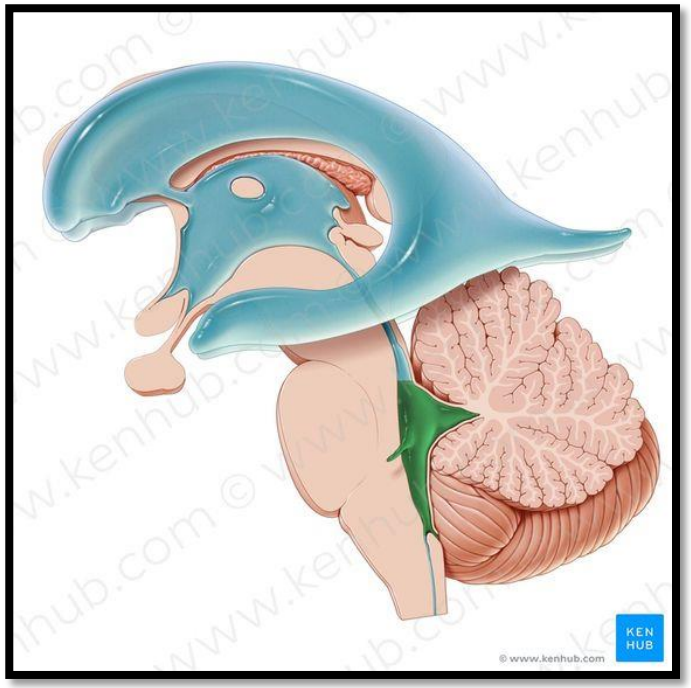
المرحلة : الثانية
المادة : التشريح

جامعة ذي قار / كلية الطب

CEREBROSPINAL FLUID AND BLOOD BRAIN BARRIER OF THE BRAIN



الدكتور
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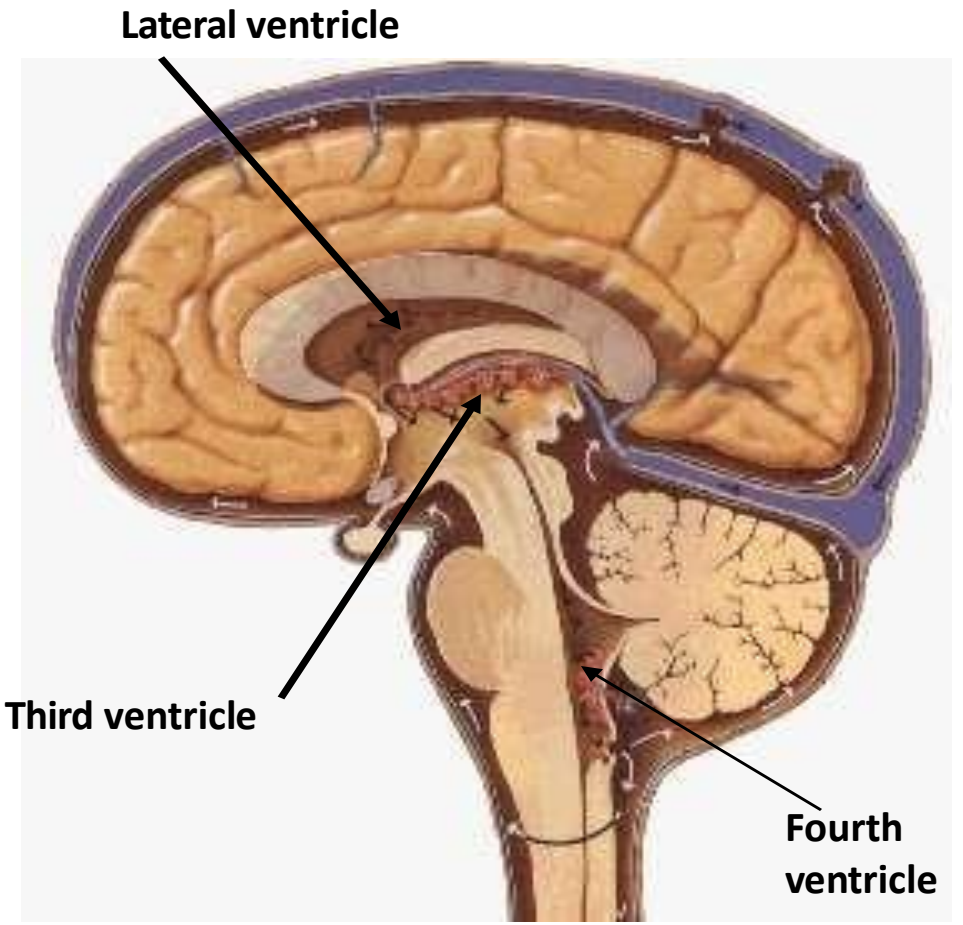
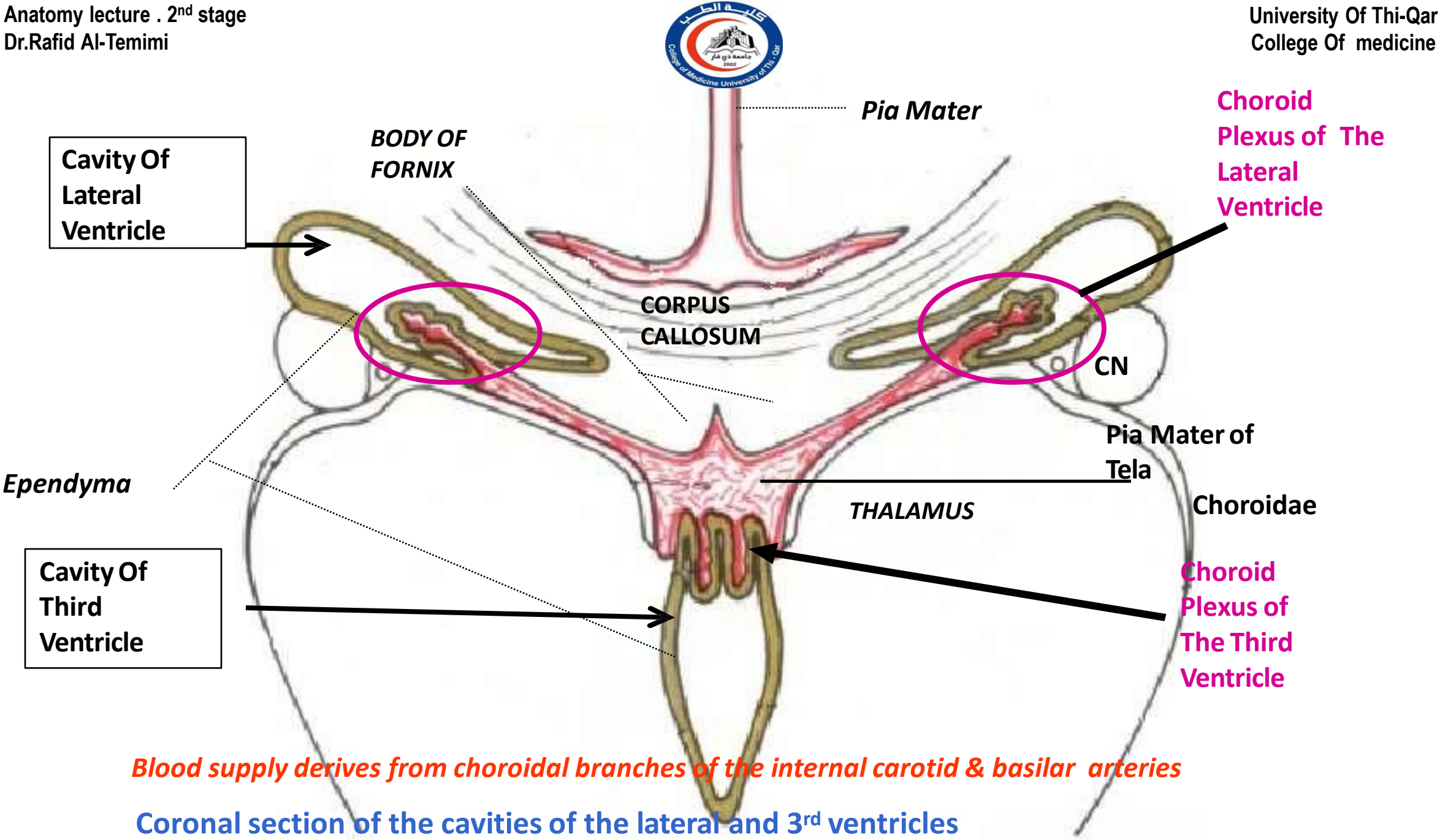
CHOROID PLEXUS

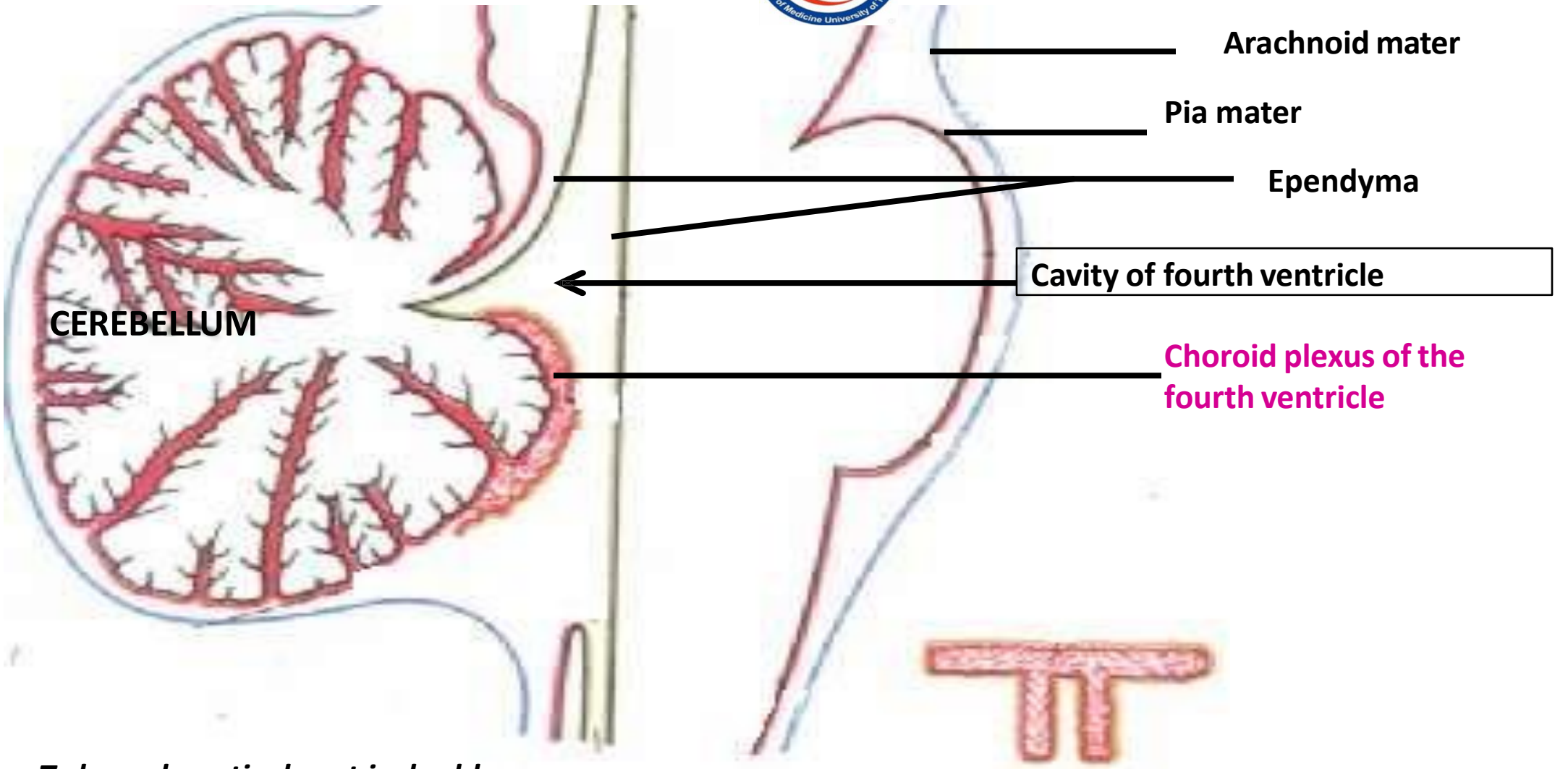
- It is formed by invaginating of vascular *pia mater* into the ventricular cavity
- It becomes highly convoluted & produce a spongy-like appearance
- It enters the 3rd and 4th ventricles through their roofs, and the lateral ventricles through the choroid fissure
- produces cerebrospinal fluid (CSF)





Blood supply derives from choroidal branches of the internal carotid & basilar arteries

Coronal section of the cavities of the lateral and 3rd ventricles



- *T shaped, vertical part is double*
- *Horizontal part extends into lateral recesses of each ventricle (foramina of Luskha)*
- *Blood supply ; posterior inferior cerebellar arteries*

What is cerebrospinal fluid (CSF) ?

- Clear, colorless fluid
- Produced by the choroid plexus
- Found in the :
  - Ventricles of the brain
  - Subarachnoid space (between Arachnoid + Pia mater) around the brain & spinal cord

- The pressure of the CSF is kept remarkably constant.
- Based on the Monro-Kellie doctrine :
- *"Volume of BLOOD, CSF & BRAIN at any time must be relatively constant"*

Physical characteristics and composition of the CSF	
Appearance	Clear and colourless
Volume	130 ml
Rate of production	0.5 ml/min
Pressure	60-150 mm of water
Composition	
protein	15-45 mg/100 ml
glucose	50-85 mg/ 100 ml
chloride	720-750 mg/100 ml
No. of cells	0-3 lymphocytes/cu mm

Function of the CSF :

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

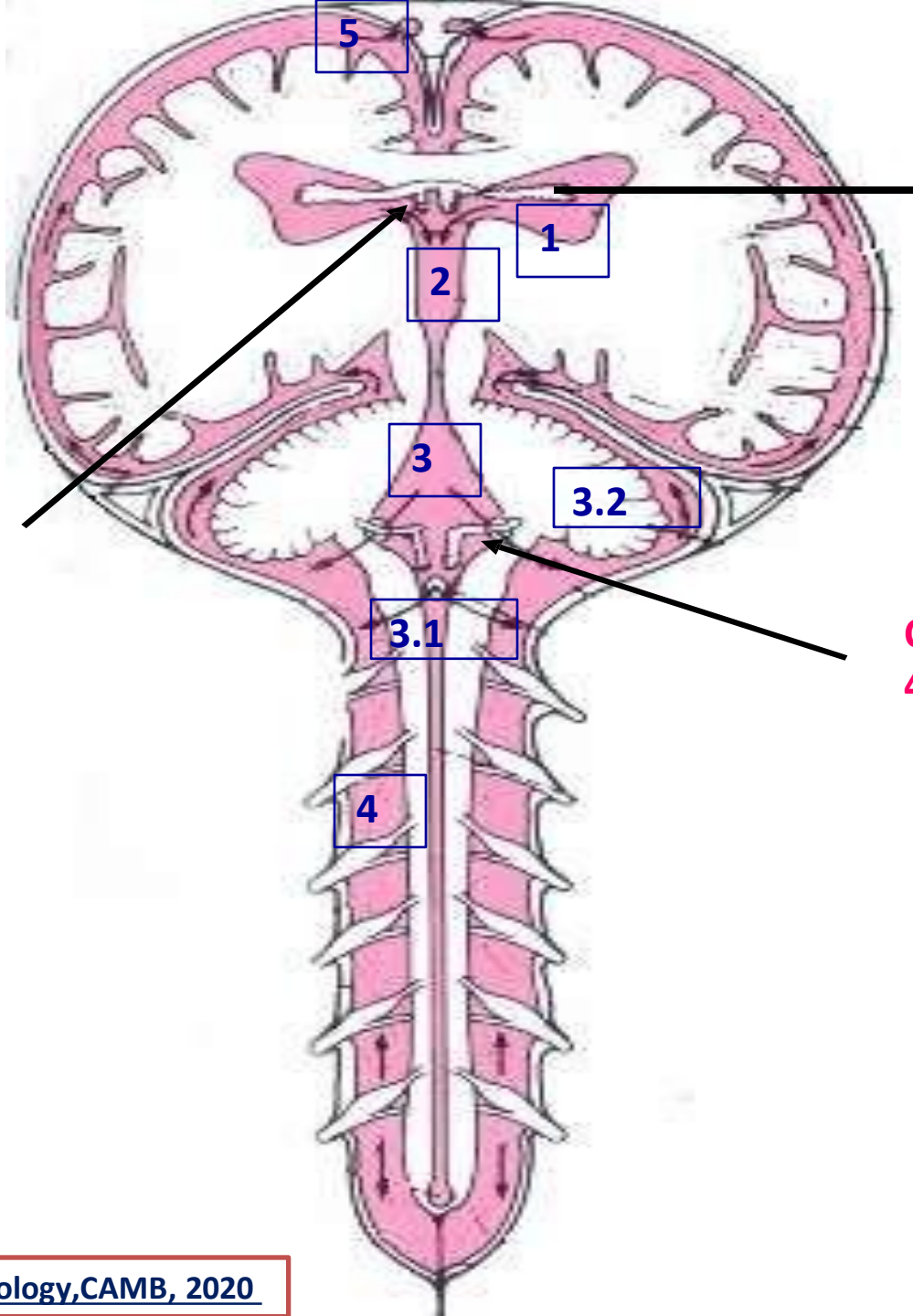
Sites of formation :

1. Choroid plexus of the ventricle cavities, mostly is formed in the LATERAL VENTRICLES
2. Some originate from the ependymal cells lining the ventricles
3. Some from the brain substances through perivascular spaces

Movement of CSF inside the ventricle is controlled by the:

1. Pulsation of the artery in the choroid plexus
2. By the aid of the cilia & microvilli of the ependymal cells

Superiorly = lateral aspect of each cerebral hemisphere



Choroid plexus of the lateral ventricle

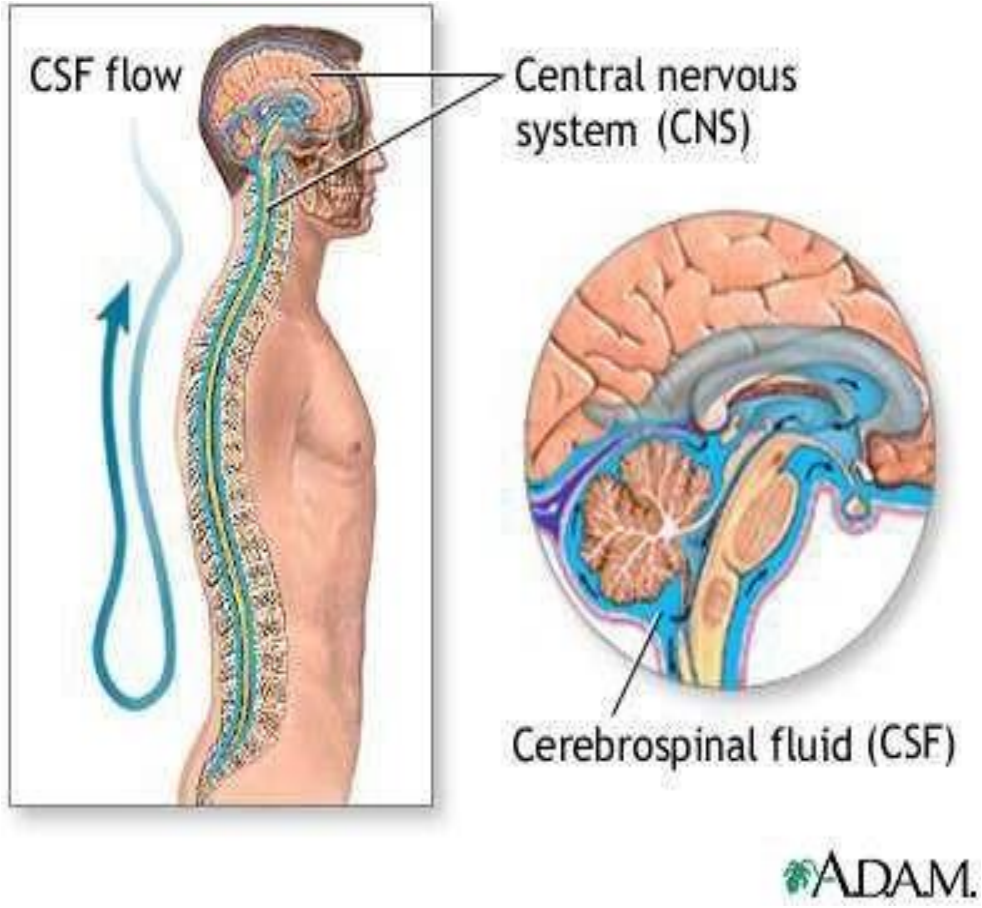
Choroid plexus of the 3rd ventricle

Choroid plexus of the 4th ventricle

Inferiorly = subarachnoid space around the brain & spinal cord

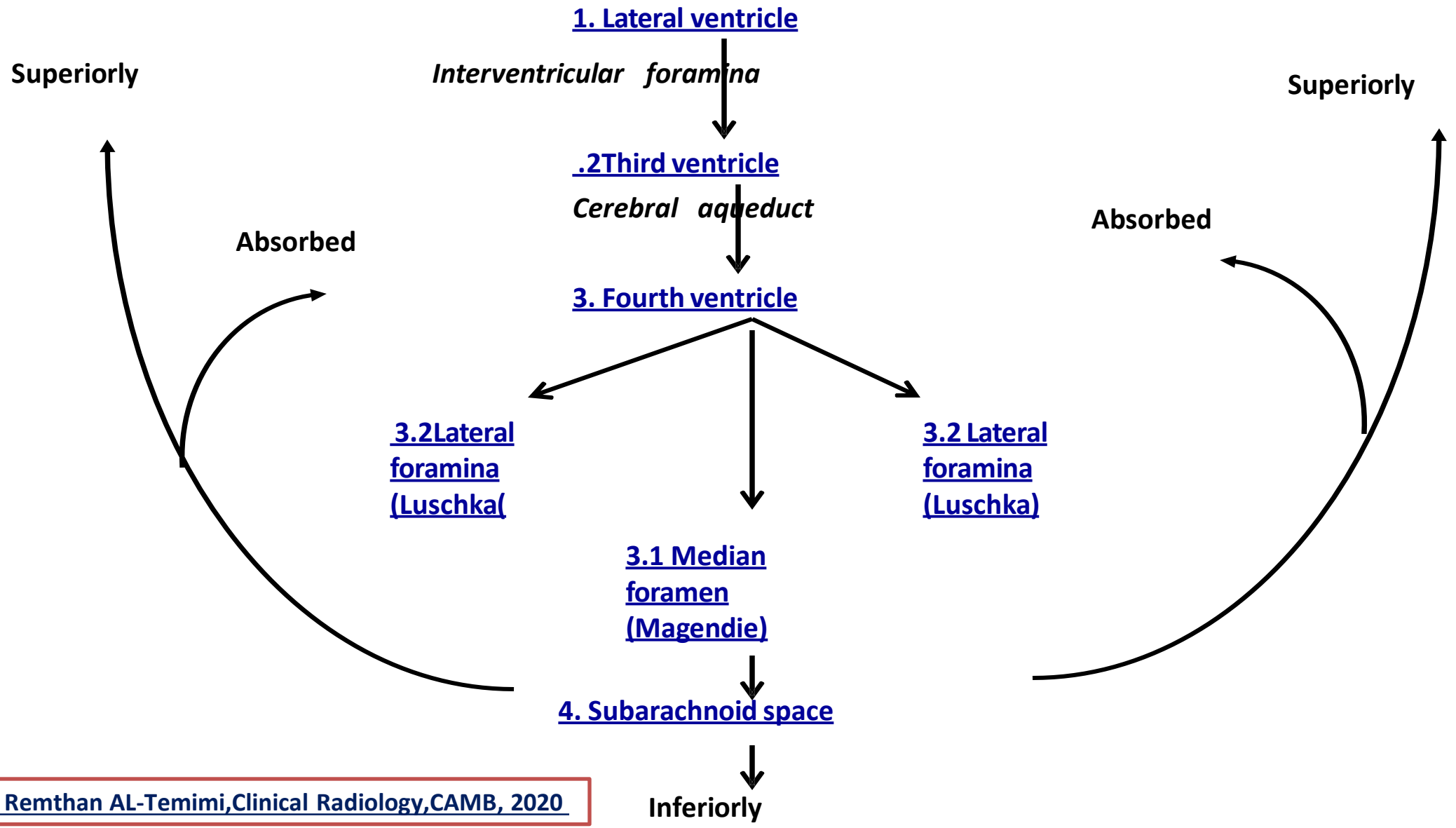
cerebrospinal fluid (CSF)

- The CSF is formed in the lateral ventricles escapes by the ***foramen of monro*** into the third ventricle
- From the third ventricle by the ***aqueduc***t into the fourth ventricle.
- Then from the fourth ventricle the fluid is poured into the subarachnoid spaces through the medial ***foramen of majendie*** and the two lateral ***foramina of luschka***.
- There is no evidence that functional communications between the cerebral ventricles and the subarachnoid spaces exist in any region except from the fourth ventricle.

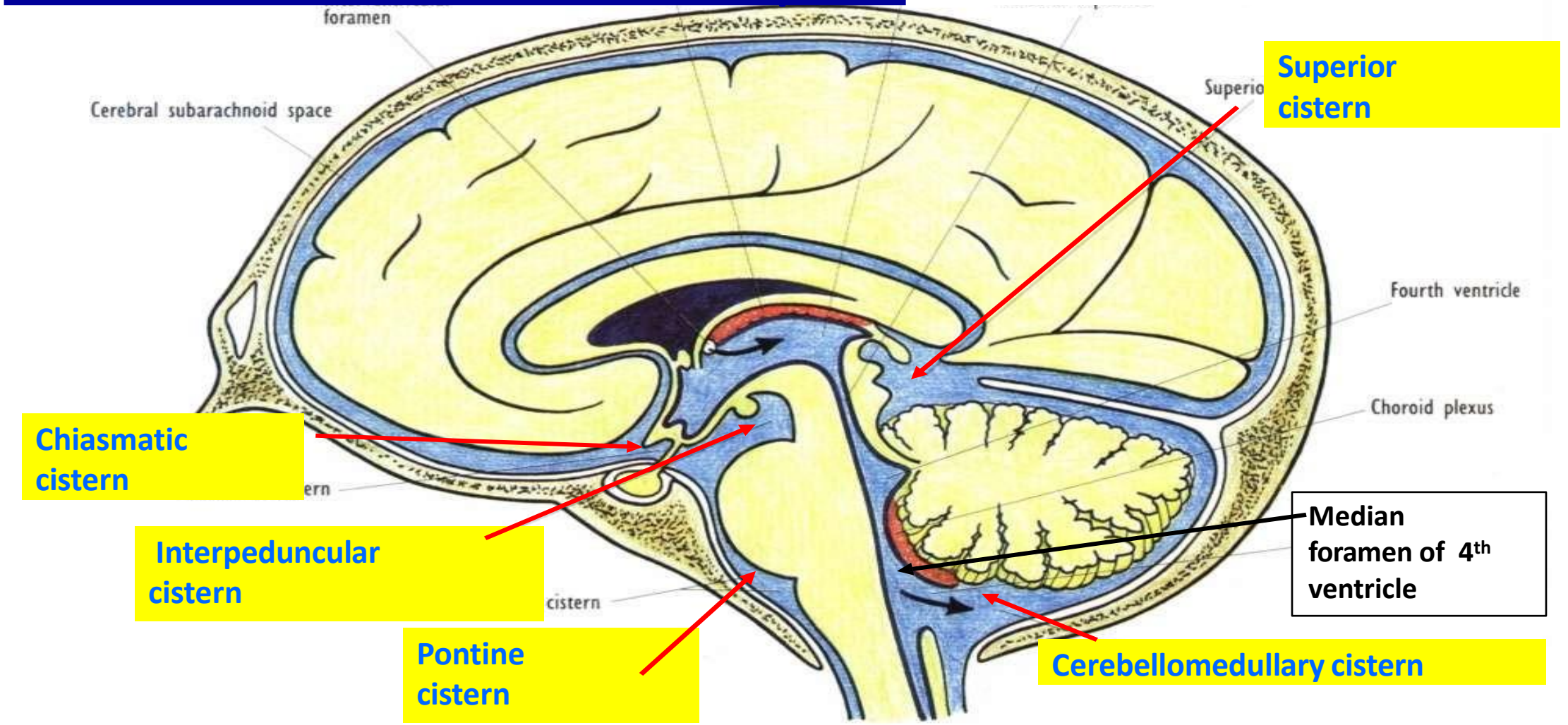


Site of formation

Choroid plexus of the lateral ventricle



Circulation of CSF in subarachnoid space :



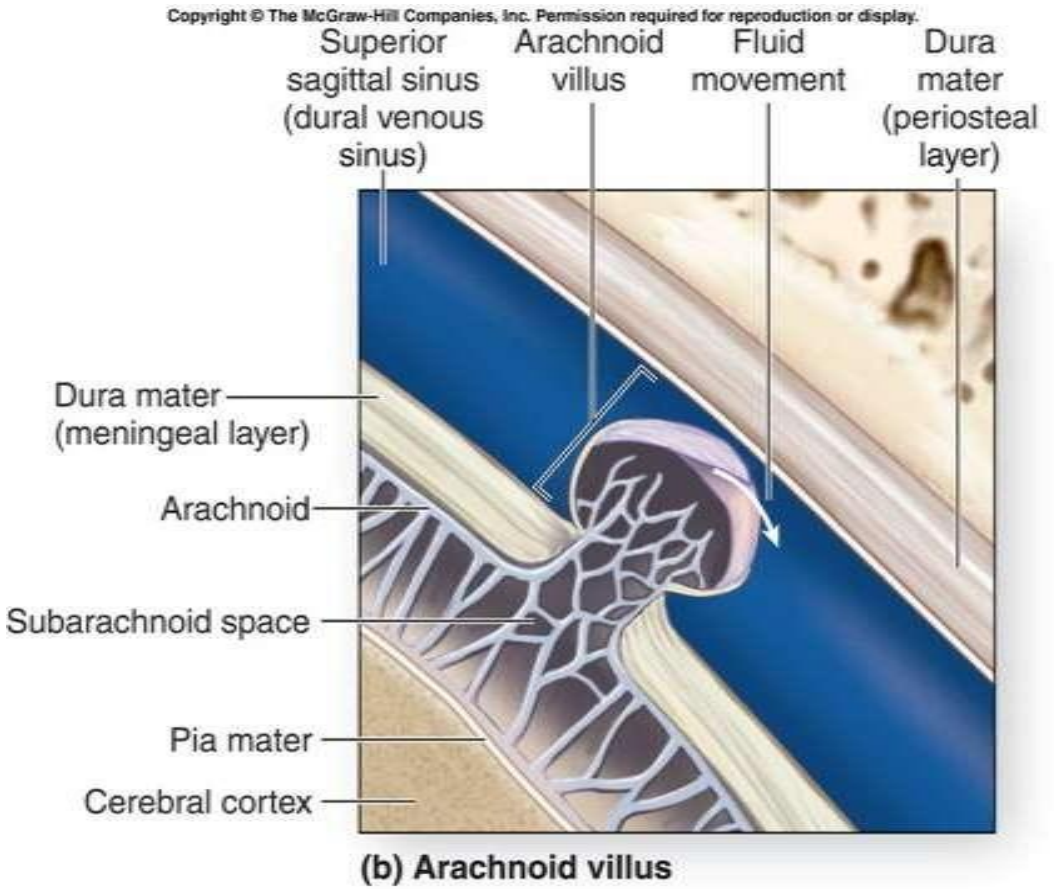
Median sagittal section to show the subarachnoid cisterns & circulation of CSF

Factors that facilitate the flow of CSF in subarachnoid space ;

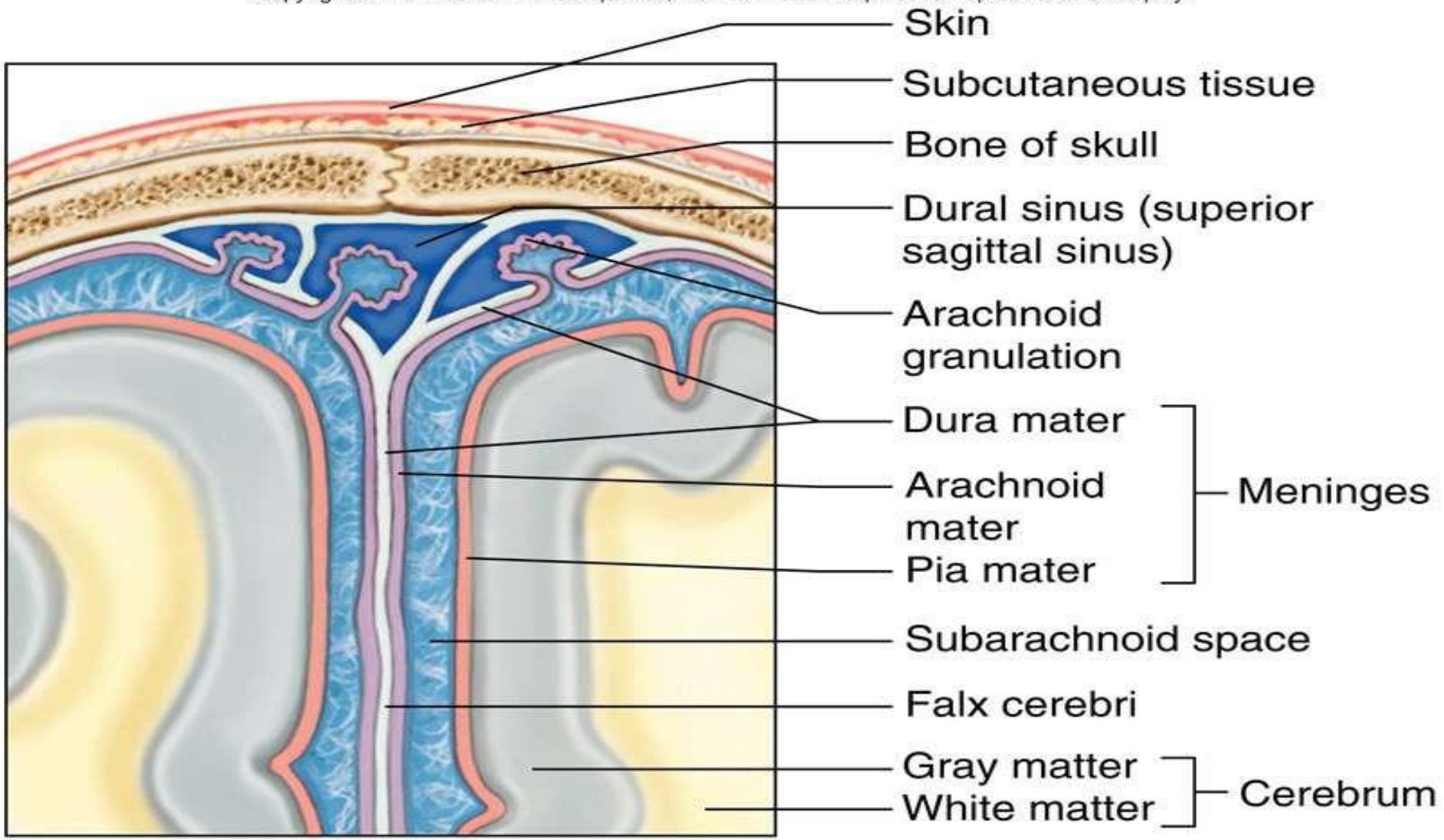
1. Pulsation of the cerebral & spinal arteries
2. Movements of the vertebral column
3. Respiration & coughing
4. Changing of the positions

Absorption of CSF into dural venous sinuses

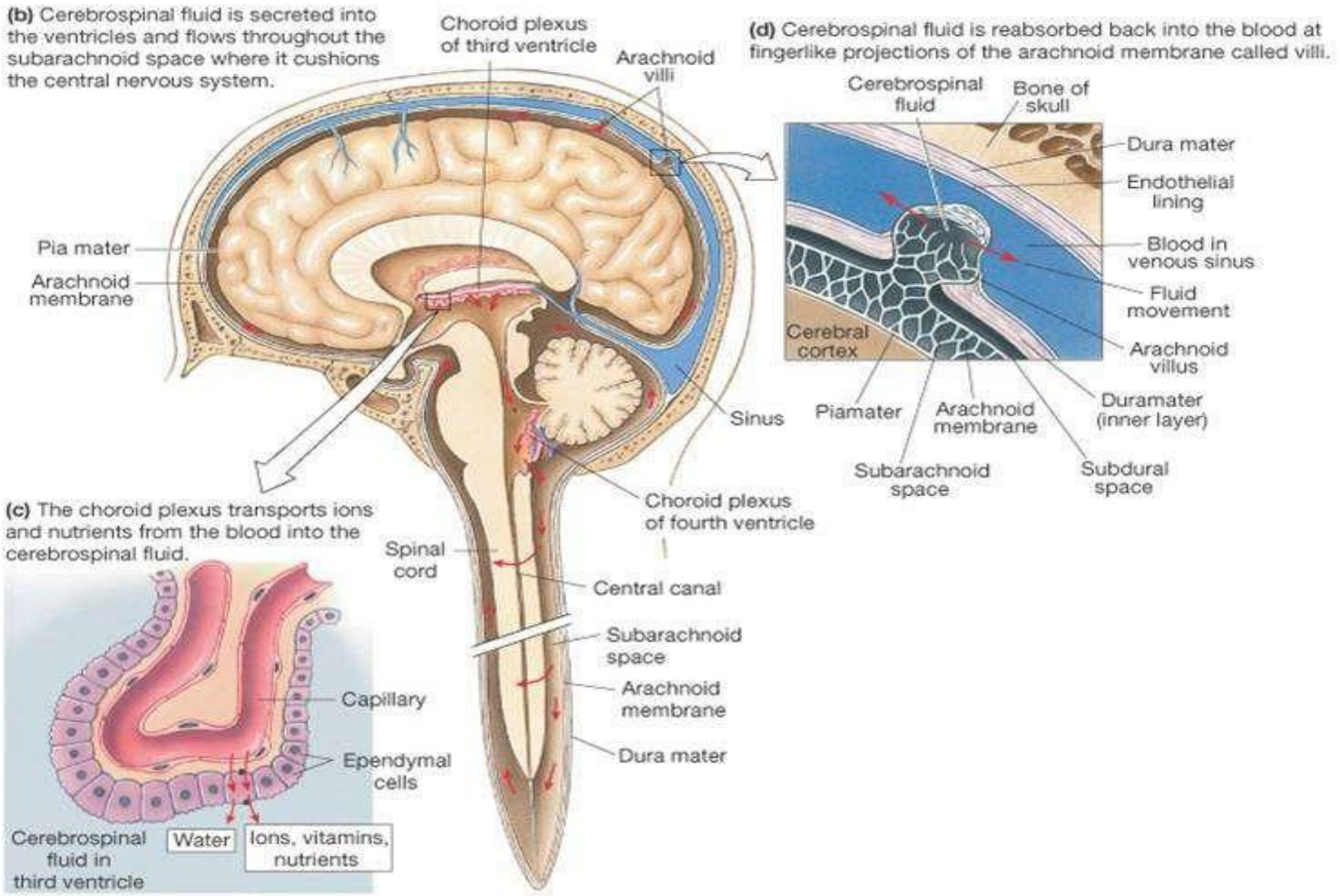
- Main sites - *arachnoid villi* (project into dural venous sinuses, especially, superior sagittal sinus)
- *Arachnoid villi* are covered by endothelium of the venous sinus
- *Arachnoid villi* tend to be grouped together & form elevations known as *arachnoid granulations*
- CSF pressure >> the pressure in the sinus
- The rate of absorption of CSF through the arachnoid villi controls the CSF pressure



(b) Arachnoid villus



(b)

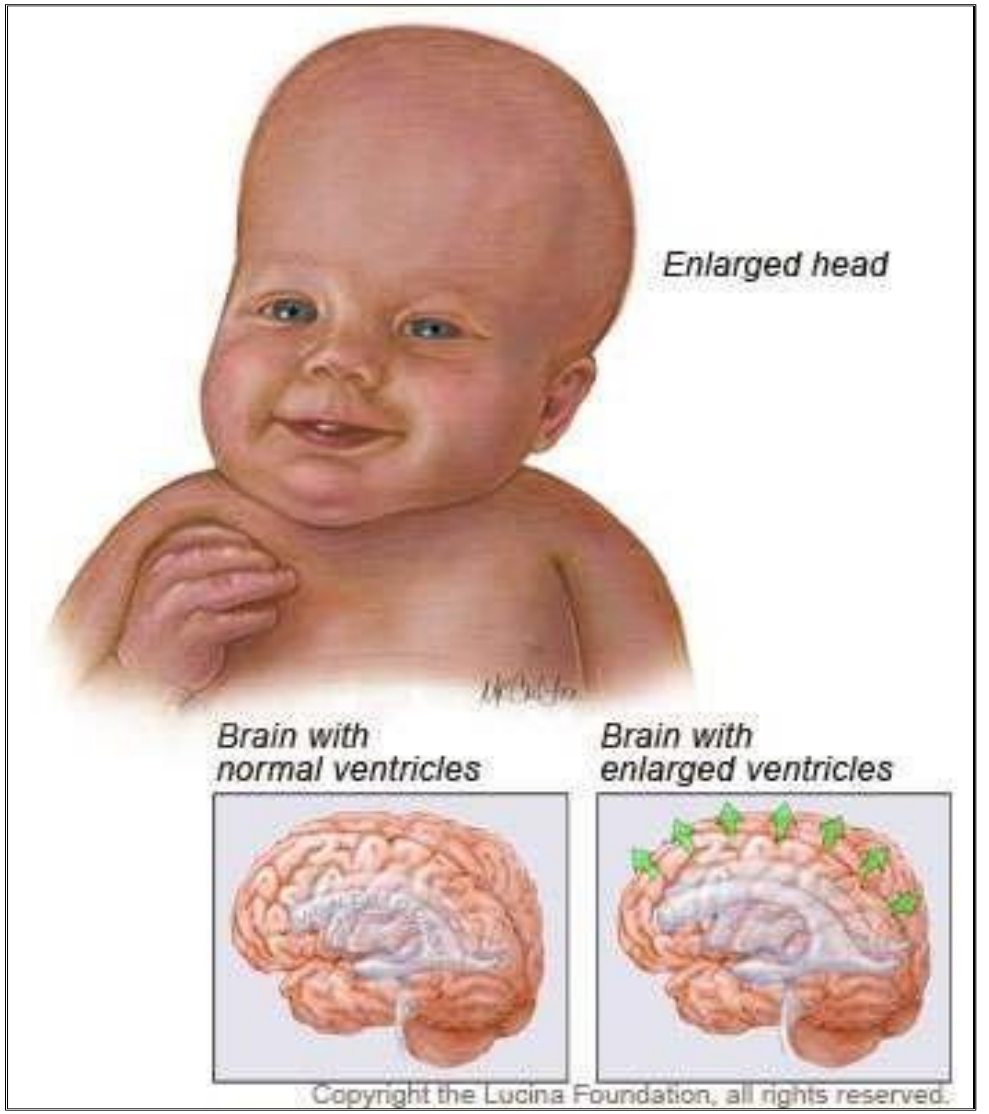


Dr.Rafid Remthan AL-Temimi,Clinical Radiology,CAMB, 2020

CLINICAL APPLICATION

Hydrocephalus

- The term hydrocephalus is derived from the Greek words "hydro" meaning water and "cephalus" meaning head.
- It is excessive accumulation of fluid in the brain.


Enlarged head
Brain with normal ventricles
Brain with enlarged ventricles
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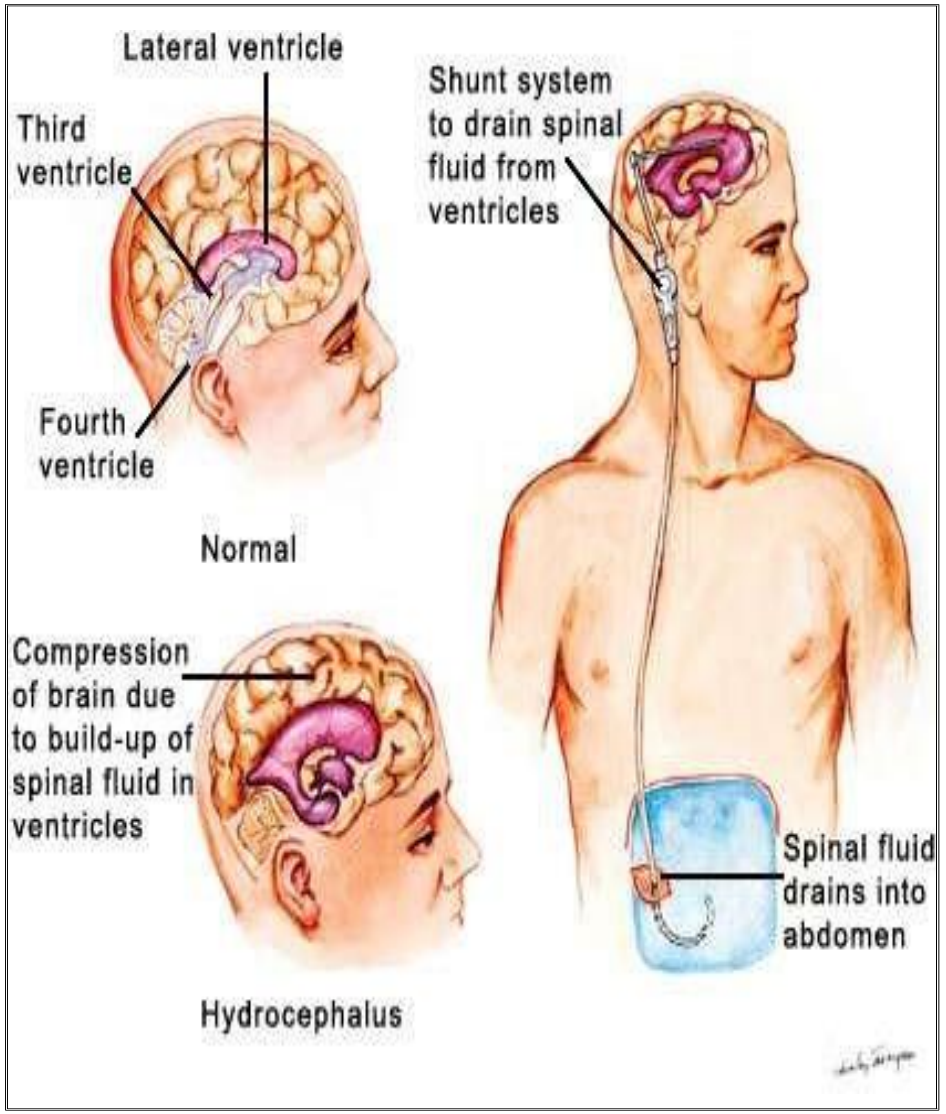

Lateral ventricle
Third ventricle
Fourth ventricle
Normal
Shunt system to drain spinal fluid from ventricles
Compression of brain due to build-up of spinal fluid in ventricles
Spinal fluid drains into abdomen
Hydrocephalus

What is the blood brain barrier (BBB)?

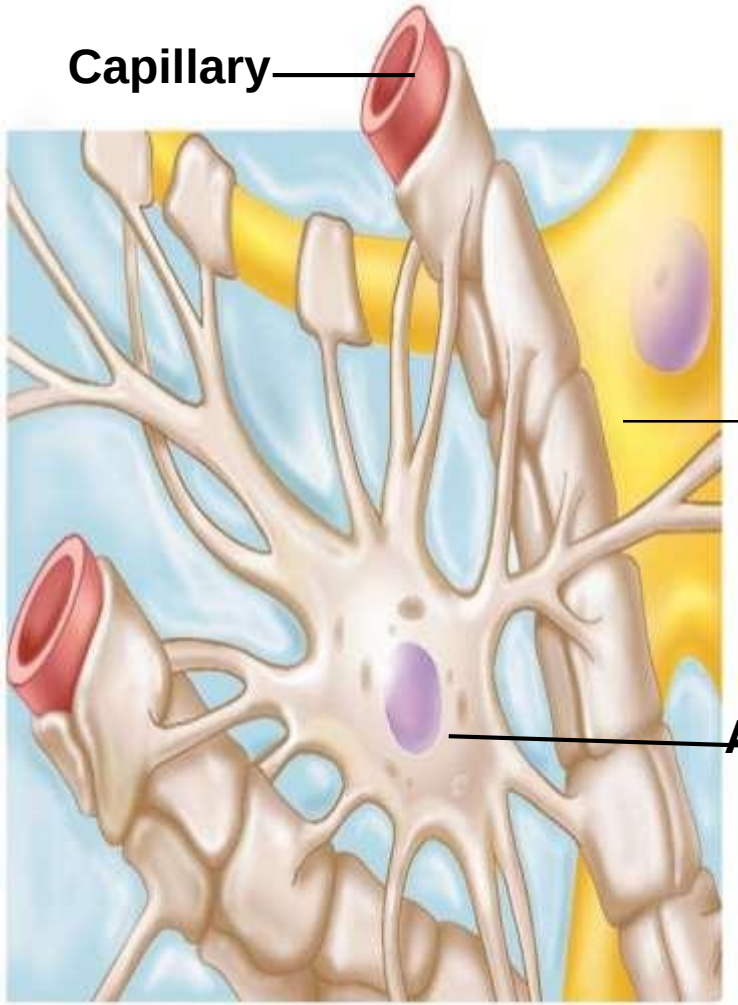
- The brain is a privileged site, sheltered from the systemic circulation by the blood-brain barrier (BBB).

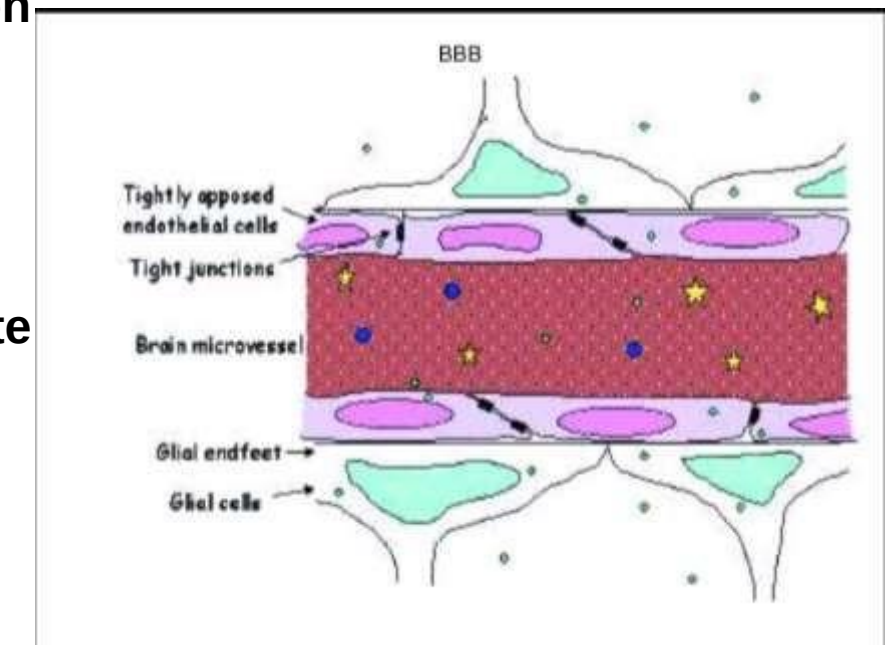
. Semipermeable barrier.

- Highly specialised brain endothelial structure.
- Helps maintain stable environment for brain.
- Separates neurons from some blood borne substances.

- It intervene between the blood in the capillaries and extracellular spaces surrounding neurons.
- Principal components:

1. Capillary endothelial cells and tight junctions between them.
2. A basement membrane on which capillary endothelial cells are arranged.
3. Foot process of astrocytes.





(a) **Astrocytes are the most abundant CNS neuroglia.**

Blood Brain Barrier: Functions

- Selective barrier
  - Allows nutrients to move by facilitated diffusion
  - Metabolic wastes, proteins, toxins, most drugs, small nonessential amino acids, K^+ denied
  - Allows any fat-soluble substances to pass, including alcohol, nicotine, and anesthetics
- Absent in some areas, e.g., vomiting center and hypothalamus, where necessary to monitor chemical composition of blood

- Areas that are devoid of:

1. Pineal gland
2. Neurohypophysis
3. Area postrema (at lower end of floor of fourth ventricle.
4. Wall of supraoptic recess of third ventricle.

BLOOD-CEREBROSPINAL FLUID BARRIER

It is the barrier between the blood and cerebrospinal fluid that exists at the choroid plexus.
The function of this barrier is same as of ***BBB***.
It doest not allow the movement of following substances like ***chemical agents,pathogens,bile pigments*** etc.
It allows the movement of only those substances which are allowed by BBB like ***Oxygen,Carbon Dioxide,Water*** etc


Thank You