

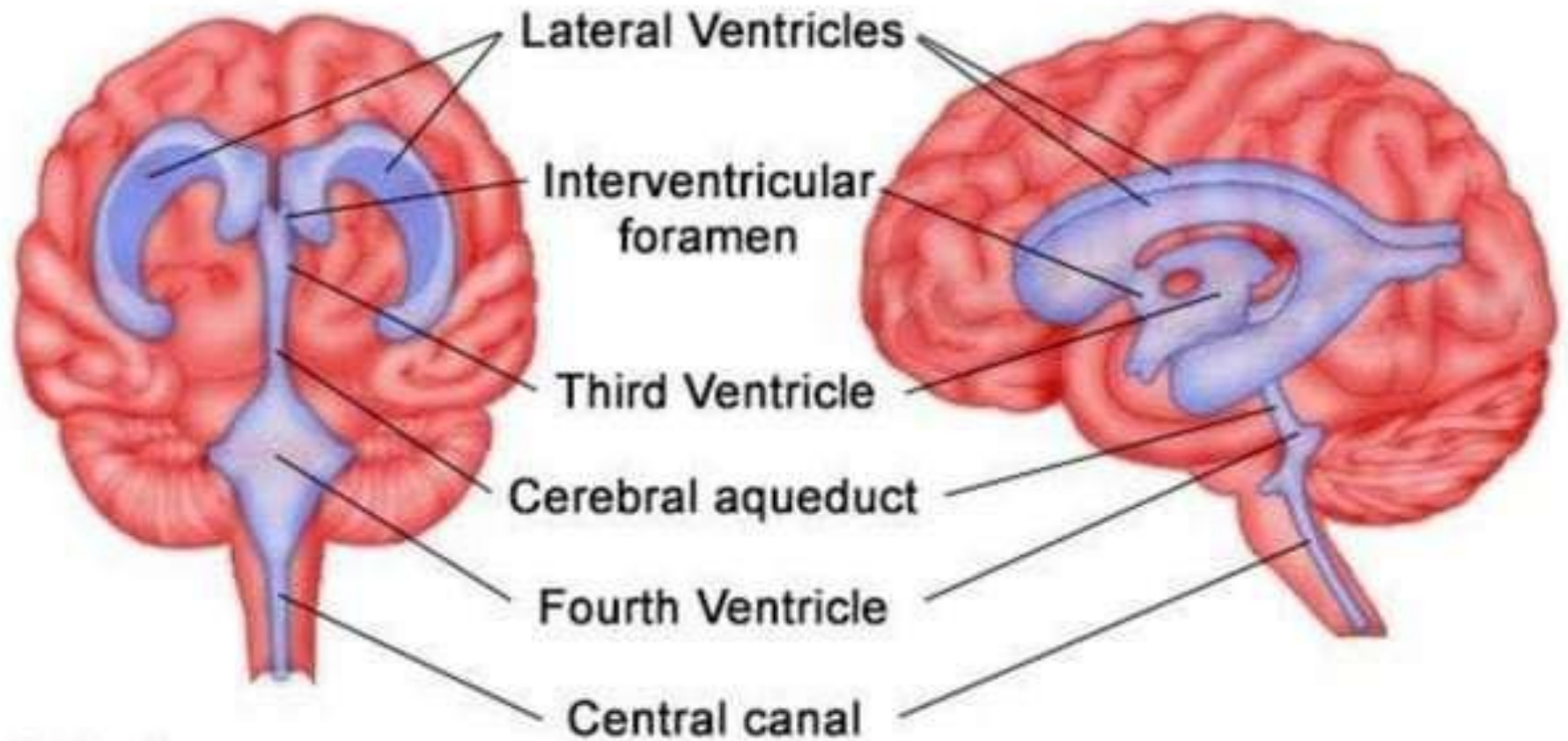
# Cerebrospinal fluid

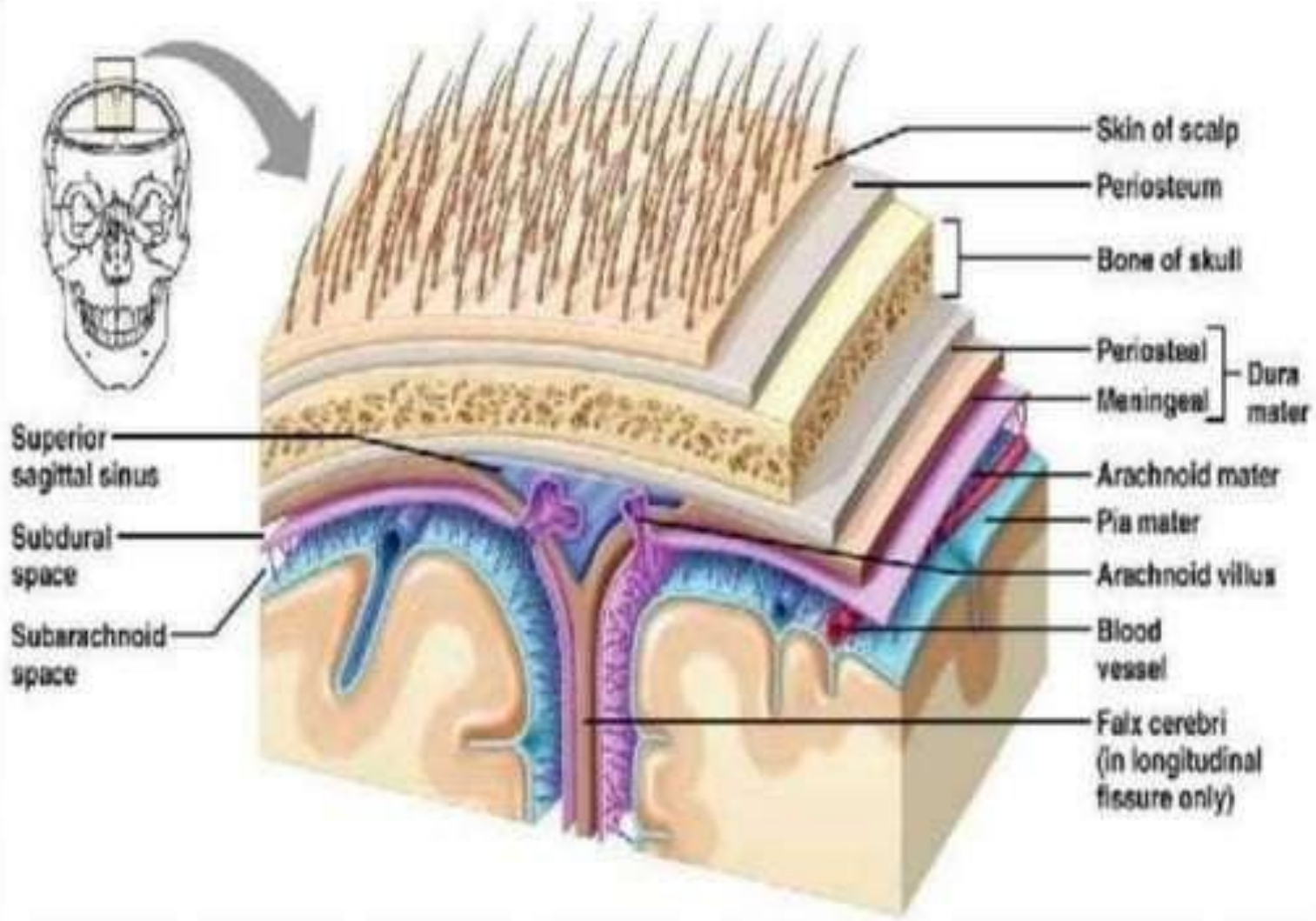
Dr. AnuPriya J

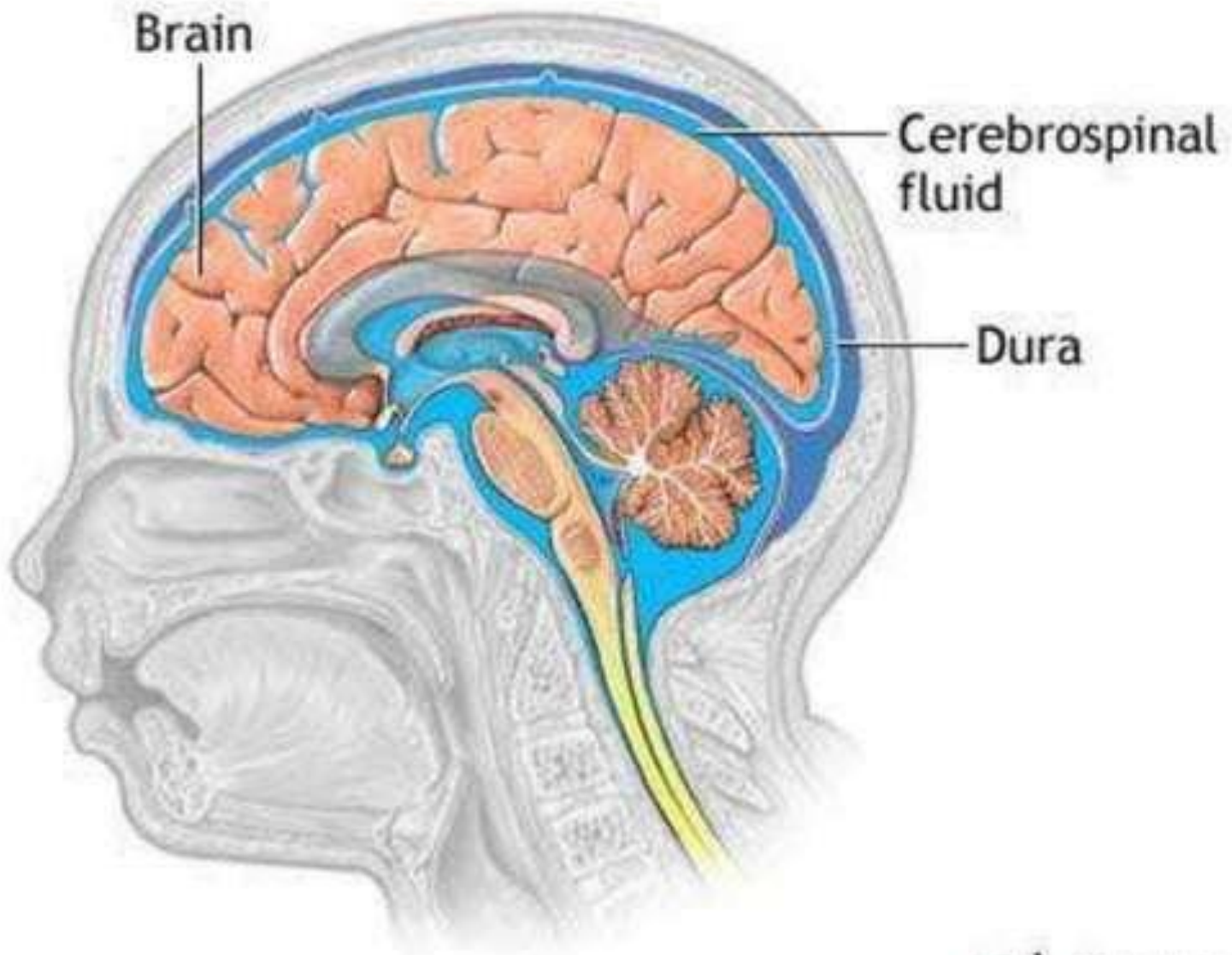
# CSF

- Cerebrospinal fluid
- Total volume:150ml
- Rate of formation:500-600ml/day
- Location :
  - Fills the ventricles of the brain and the subarachnoid space that surrounds the brain and the spinal cord.

# Ventricles of the Brain





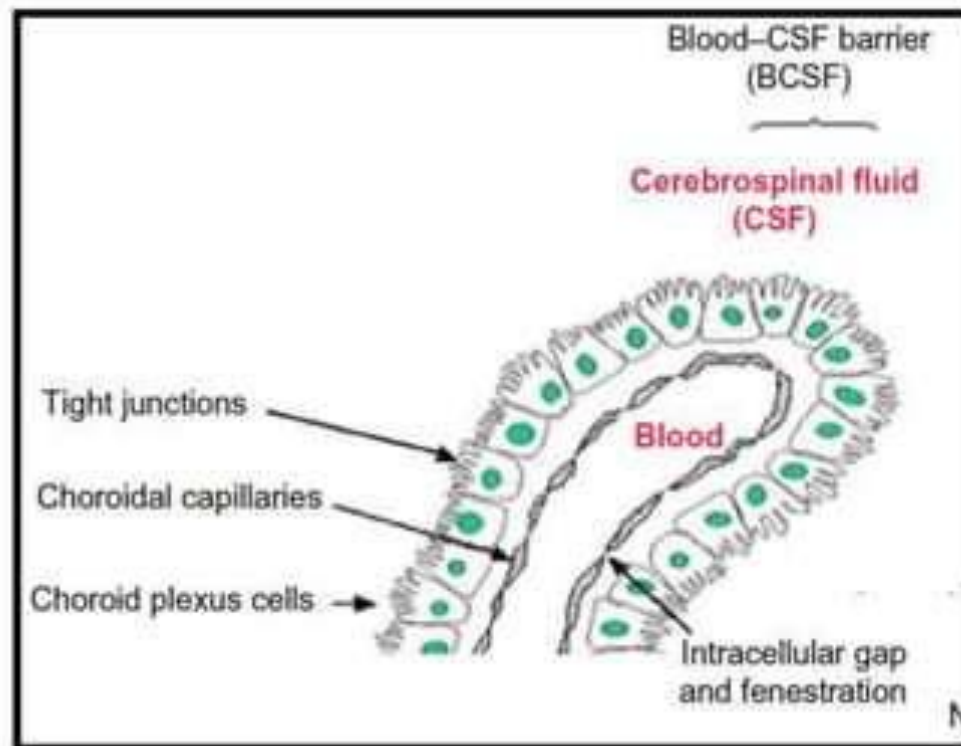


# Formation of CSF

- 50-70% : choroid plexuses
- 30-50%: blood vessels along the ventricular wall

# Choroid Plexuses

- Modified ependymal cells.
- There are four choroid plexuses (CP) in the brain, one in each of the ventricles.
- The CP consists of a **layer of cuboidal epithelial cells surrounding a core of capillaries and loose connective tissue.**



# Mechanism of formation

## Formed continuously by the choroid plexus in two stages:

1. Plasma is passively filtered across the choroidal capillary endothelium
  2. Secretion of water and ions across the choroidal epithelium
- Bicarbonate, Chloride, and Potassium ions, enter the CSF via channels in the epithelial cell apical membranes.
  - Aquaporins provide for water movement to balance osmotic gradients.



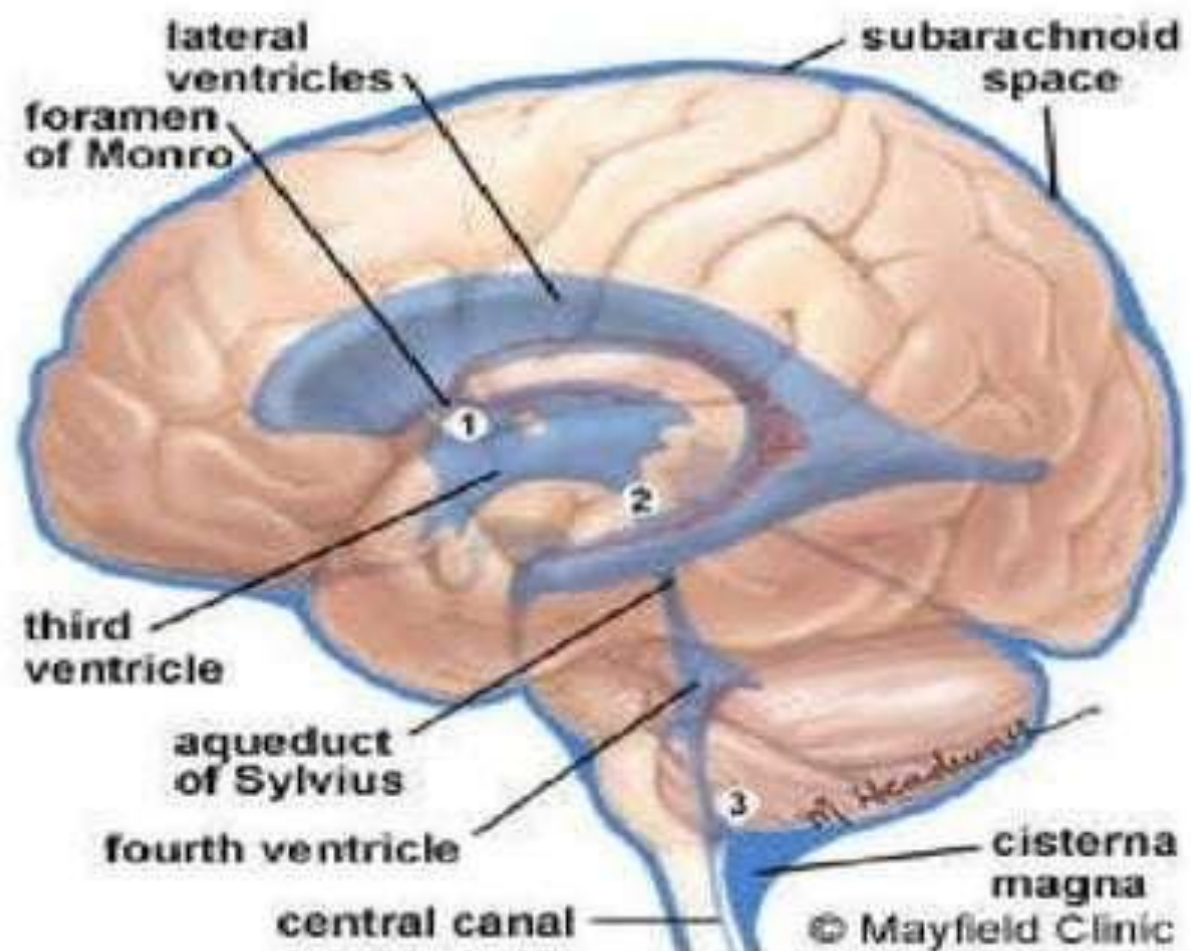
# Composition

- Clear, colorless, alkaline fluid.
- Specific gravity 1.005 to 1.008.
- pH (7.33) slightly less than that of plasma (7.4).
- Iso-osmolar with plasma 289 mOsm / kg / water.
- Watery solution similar in composition to blood plasma

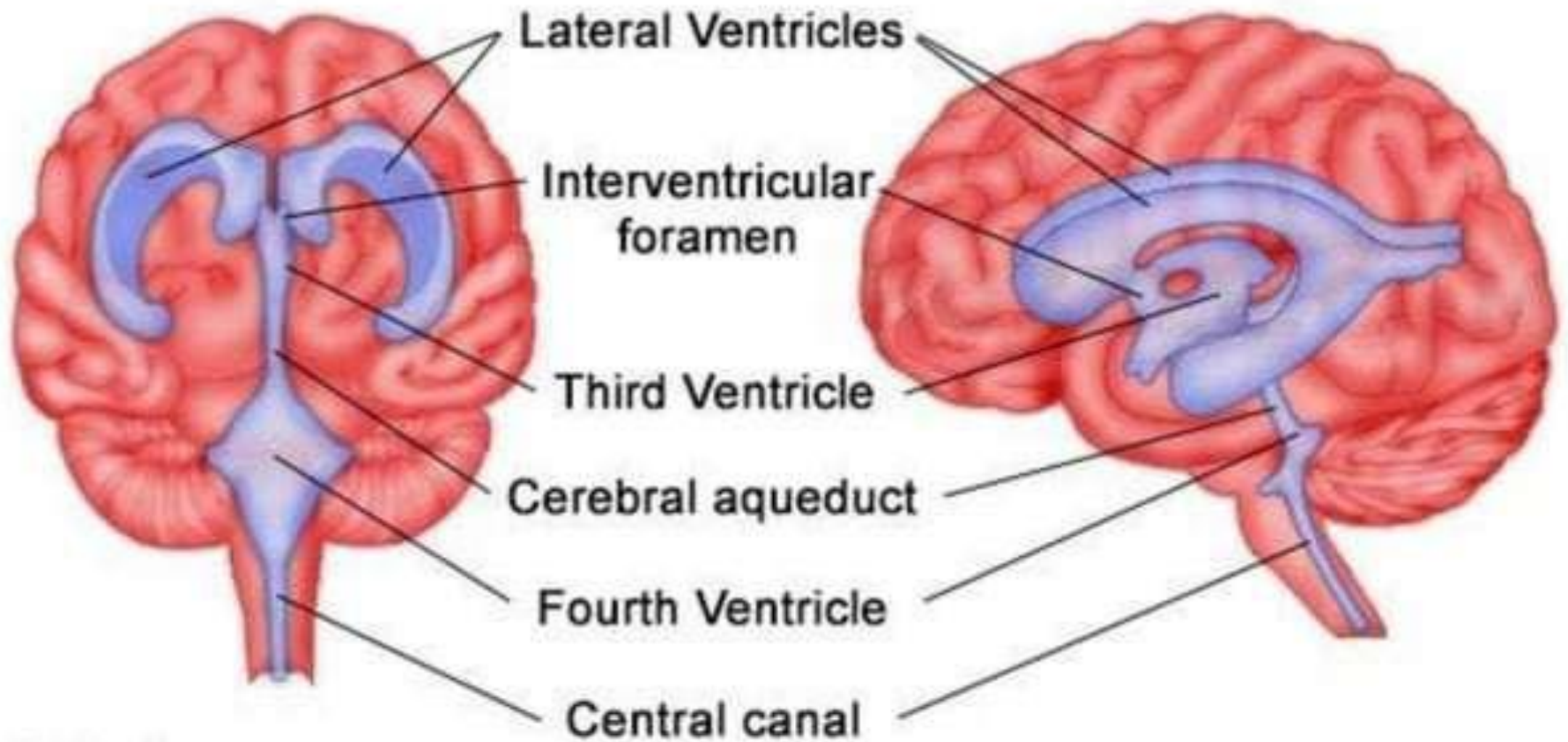
# Composition

- Contains less protein and different ion concentrations than plasma. Almost *protein free*. (20 – 30 mg%).
- Almost *cell free* (lymphocytes 0-5 / mm<sup>3</sup>).
- Contains less glucose (50mg%) than plasma.
- Contains some urea & creatinine.
- Also contains chloride, Na<sup>+</sup> , K<sup>+</sup> , HCO<sub>3</sub><sup>-</sup>

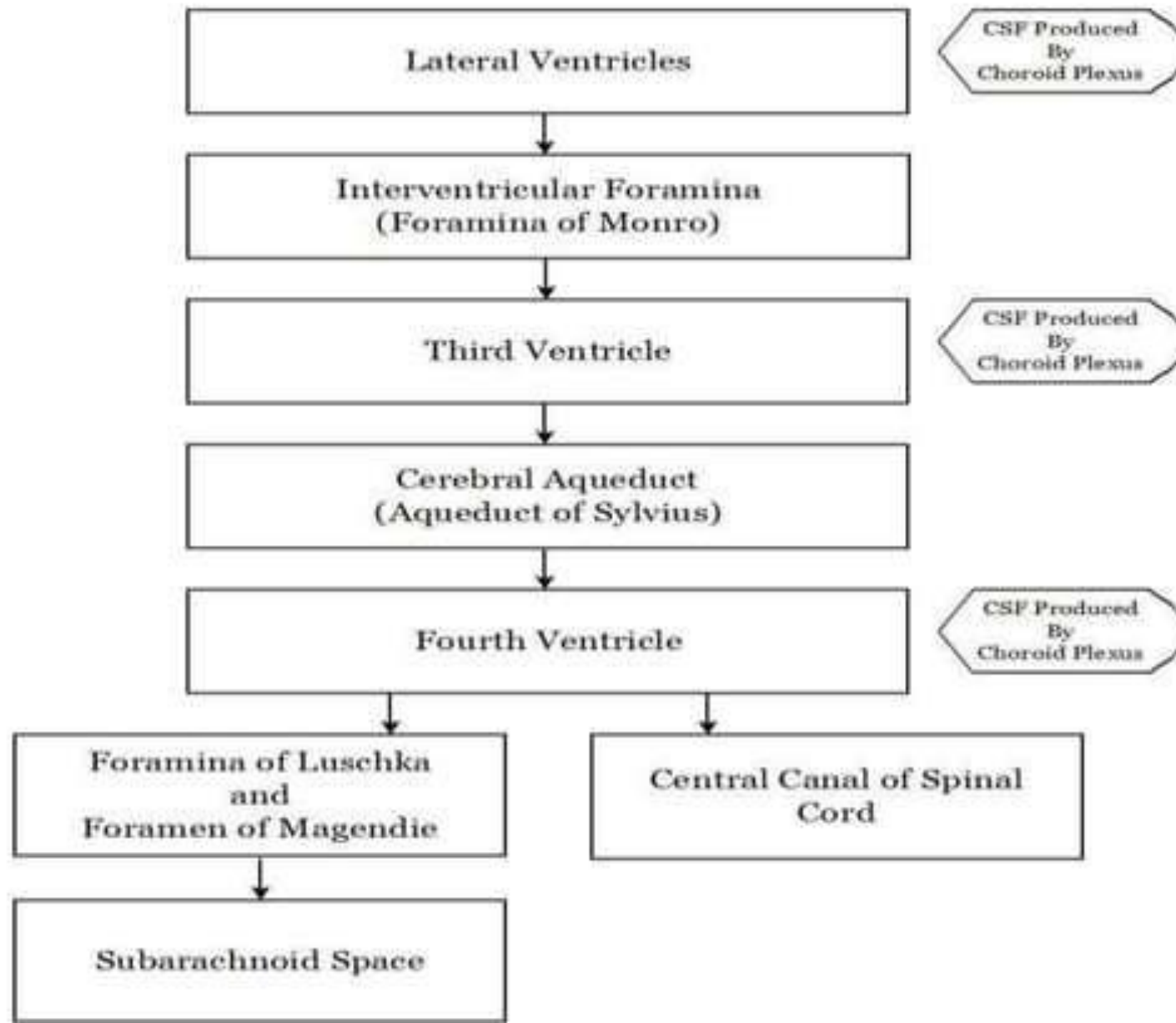
# Circulation of CSF

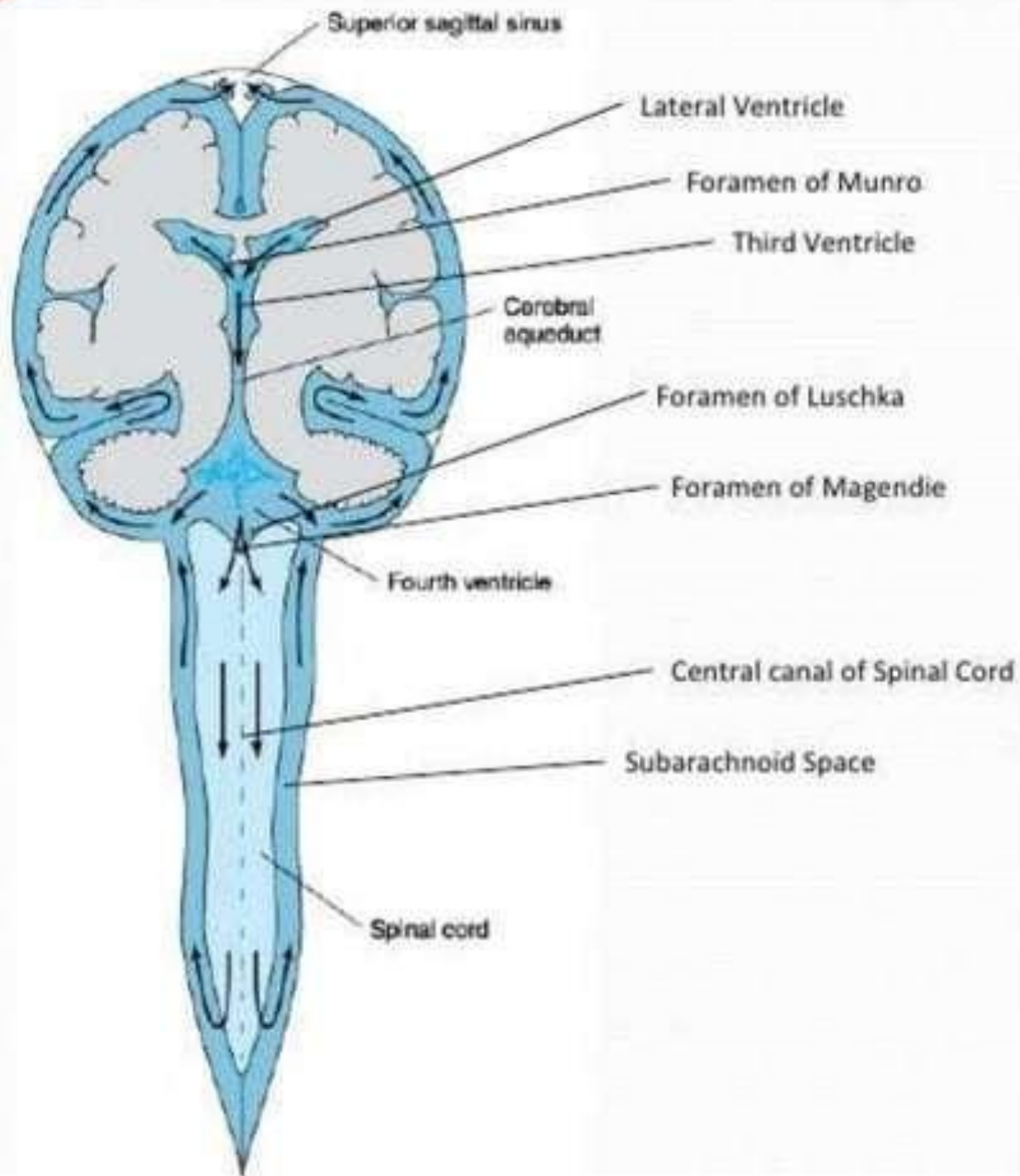


# Ventricles of the Brain



# Circulation of CSF





# Absorption of CSF

- ❑ Arachnoid villi - Into the subdural venous sinuses .
- ❑ Recent studies – more important route – via cribriform plate above the nose – to cervical lymphatics

# Absorption of CSF

- ❑ If CSF pressure is elevated, reabsorption is more via the arachnoid villi.
- ❑ Abnormal increase in amount – aquaporin water channels expressed in the choroid plexus & brain microvessels – compensatory adaptation



# Absorption of CSF

## Factors that facilitate the movement of fluid:

1. Oncotic pressure of plasma is higher than that of CSF (as CSF has less proteins)
2. Hydrostatic pressure of CSF is higher than that of the subdural venous sinuses.

# Functions of CSF

- Mechanical: protective, nourishment, required for cerebral blood flow.
- Therapeutical: needed for administration of drug; lumbar puncture.

# Functions of CSF

- Protects brain from mechanical injury
- **Effect of buoyancy** – Brain has a higher specific gravity than CSF. Therefore, the brain floats freely in the CSF.
- Weighs about 1400 g in air; but only 50 g in CSF.
- Protection from minor injuries during routine day-to-day activities.
- Impact of major injuries is greatly diminished

# Functions of CSF

## ➤ Cushion effect:

- CSF supports the brain; cushion like effect
- Post lumbar puncture – severe headache after CSF removal – brain hangs on the vessels & nerve roots, and traction on them stimulates pain fibers

# Functions of CSF

- Provides microenvironment for brain cells
- Serves as a fluid buffer – buffers changes in the blood & brain interstitial fluid –
- Thereby, ensures constancy in the external environment of neurons.

# Functions of CSF

- Removal of proteins & waste products of metabolism
- Lymphatics absent in the brain & the spinal cord
- CSF serves the function of lymphatics

# Functions of CSF

## ➤ Role in homeostasis

- Changes in blood gases in CSF – chemoreceptors – sense & regulate respiration, BP

## ➤ Blood-CSF barrier

- Abnormalities in composition – Diagnose diseases like meningitis, encephalitis etc.,

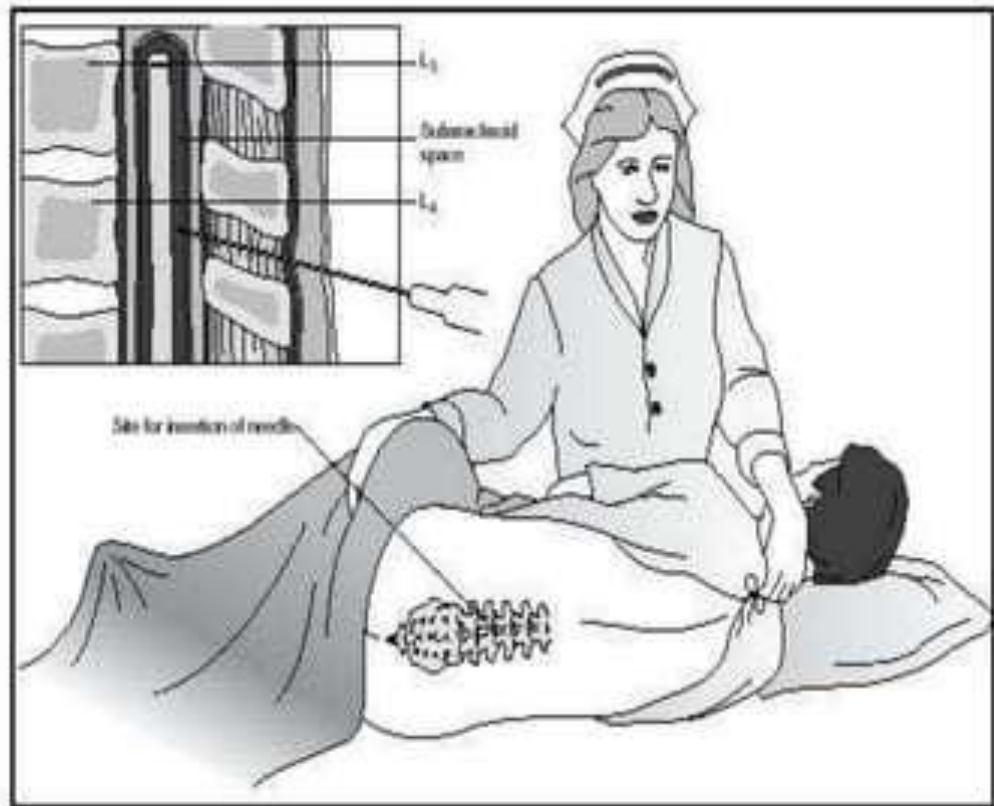
# Applied aspects

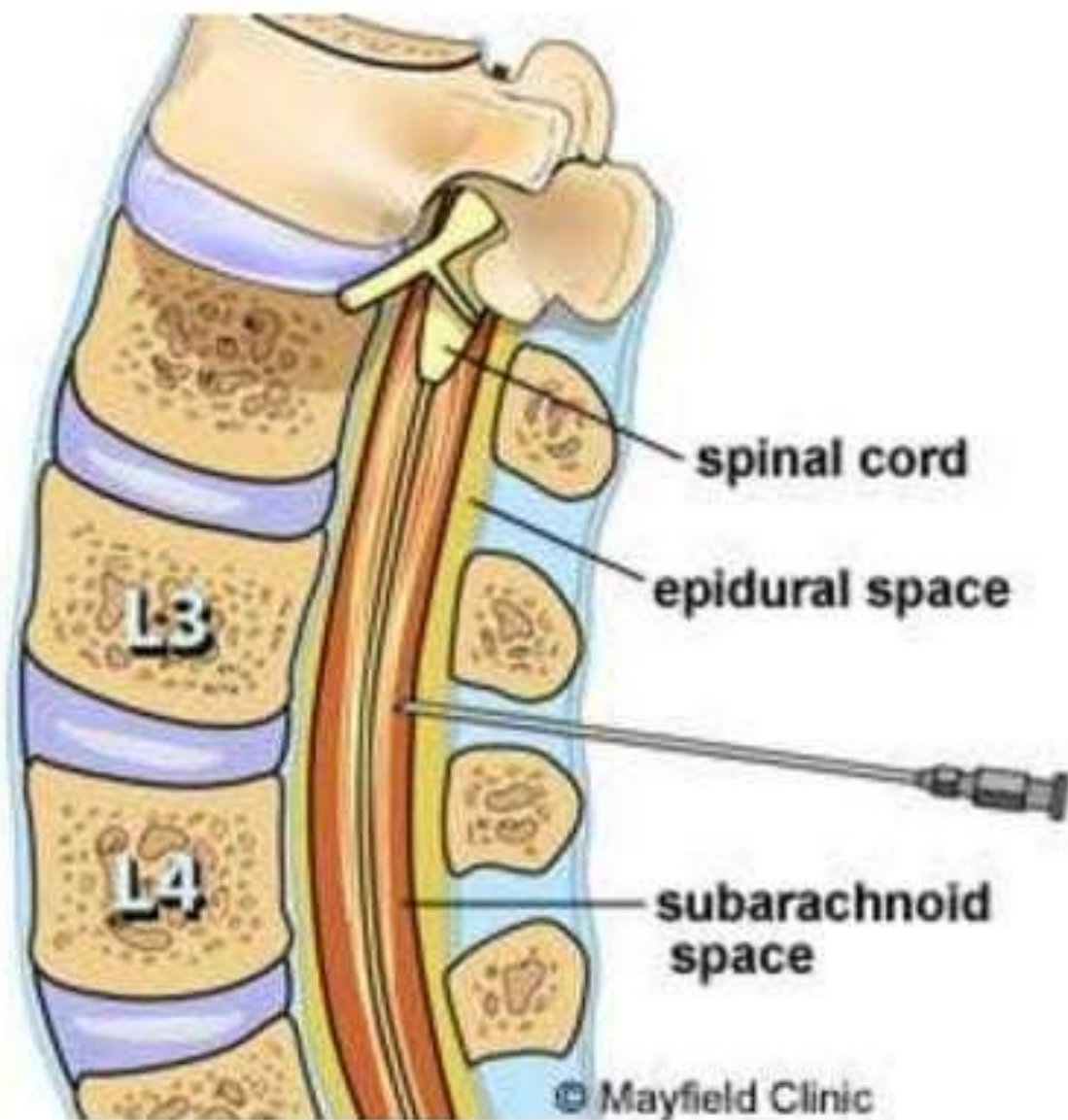
- LUMBAR PUNCTURE
- HYDROCEPHALUS



# Lumbar puncture

- Process by which CSF is taken out from spinal subarachnoid space for study.
- An LP needle is introduced usually between 3<sup>rd</sup> & 4<sup>th</sup> lumbar spines with subject lying on his side.





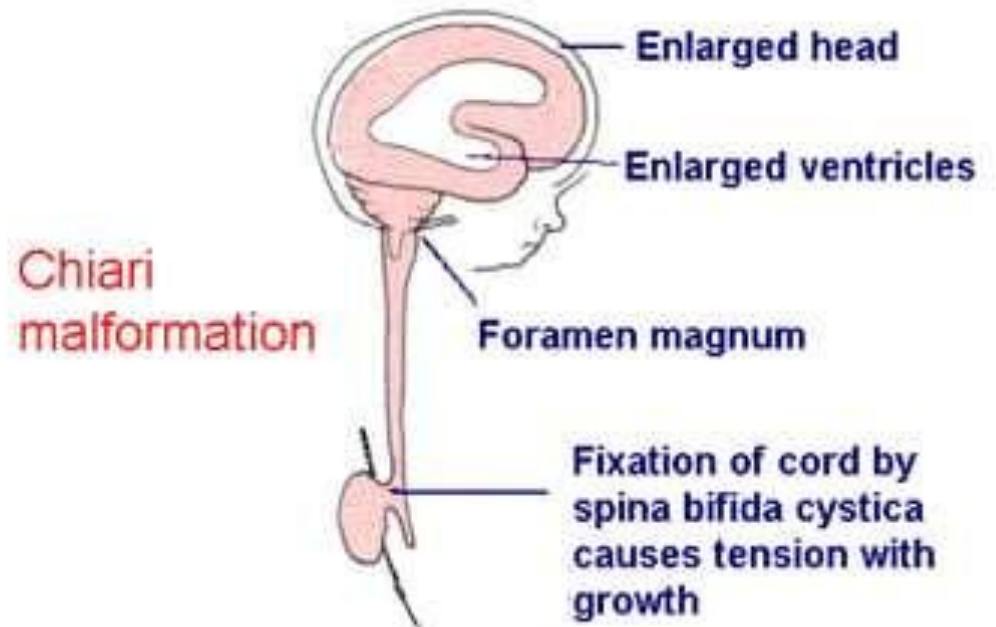
# Lumbar puncture

- Study the sample – CSF analysis
- Drug delivery. ex: anaesthetics

# Hydrocephalus

- Pathological accumulation of CSF within brain spaces
- Types – external & internal

## HYDROCEPHALY (HYDROCEPHALUS)



# Hydrocephalus

- **Communicating (external)** – excess fluid in subarachnoid space – cause – rate of formation greater than absorption.
- **Non communicating (internal)** - excess fluid accumulation in ventricular system proximal to block.
- Common sites of block – Foramen of Munro, Luschka, Aqueduct of Sylvius & within ventricular system itself.

# Summary Video

A glowing blue brain scan image, likely an MRI or CT scan, showing the intricate structure of the brain. The image is set against a dark background, making the blue glow stand out. Overlaid on the center of the brain is the text "THANK YOU FOR LISTENING!" in a bold, black, sans-serif font.

**THANK YOU  
FOR LISTENING!**





# References

- Ganong
- GK Pal