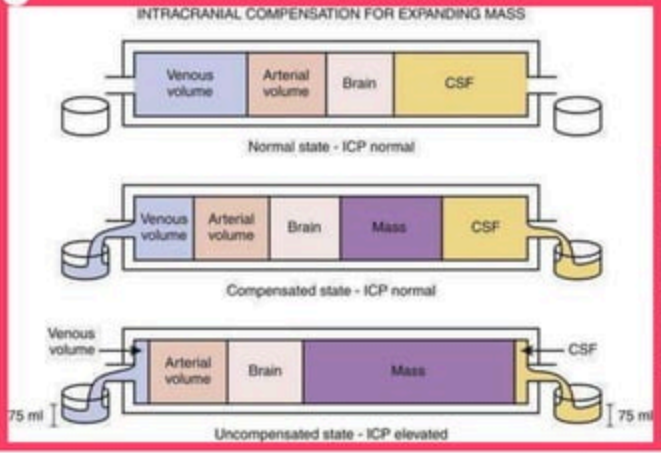
Pathway of CSF flow

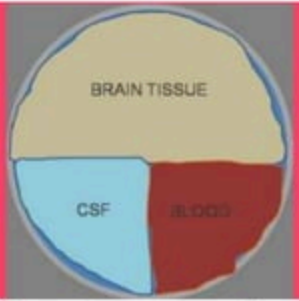


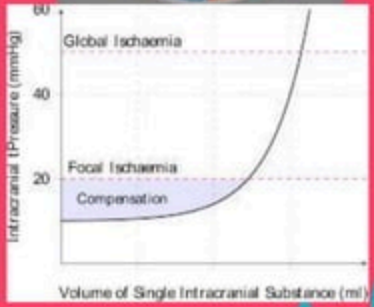
nd Physiology, 11/e

Hydrocephalus

Monroe-Kellie Doctrine

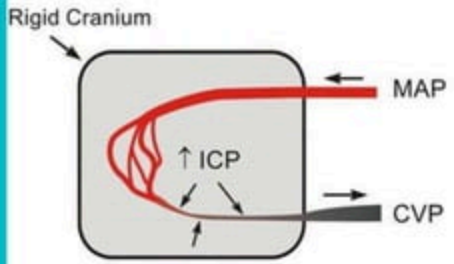






Cerebral Perfusion Pressure

$$CPP = MAP - ICP$$



ICP increased by:

- Intracranial bleeding
- cerebral edema
- tumor

Increased ICP:

- collapses veins
- decreases effective CPP
- reduces blood flow

CPP = cerebral perfusion pressure
MAP = mean arterial pressure
ICP = intracranial pressure **(normally 0-10 mmHg)**
CVP = central venous pressure

Cerebral Blood Flow

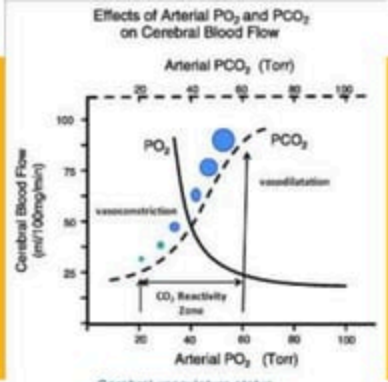
Q	Flow rate
P	Pressure
r	Radius
η	Fluid viscosity
l	Length of tubing

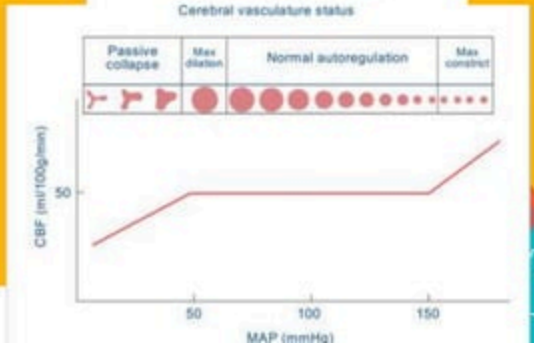
$$Q = \frac{\pi \mathrm{Pr}^4}{8\eta l}$$

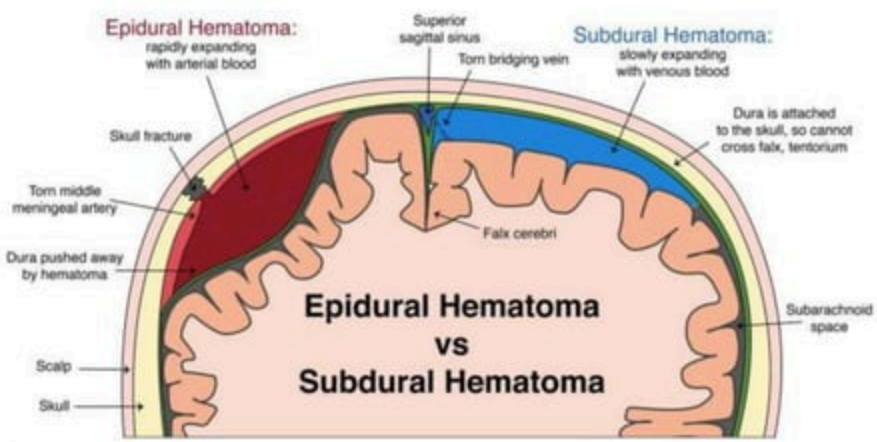
- Direct relationship between:
  - Flow.
  - CPP
  - Calibre of cerebral vessels.
- Where
  - π is the mathematical constant.
  - P the pressure gradient which is the CPP.
  - r the radius/calibre of blood vessel.
  - η the dynamic viscosity of blood.
  - l the length of the blood vessel.

Cerebral autoregulation

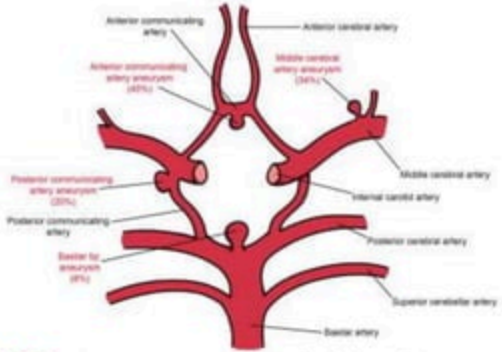
Radius of cerebral arterial blood vessels regulated by:
- Cerebral metabolism rate of O2
- Carbon dioxide and oxygen
- Autoregulation
- Neurohumeral factors

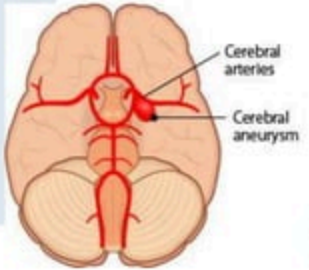




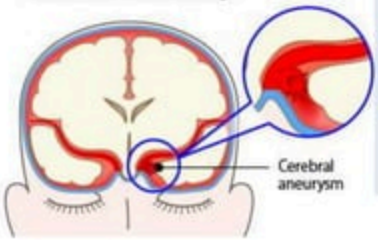

Epidural Hematoma:
rapidly expanding
with arterial blood
Superior
sagittal sinus
Torn bridging vein
Subdural Hematoma:
slowly expanding
with venous blood
Dura is attached
to the skull, so cannot
cross falx, tentorium
Skull fracture
Torn middle
meningeal artery
Falx cerebri
Dura pushed away
by hematoma
Epidural Hematoma
vs
Subdural Hematoma
Subarachnoid
space
Scalp
Skull
© Lineage
Lucy Liu

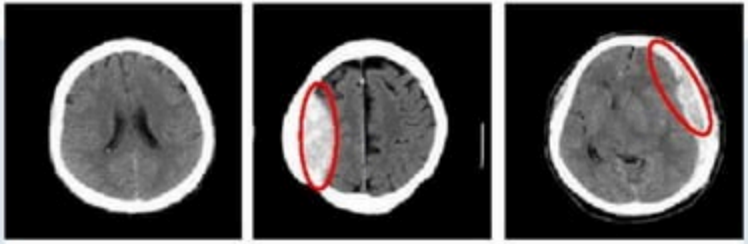
Saccular (Berry) Aneurysms of the Circle of Willis



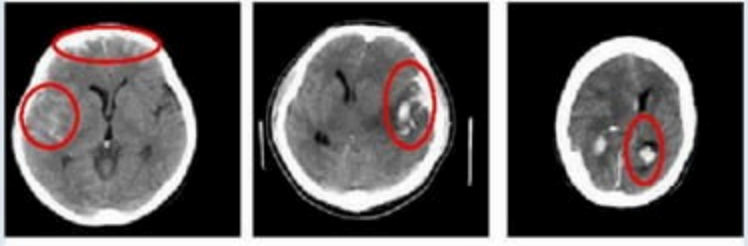


Subarachnoid hemorrhage

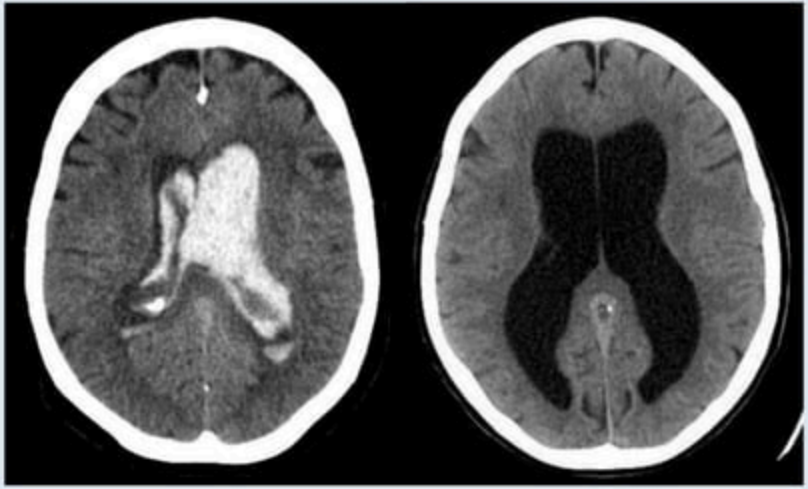




Normal EDH SDH

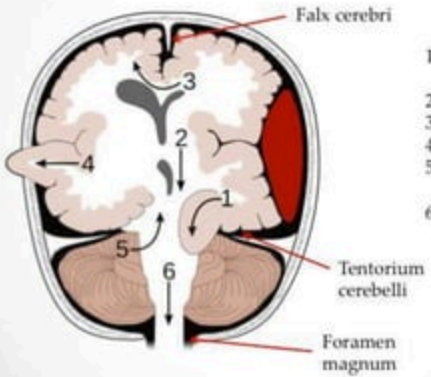


SAH ICH IVH



Effects of increased ICP

Herniation



1) Uncal (descending transtentorial)
2) Central
3) Cingulate (subfalcine)
4) Transcalvarial
5) Upward (ascending transtentorial)
6) Tonsillar

Thanks!

Any questions?

References

1. Cipolla MJ. The Cerebral Circulation. San Rafael (CA): Morgan & Claypool Life Sciences; 2009.
2. Cerebral physiology. Alifia Tameem. Anaesth Crit Care Pain. 2013;13(4):113-118
3. Physiology. Linda S Costanzo, 2nd edition;2002.
4. Pre-Interview Assessment for Emergency Medicine Master of Medicine (PIAEM) Preparatory course 2017 notes
5. Pre-Interview Assessment for Emergency Medicine Master of Medicine (PIAEM) Preparatory course 2016 notes