CEREBROSPINAL FLUID (CSF)

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- **Cerebrospinal fluid (CSF) is a clear, colorless liquid that protects the brain and spinal cord from chemical and physical injuries. It also carries oxygen, glucose, and other needed chemicals from the blood to neurons and neuroglia.**
- **CSF continuously circulates through cavities in the brain and spinal cord and around the brain and spinal cord in the subarachnoid space.**

- **Four CSF-filled cavities within the brain, which are called ventricles. A lateral ventricle is located in each hemisphere of the cerebrum.**
- ***The third ventricle is a narrow* cavity along the midline superior to the hypothalamus and between the right and left halves of the thalamus.**
- **The fourth ventricle lies between the brain stem and the cerebellum.**

- **Volume - 80 to 150 mL in an adult.**
- **Daily production- 1500ml**
- **Normal pressure in supine position in lumbar subarachnoid space is – 50-200 mm of water**
- **In sitting position- 200-250 mm of water**
- **Specific gravity- 1.003-1.008**

Formation of CSF in the Ventricles

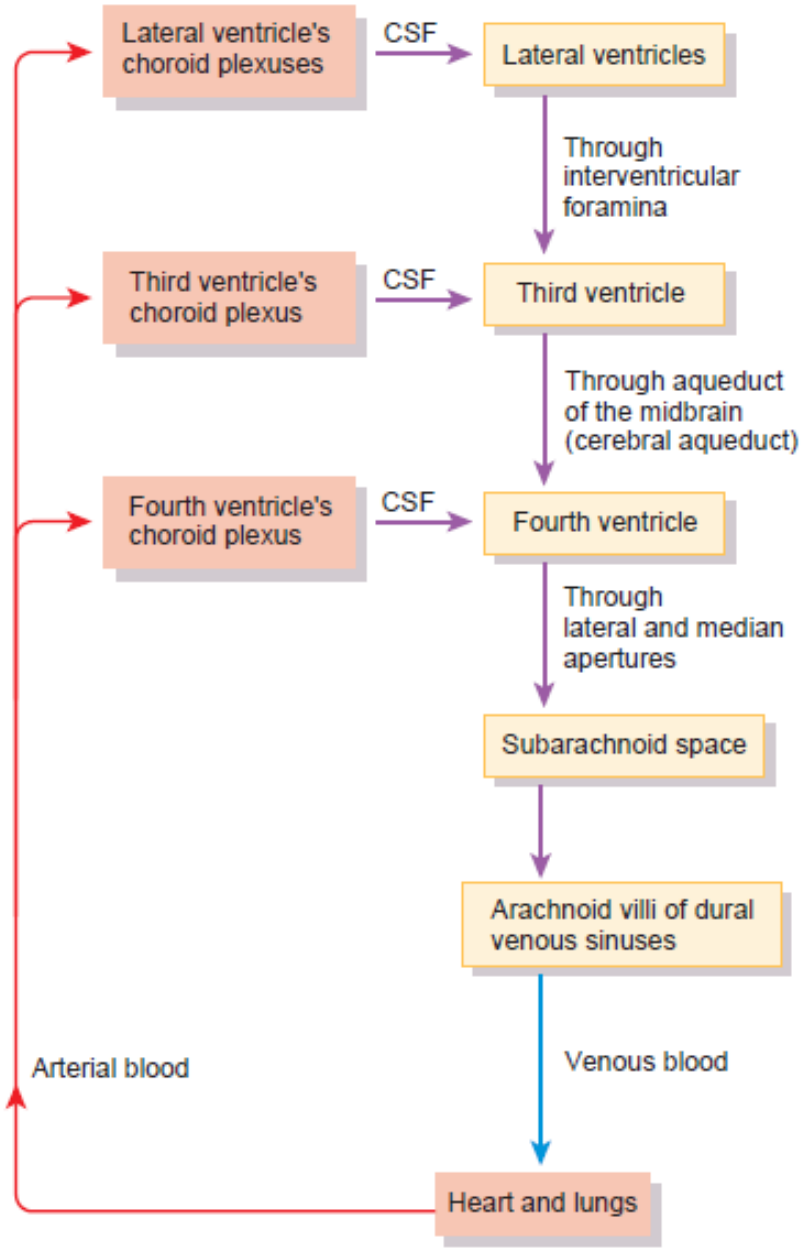
- **The sites of CSF production are the choroid plexuses, networks of blood capillaries in the walls of the ventricles. The capillaries are covered by ependymal cells that form CSF from blood plasma by filtration and secretion.**

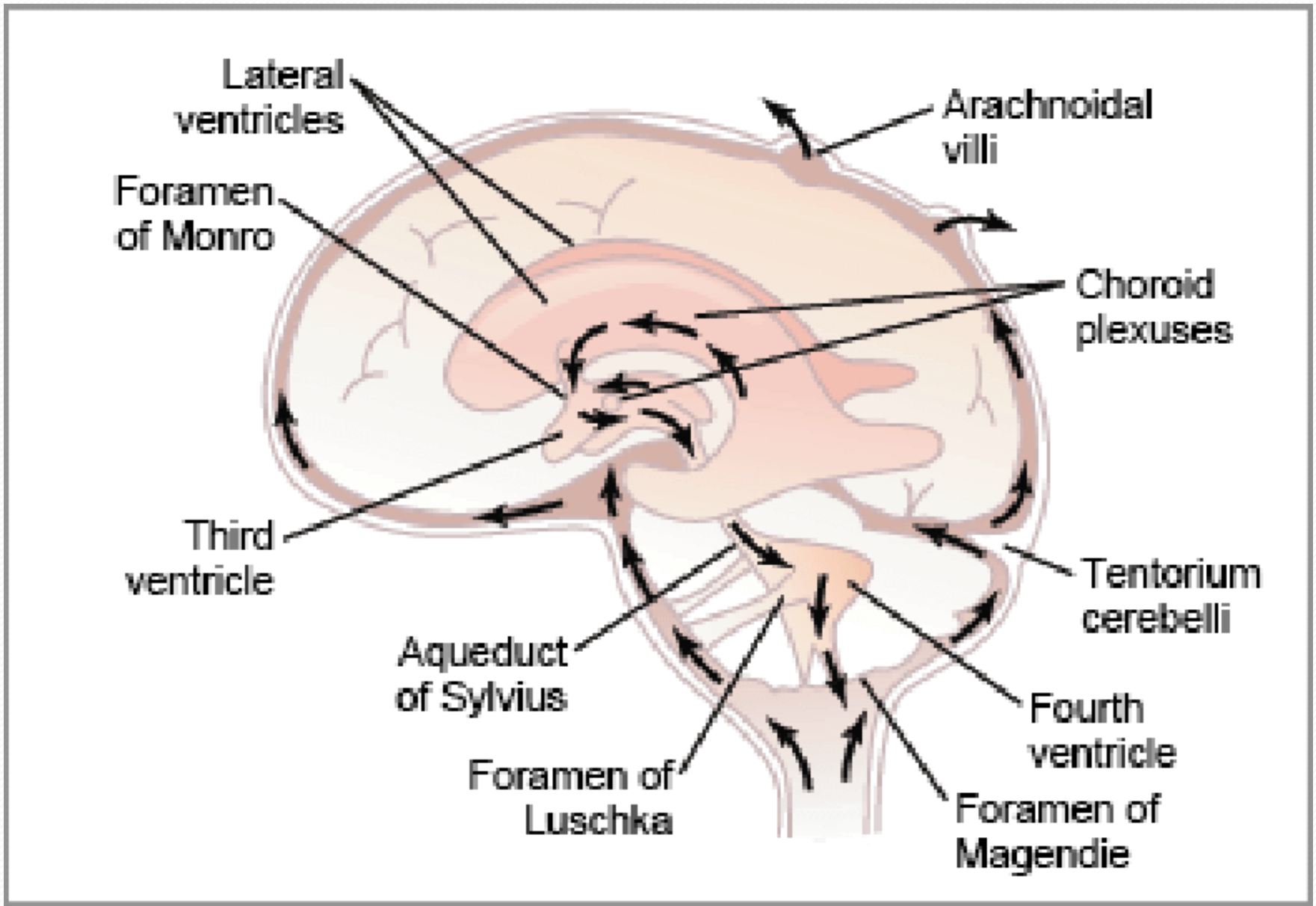
Circulation of CSF

- **The CSF formed in the choroid plexuses of each lateral ventricle flows into the third ventricle interventricular foramina**
- **More CSF is added by the choroid plexus in the roof of the third ventricle. The fluid then flows through the cerebral aqueduct, which passes through the midbrain, into the fourth ventricle. The choroid plexus of the fourth ventricle contributes more fluid.**

- **CSF enters the subarachnoid space through three openings in the roof of the fourth ventricle: a median aperture and the paired lateral apertures, one on each side.**
- **CSF then circulates in the central canal of the spinal cord and in the subarachnoid space around the surface of the brain and spinal cord.**

- **CSF is gradually reabsorbed into the blood through arachnoid villi, fingerlike extensions of the arachnoid that project into the dural venous sinuses, especially the superior sagittal sinus. (A cluster of arachnoid villi is called an arachnoid granulation.)**
- **Normally, CSF is reabsorbed as rapidly as it is formed by the choroid plexuses, at a rate of about 20 mL/hr (480 mL/day). Because the rates of formation and reabsorption are the same, the pressure of CSF normally is constant.**


Lateral ventricle's choroid plexuses
CSF
Lateral ventricles
Through interventricular foramina
Third ventricle's choroid plexus
CSF
Third ventricle
Through aqueduct of the midbrain (cerebral aqueduct)
Fourth ventricle's choroid plexus
CSF
Fourth ventricle
Through lateral and median apertures
Subarachnoid space
Arachnoid villi of dural venous sinuses
Venous blood
Heart and lungs
Arterial blood

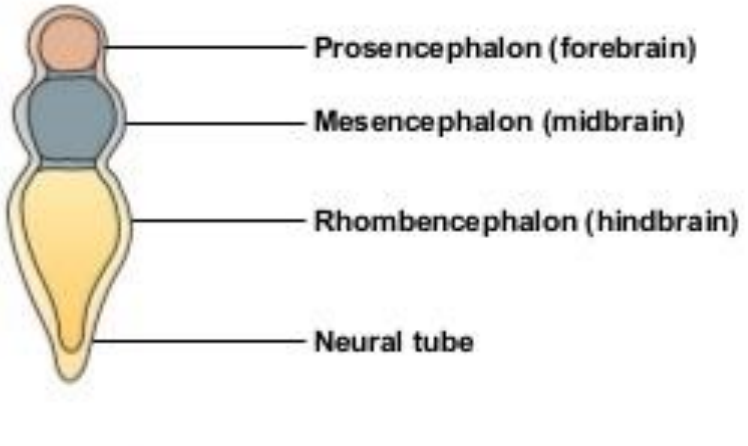

Lateral ventricles
Foramen of Monro
Third ventricle
Aqueduct of Sylvius
Foramen of Luschka
Arachnoidal villi
Choroid plexuses
Tentorium cerebelli
Fourth ventricle
Foramen of Magendie

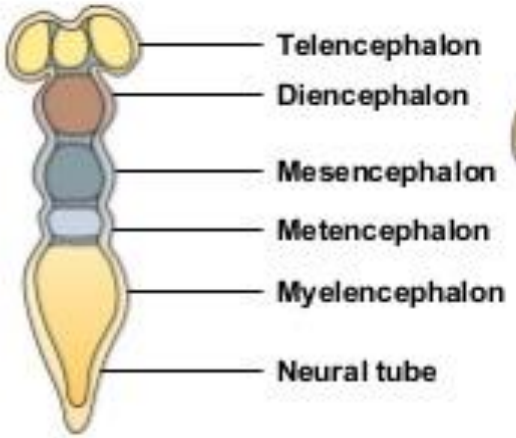
Blood-cerebrospinal fluid barrier

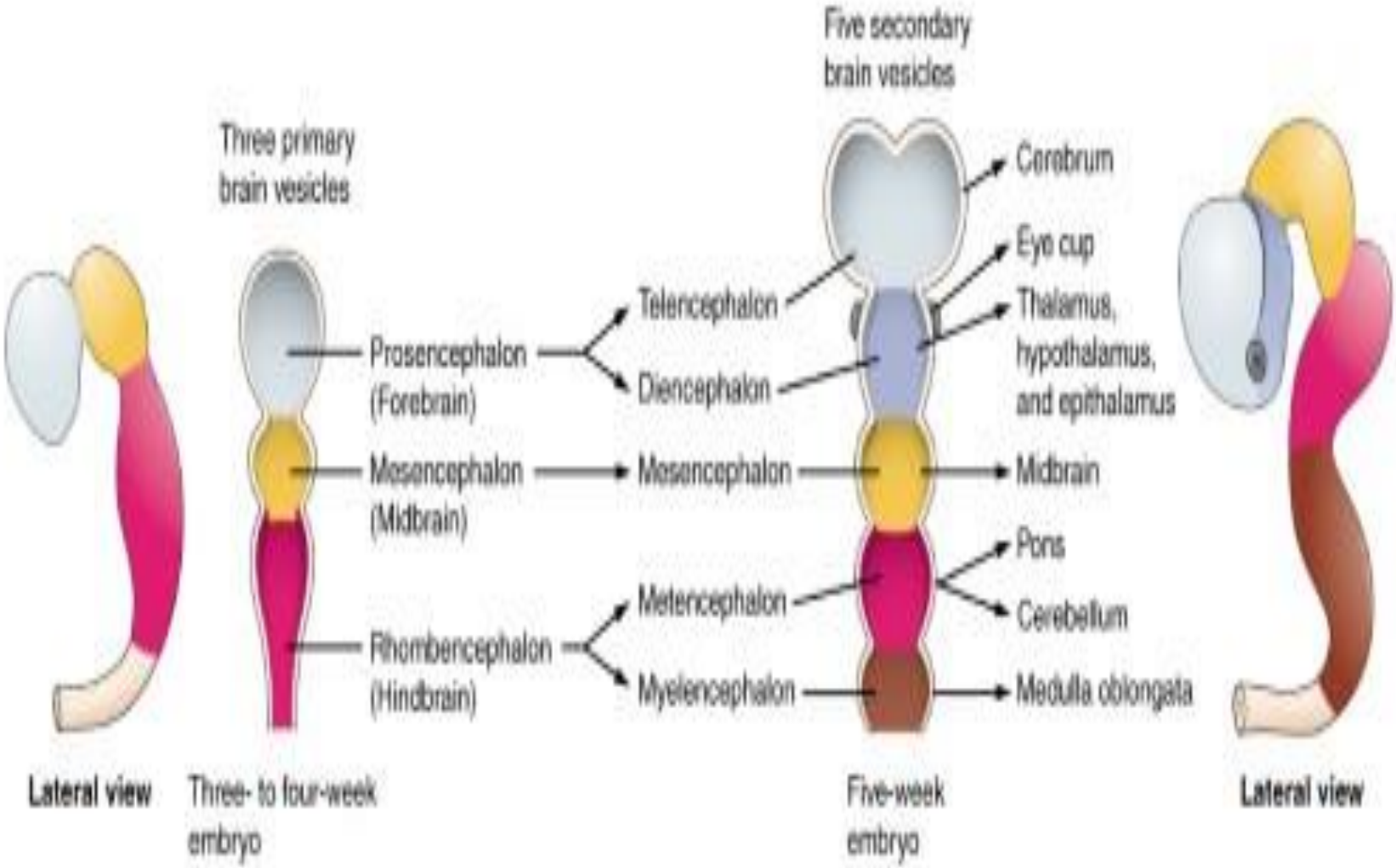
- **The epithelium and other tissues of the choroid plexus form an effective barrier between the blood and CSF.**
- **This barrier allows selective passage of substance from blood to CSF, but not in reverse direction.**
- **The arachnoid villi provide a valvular mechanism for flow of CSF into blood, without permitting back-flow of blood into the CSF.**

Brain Development

- Neural tube
- Three primary vesicles:
  - Forebrain (Prosencephalon)
  - Midbrain (Mesencephalon)
  - Hindbrain (Rhombencephalon)
- Five secondary vesicles:
  - Telencephalon
  - Diencephalon
  - Mesencephalon
  - Metencephalon
  - Myelencephalon






Three primary brain vesicles
Five secondary brain vesicles
Prosencephalon (Forebrain)
Mesencephalon (Midbrain)
Rhombencephalon (Hindbrain)
Telencephalon
Diencephalon
Mesencephalon
Metencephalon
Myelencephalon
Cerebrum
Eye cup
Thalamus, hypothalamus, and epithalamus
Midbrain
Pons
Cerebellum
Medulla oblongata
Lateral view
Three- to four-week embryo
Five-week embryo
Lateral view