

Ventricular System and Cerebrospinal Fluid

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July 2023

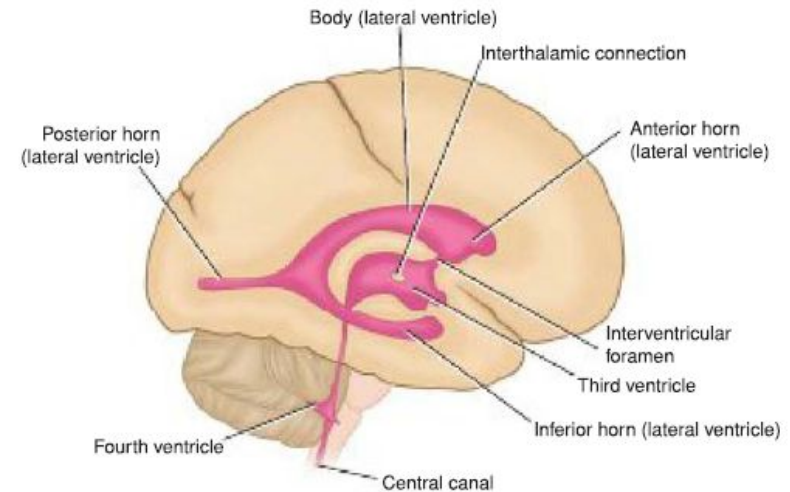
Ventricular System and Cerebrospinal Fluid

Objectives

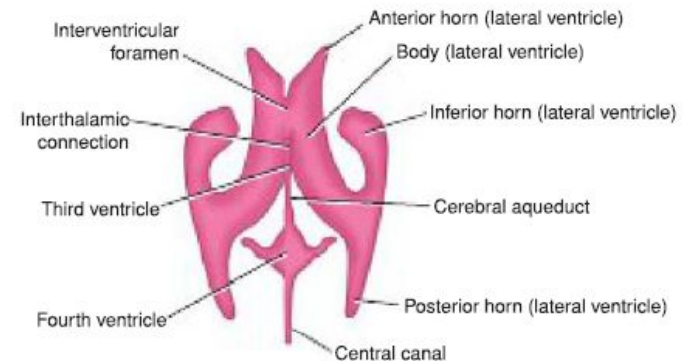
- CSF location, function, production & absorption
- Blood-brain barrier
- Blood-cerebrospinal fluid barrier

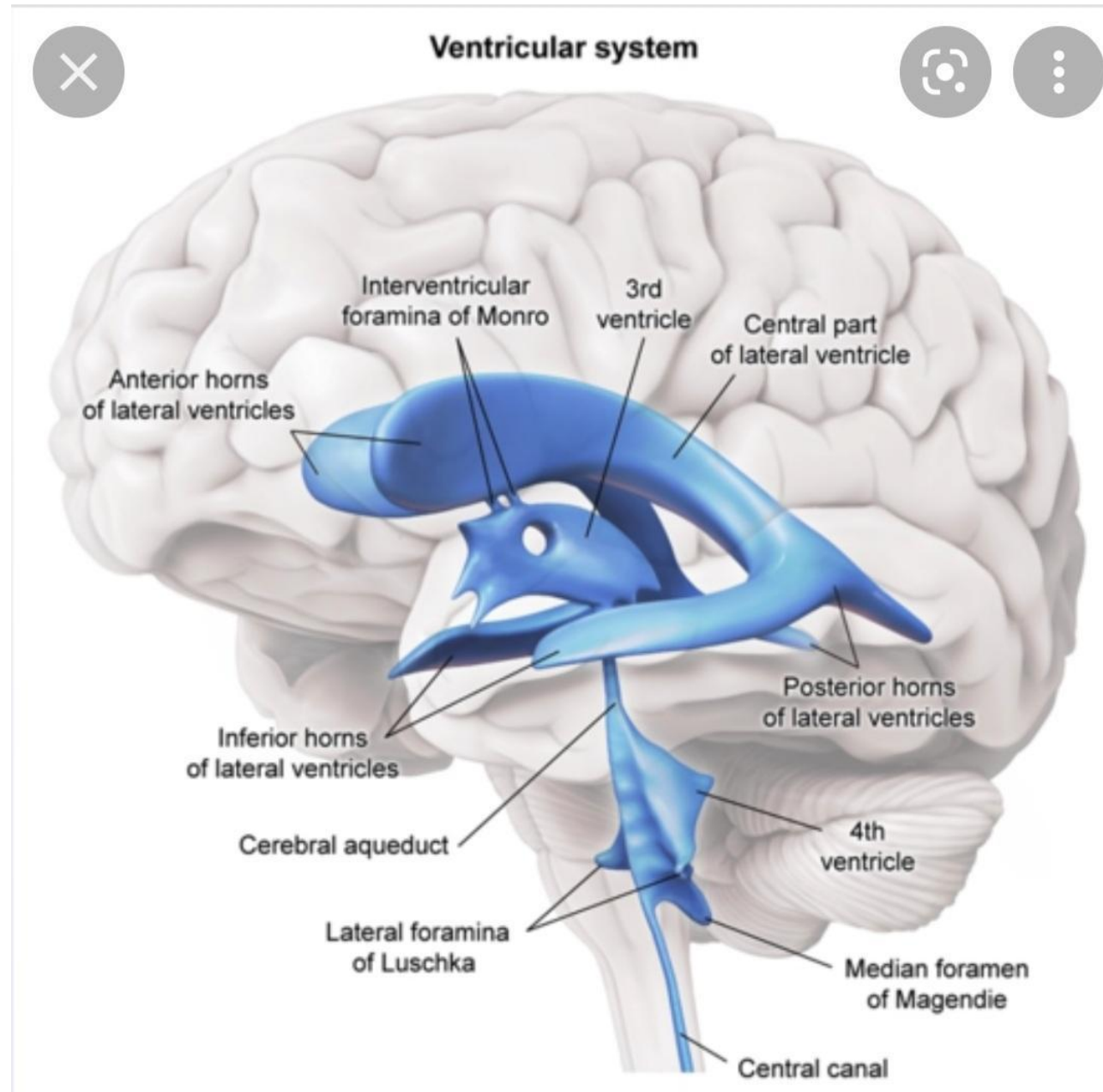
Ventricular System

- 2 lateral ventricles
 - Interventricular foramina (of Monro)
- 3^d ventricle
 - Cerebral aqueduct (aqueduct of Sylvius)
- 4th ventricle
 - Central canal of the spinal cord
 - 3 foramina in its roof, with the subarachnoid space (2 Luschka, 1 Magendie)



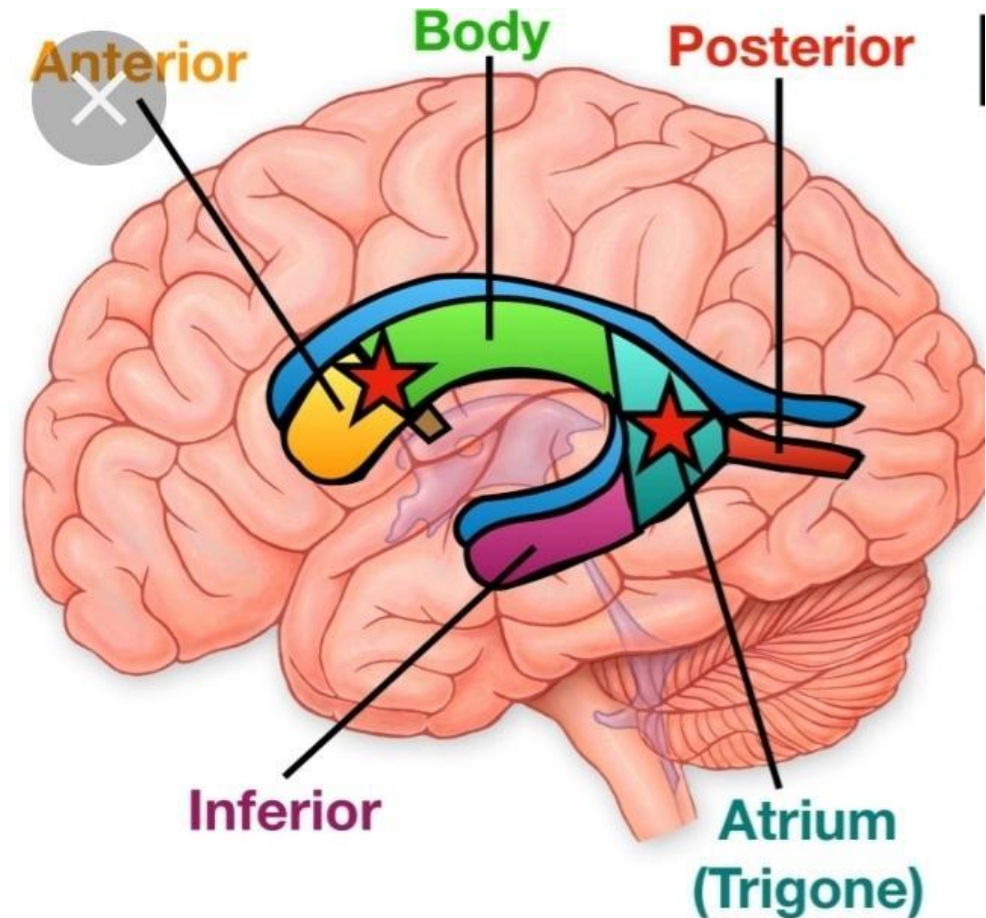
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Lateral ventricles

- Body
- Anterior (frontal) horn
- Posterior (occipital) horn
- Inferior (temporal) horn
- Trigone (Atrium)

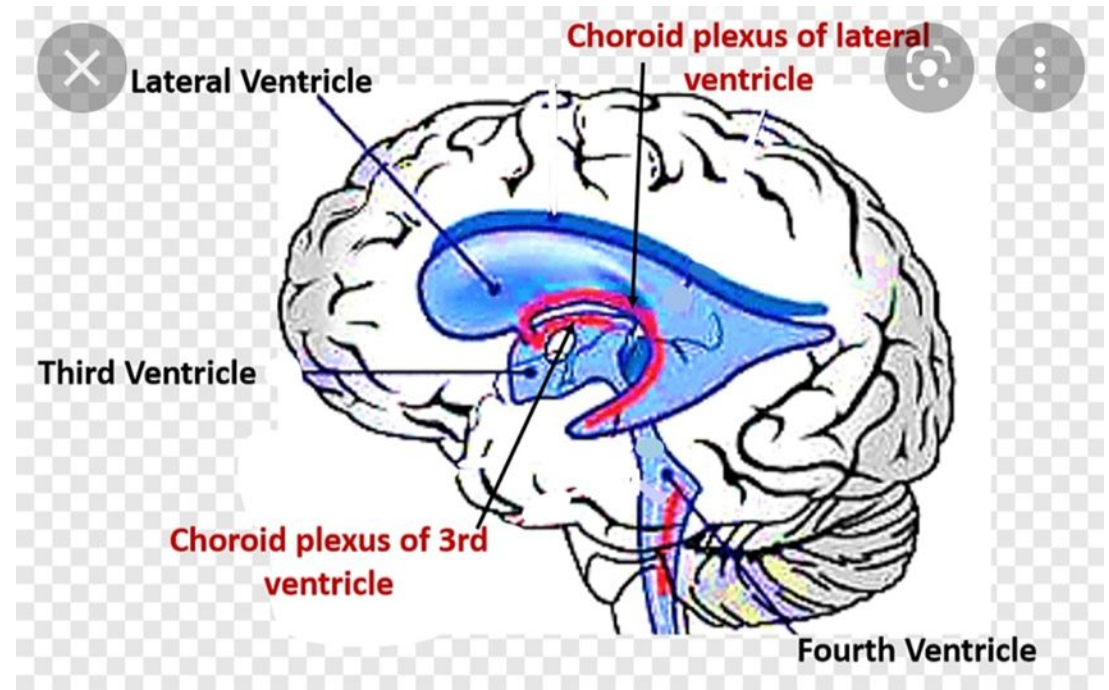


3d & 4th ventricles

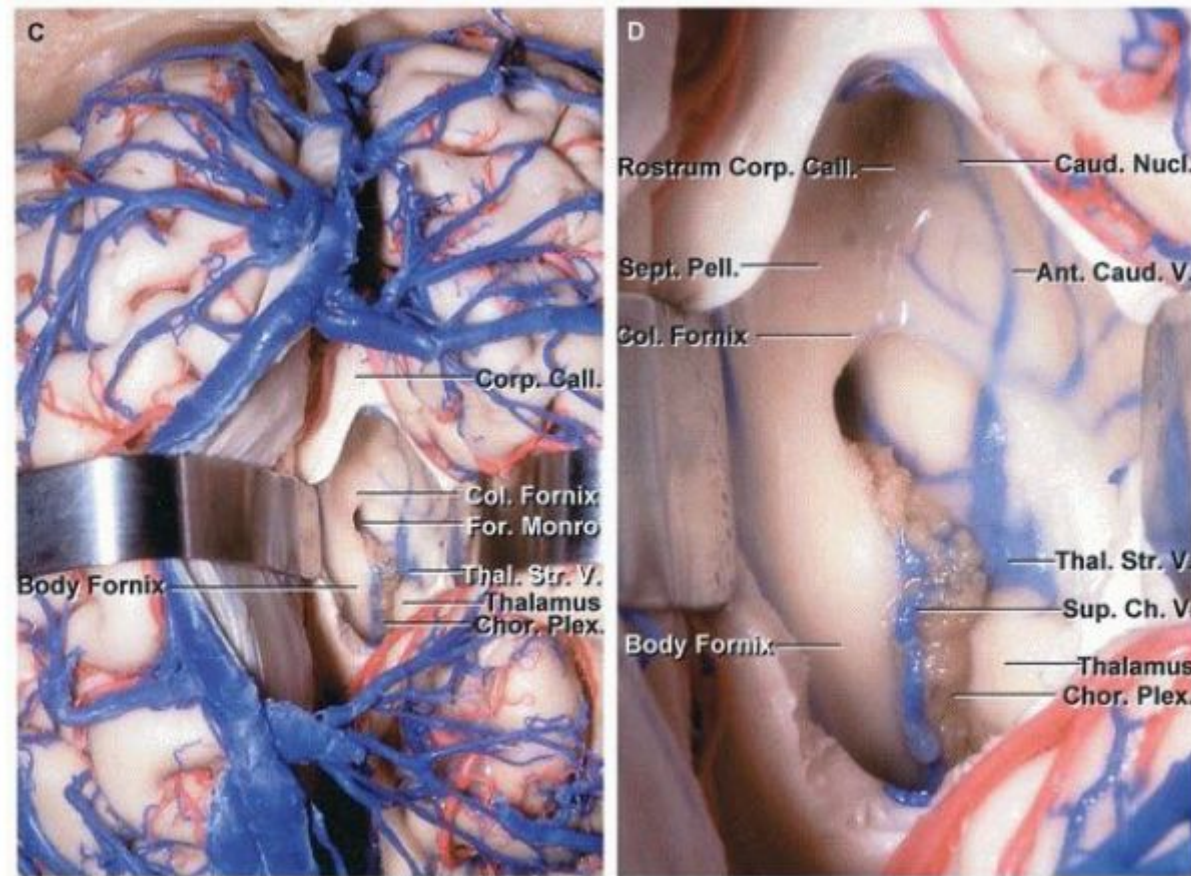
- 3d ventricle: a slitlike cleft between the two thalami
 - Choroid plexus is suspended from the roof
- 4th ventricle: a tent-shaped cavity
 - Situated anterior to the cerebellum and posterior to the pons and the superior half of the medulla
 - Floor: a rhomboid-shaped
 - Roof: Superior medullary velum & Inferior medullary velum
 - Choroid plexus is suspended from the inferior half of the roof (PICA)

Choroid plexus of the ventricular system

- In lateral ventricles:
 - Body: medial & inferior
 - Inferior horn: medial & superior
- In 3d ventricle:
 - roof
- In 4th ventricle:
 - the inferior half of the roof

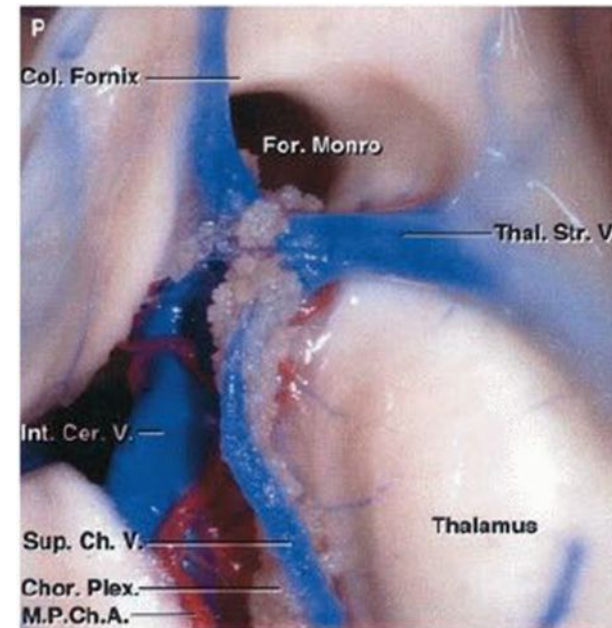


Rt lateral Ventricle (via transcallosal approach)



Transchoroidal approach to 3d Ventricle

- Transchoroidal approach directed through the body portion of the choroidal fissure using an opening through the corpus callosum
- The choroidal fissure has been opened by incising along the tenia fornicis, not tenia thalami



Subarachnoid space

- Between the arachnoid & pia mater, around the brain and spinal cord
- Filled with CSF
- Contains the large blood vessels of the brain
- Basal subarachnoid cisterns
- In Spine: it ends at S2-S3

Cerebrospinal Fluid

Table 16-1 Cerebrospinal Fluid Physical Characteristics and Composition

Appearance	Clear and colorless
Volume Brain & spine	c. 150 mL
Rate of production	0.5 mL/min 20 mL/hr 500 mL/d
Pressure (spinal tap with patient in lateral recumbent position)	60–150 mm of water
Composition	
Protein	15–45 mg/100 mL
Glucose	50–85 mg/100 mL
Chloride	720–750 mg/100 mL
Number of cells	0–3 lymphocytes/mm ³

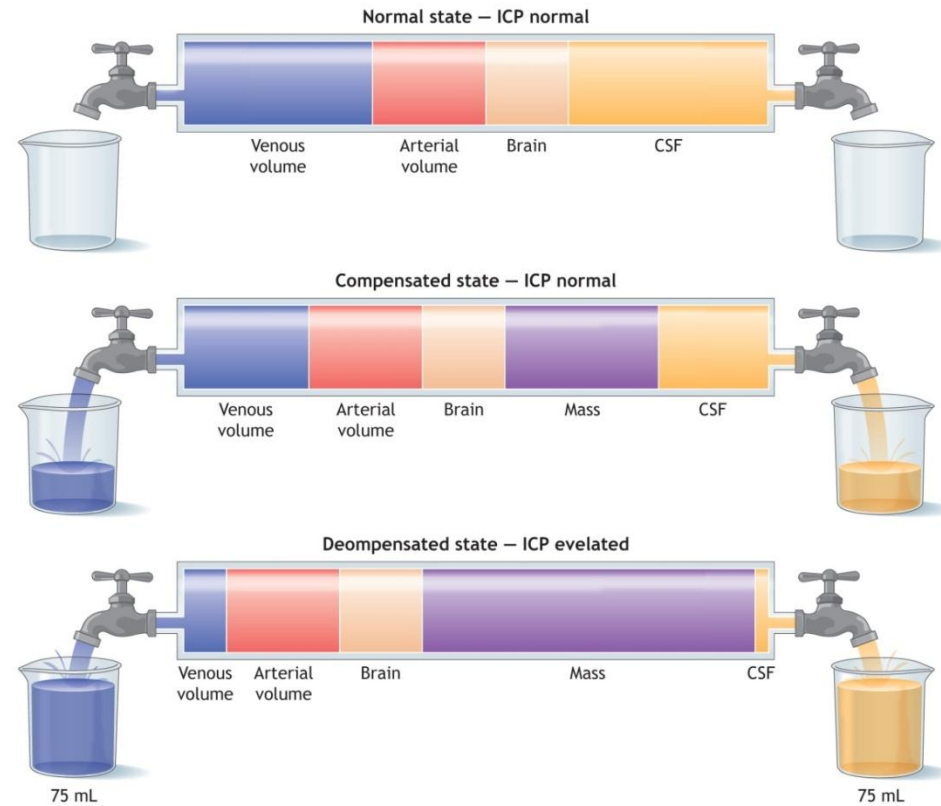
CSF function



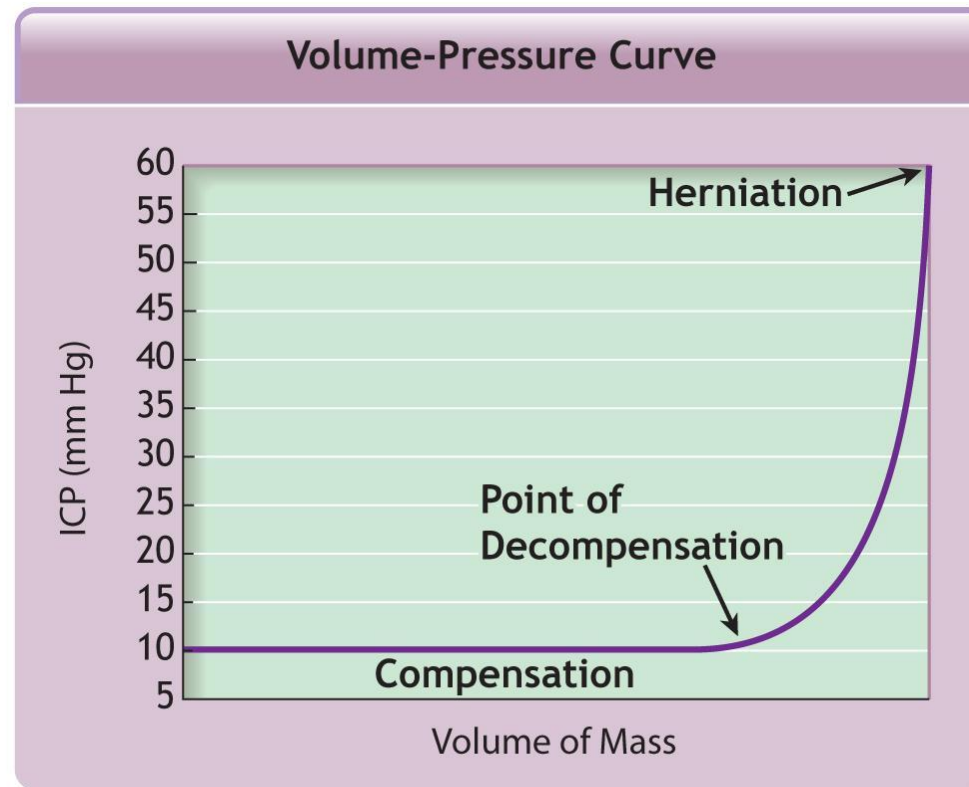
Table 16-2 Cerebrospinal Fluid Functions

1. Cushions and protects the central nervous system from trauma
2. Provides mechanical buoyancy and support for the brain
3. Serves as a reservoir and assists in the regulation of the contents of the skull
4. Nourishes the central nervous system
5. Removes metabolites from the central nervous system
6. Serves as a pathway for pineal secretions to reach the pituitary gland

Monro-Kellie Doctrine

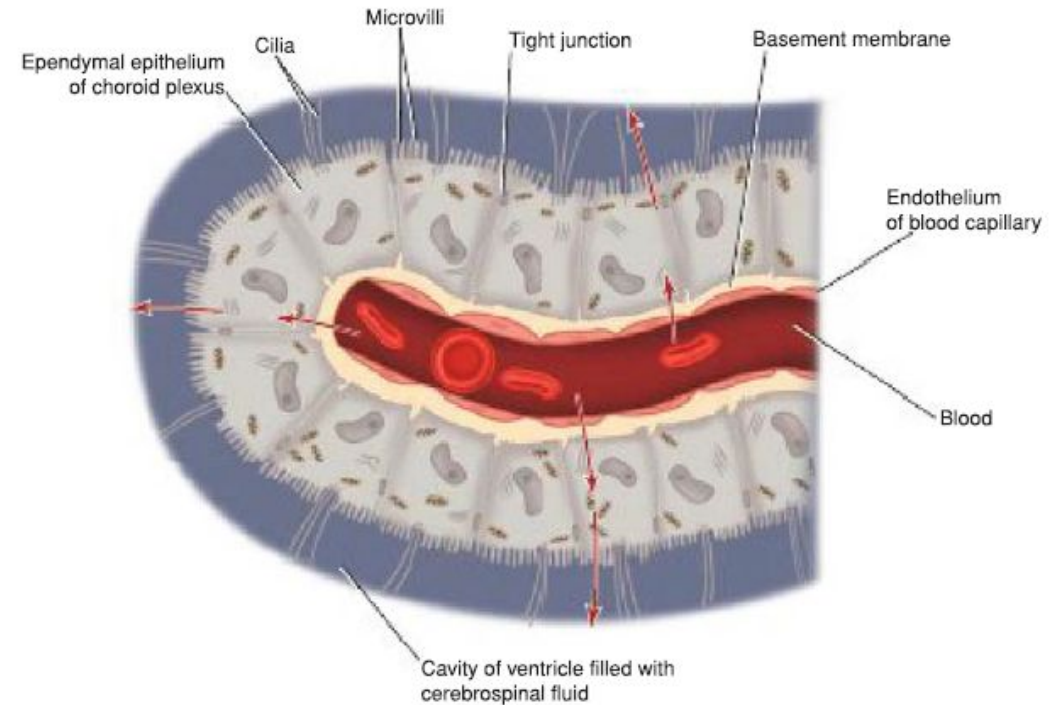


Volume-Pressure Curve

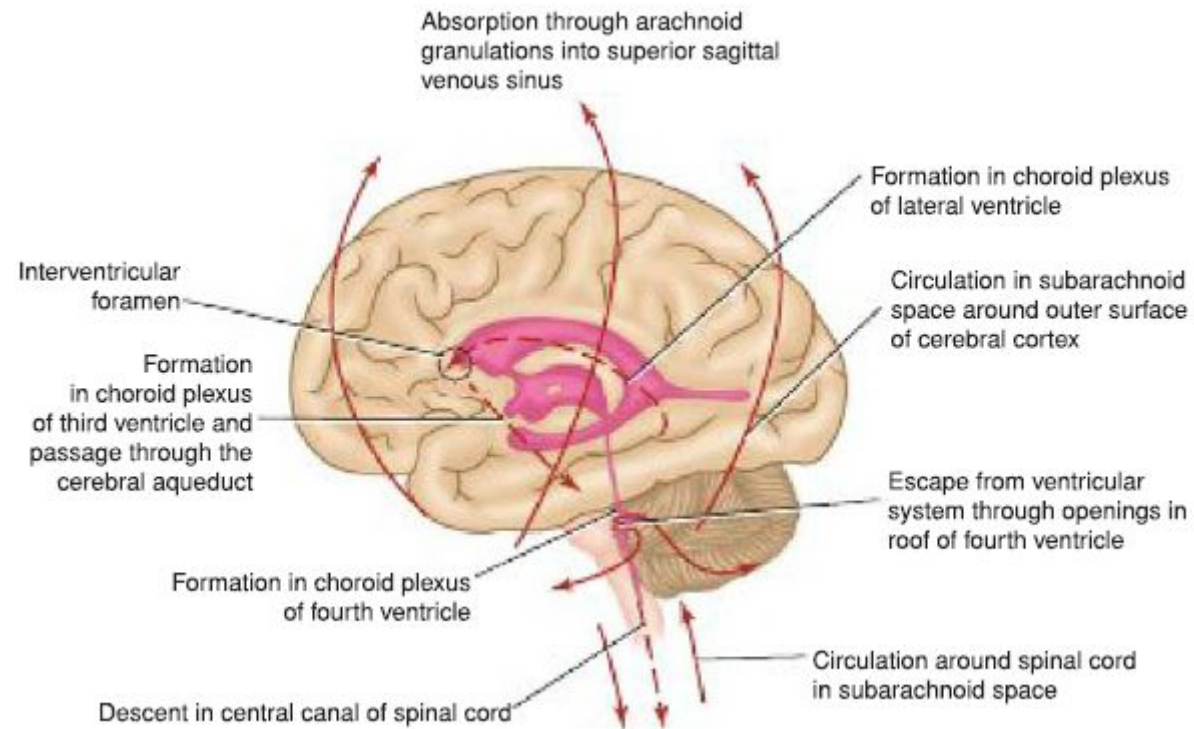


CSF formation

- Mainly in the choroid plexuses
 - Active secretion
 - Not pressure regulated
- Ependymal cells
- Brain

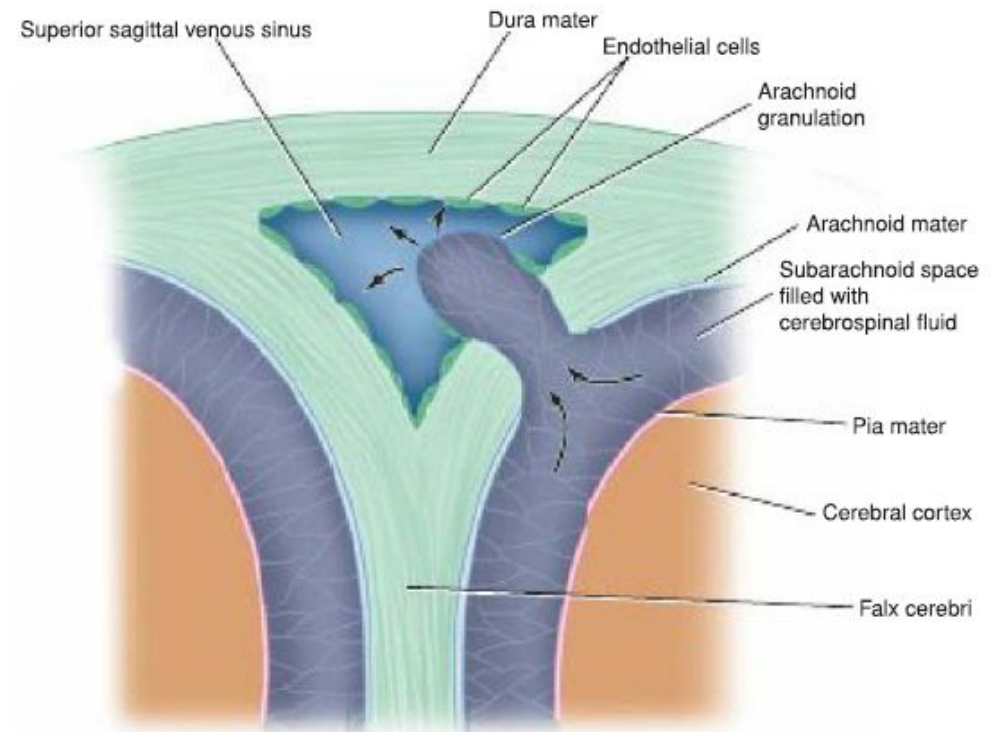


CSF circulation



CSF absorption

- Arachnoid villi (granulations) esp. in superior sag. Sinus
- Occurs when CSF pressure exceeds the venous pressure in the sinus
- One way valve
- CSF absorption controls CSF pressure



Blood-Brain & Blood-CSF Barriers

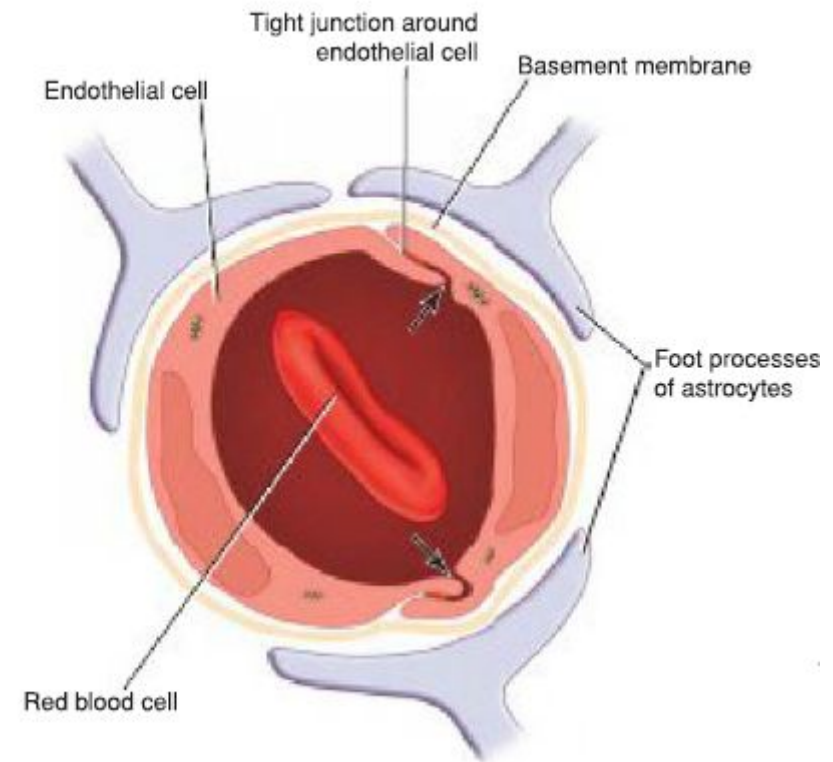
- The CNS requires a very stable environment In order to function normally
- This is provided by isolating the nervous system from the blood by these barriers
- They protect brain and spinal cord from potentially harmful substances while permitting gases and nutriment to enter the nervous tissue

Blood-Brain Barrier (BBB)

Structure

- Endothelial cells
 - Tight junctions (Lipid)
- Basement membrane
- The foot processes of the astrocytes

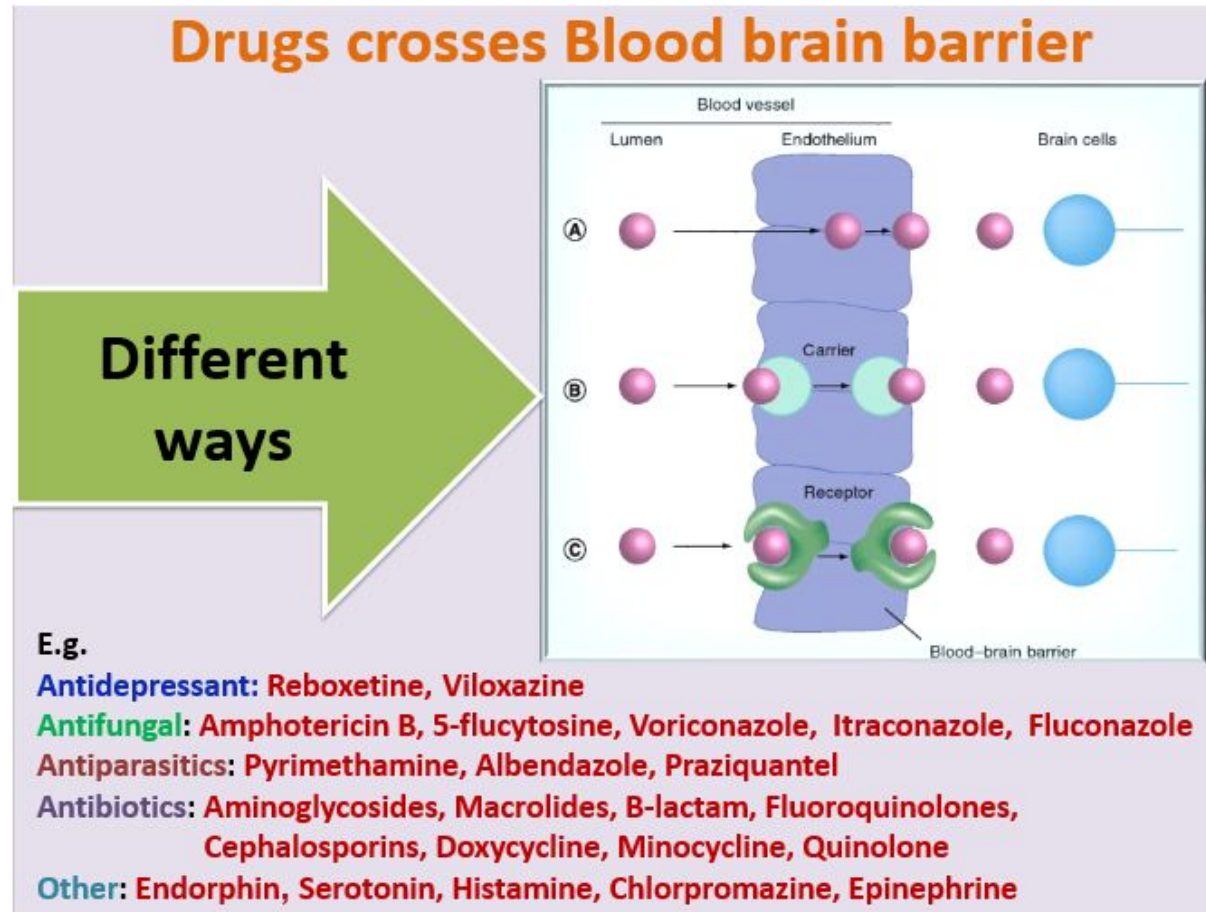
In newborn: BBB is more permeable (Bilirubin → kernicterus)



Blood-Brain Barrier (BBB)

- BBB permeability is inversely related to the size of the molecules and directly related to their lipid solubility
- BBB is absent in:
 - pineal gland
 - posterior lobe of the pituitary
 - tuber cinereum
 - the wall of the optic recess
 - area postrema (sample the chemical content of the plasma directly)
- BBB is disrupted in brain traumatic, inflammatory or toxic inj., as well as in malignant brain tumors
- Influence choice and dose of antibiotics

Blood-Brain Barrier (BBB)

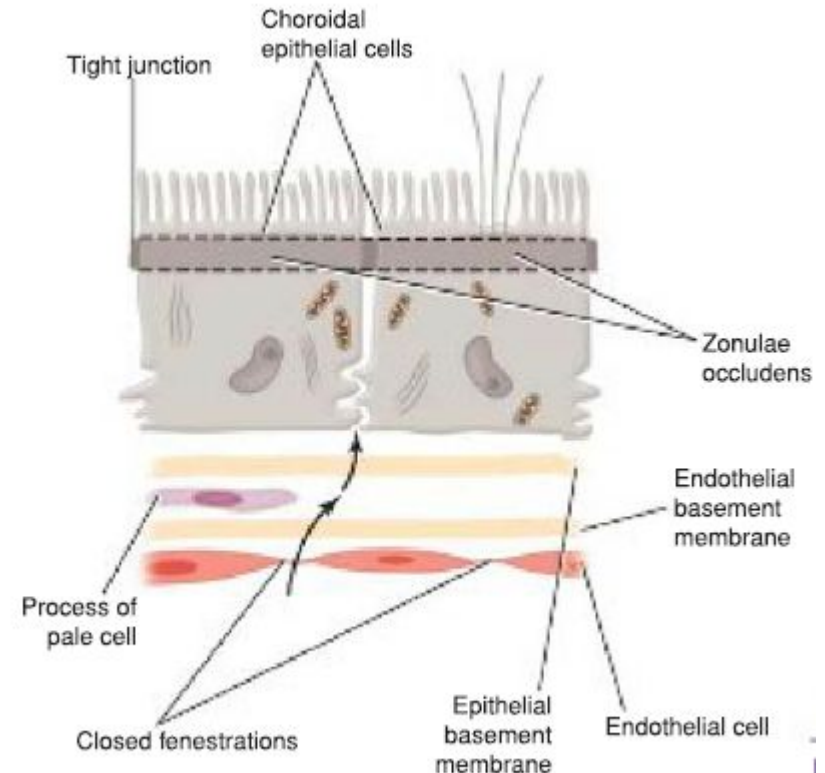


Blood-Cerebrospinal Fluid Barrier

Structure

- Endothelial cells with closed fenestrations
- Basement membrane
- Scattered pale cells
- Basement membrane
- Choroidal epithelial cells

□ Tight junctions



Cerebrospinal Fluid-Brain Interface

- A comparable physiologic barrier between CSF and the CNS extracellular compartment does not exist!

Clinical Notes

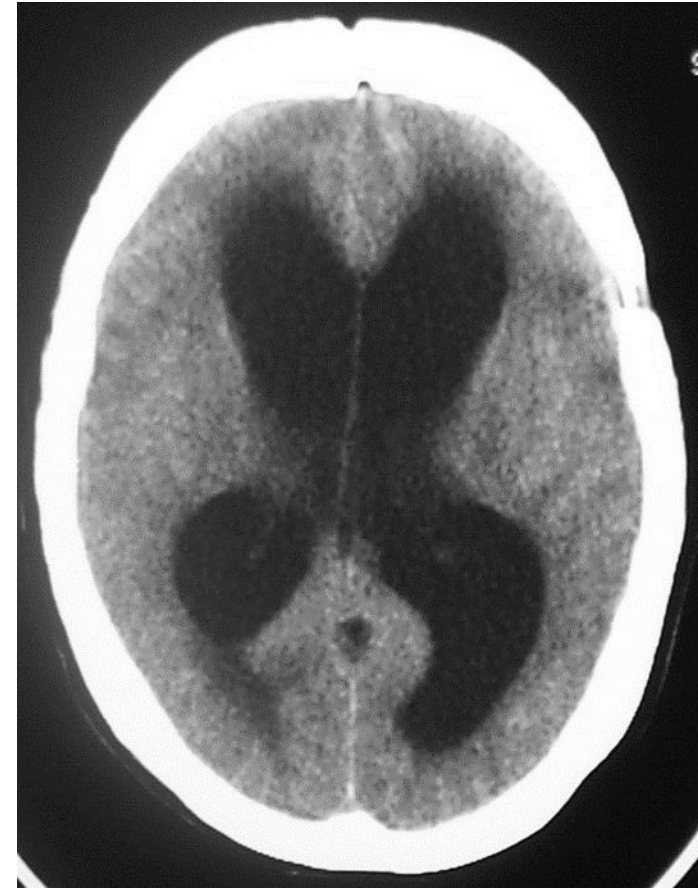
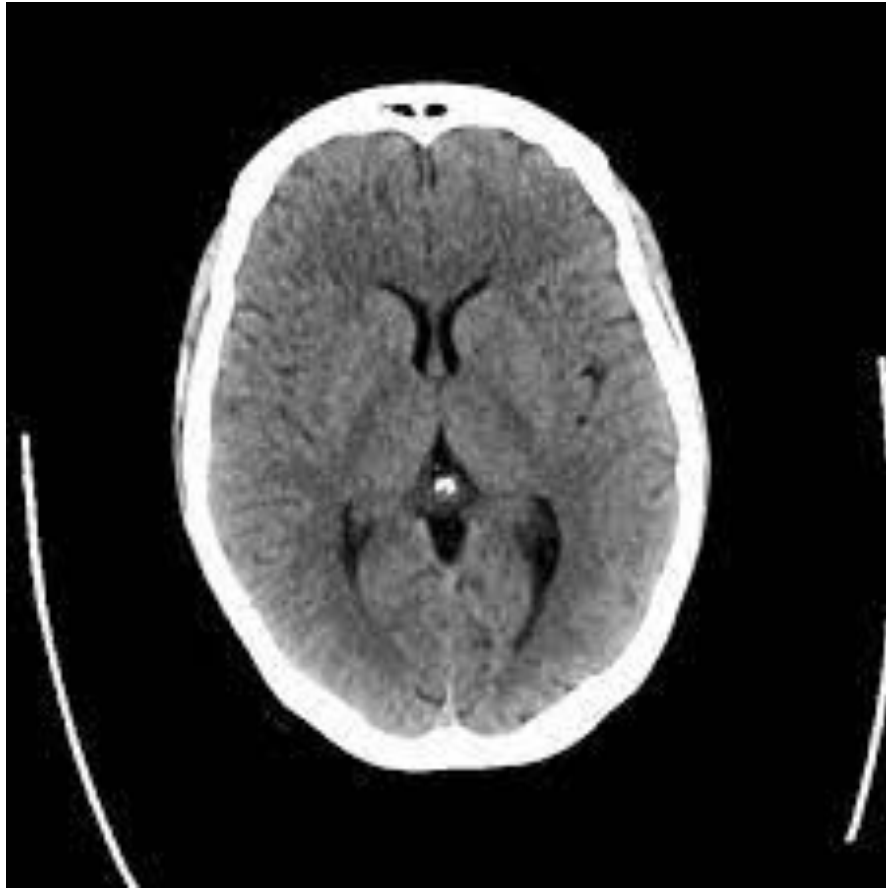
- Papilledema

- High ICP → high CSF pressure → Compression of retinal vein BL → optic disc swelling BL “Papilledema” → ON atrophy & blindness if persistent

- Hydrocephalus

- Abnormal increase in CSF formation (rare, like in CPP)
 - Blockage of CSF circulation (tumor, AS), noncommunicating HCP
 - ↓ CSF absorption (post meningitis, sinus thrombosis), communicating HCP

Hydrocephalus



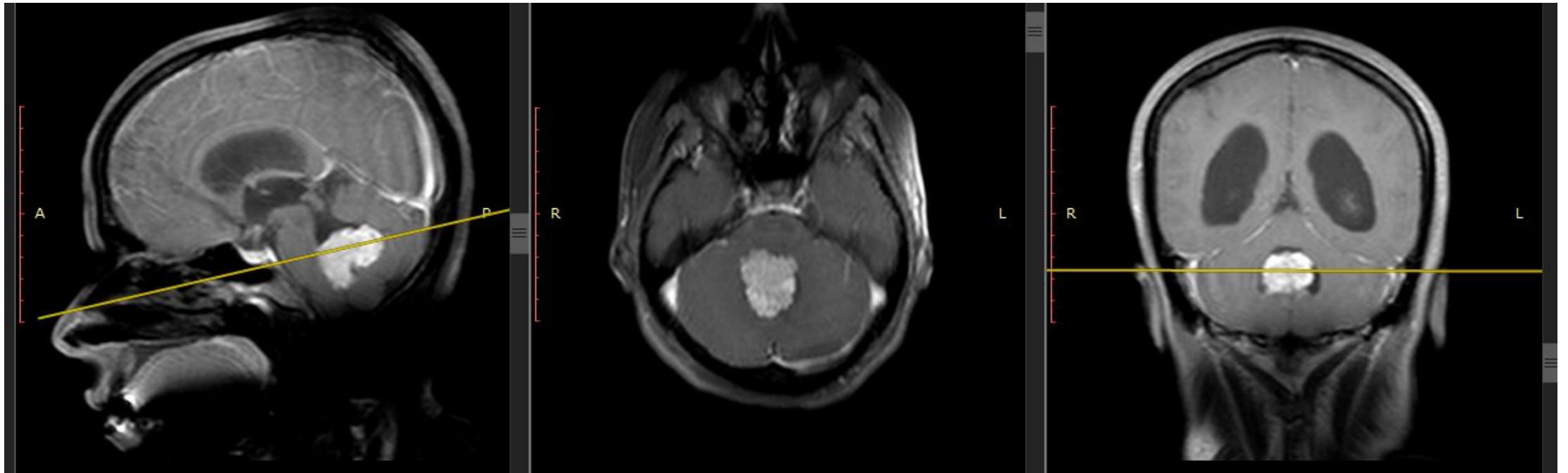
CSF analysis in meningitis

Tuberculosis	Fungal	Viral	Bacterial	Normal	
Variable	Elevated	Normal or slightly elevated	Elevated	5-20	Opening pressure cm H ₂ O
10 - 1000	10 - 1000	25 – 2000	> 1000	< 5	Leukocytes
Lymphocyte predominance	Lymphocyte predominance	Early: Neutrophils Late: Lymphocytes	Neutrophil predominance	0	Cell differential
Very High	High	Normal or slightly elevated	High	15 – 45	Protein
Low	Low	Normal	Low	45 - 85	Glucose
+ (AFB)	+ (Fungal)	-	+	-	Cultures

4th ventricle tumors

- Medulloblastoma: arises from the vermis (roof) of the 4th V
- Ependymoma: arises from the floor of the 4th V (can invade hypoglossal and vagal nuclei, affecting movements of the tongue and/or swallowing, respiration, heart rate, and blood pressure)

4th ventricle tumor





For you!