FOURTH VENTRICLE AND CEREBRAL AQUEDUCT

LECTURE OUTLINE

At the end of the lecture, student should be able to;

• Name the ventricles of brain along with their location.
• Explain the structure and location of fourth ventricle.
• Explain the structure and location of cerebral aqueduct.
• Know the normal CSF secretion and circulation.
• Define the Blood brain barrier.
• Discuss the Applied anatomy of ventricles and CSF flow.

VENTRICLES OF BRAIN

• They are cavities within the brain.
• Irregularly shaped.
• Lined with ependymal cells.
• Four ventricles.
  • Lateral ventricle (each hemisphere).
  • Third ventricle (in diencephalon).
  • Cerebral aqueduct (in midbrain).
  • Fourth ventricle: (lies between pons, upper part of medulla and cerebellum, continuous with central canal of spinal cord).

[Diagram of brain with ventricles labeled]
The positions of the ventricles of the brain (in yellow) superimposed on its surface. Viewed from the left side.
CEREBROSPINAL FLUID

Surrounds and bathes the CNS

- Functions:
  1. Supporting of brain and spinal cord
  2. Transport of nutrients, chemical messengers, and waste products

THE FORMATION OF CSF

- Choroid plexus: contains specialized ependymal cells and capillaries (500ml/day), total volume: 150ml
- Choroid plexuses secrete CSF into ventricles

CIRCULATION:

- from choroid plexus to ventricles and central canal of spinal cord to subarachnoid space to sinuses
- CSF reaches subarachnoid space through two lateral apertures and single medial aperture in the 4th ventricle
- Arachnoid villi (granulations): penetrate dura mater meningeal layer of venous sinuses, CSF absorbed into the venous circulation

SECRETION AND CIRCULATION OF CSF
FOURTH VENTRICLE

- The fourth ventricle is a cavity which lies posterior to the pons and upper half of the medulla oblongata and anterior to the cerebellum.
- It is continuous with the cerebral aqueduct (mesencephalic or duct of Sylvius) above and the central canal of the spinal cord in the lower half of the medulla.
- On each side, a narrow prolongation, the lateral recess, projects around the brainstem; its lateral aperture (foramen of Luschka) lies below the cerebellar flocculus.

The fourth ventricle has

- lateral boundaries,
- a roof
- and a floor.
FOURTH VENTRICLE

The lateral boundaries

- are formed on each side by the superior cerebellar peduncle,
- the inferior cerebellar peduncle
- and the cuneate and gracile tubercles.

Roof of the fourth ventricle

- Formed by thin laminae of white matter.
- The lower has a median aperture (foramen of Magendie);
- cerebrospinal fluid escapes through this opening and lateral apertures into the subarachnoid space
- their blockage can produce one type of hydrocephalus.

FOURTH VENTRICLE

The floor of the fourth ventricle

- also known as rhomboid fossa,
  is formed by the dorsal surfaces of the pons and medulla oblongata.
**Floor of Fourth Ventricle, Posterior View**

1. Substantia ferruginea
2. Facial colliculus
3. Striae medullares
4. Vestibular area
5. Hypoglossal triangle
6. Vagal triangle
7. Calamus scriptorius

**FOURTH VENTRICLE, SAGITTAL SECTION, MEDIAL VIEW**

1. Superior medullary velum
2. Pons
3. Medulla oblongata
4. Pia mater
5. Ependyma
6. Choroid plexus

**CEREBRAL AQUEDUCT**

- The cerebral aqueduct is a narrow canal in the midline.
- Connects the third and fourth ventricle.
- It is 1.5 cm long and 1-2 mm, in diameter.
- Its floor is formed by the tegmentum of the midbrain.
- Its roof consists of the quadrigeminal body of the midbrain and posterior comissure.
TELA CHOROIDEA

- is a layer of pia mater of great vascularity which invaginates close to the median plane into the cavity of the fourth ventricle to form the choroid plexus of the fourth ventricle.
- Anatomic findings indicate that the average normal ventricular system has a capacity of less than 16 ml.

BLOOD-BRAIN BARRIER

- Endothelial cells connected by tight junctions
- Astrocytic endfeet surround brain microvessels.
- Only lipid soluble compounds diffuse through
- Water and ions: channels in apical and basal cell membranes
- Larger polar substances: by active transport
- Transport is selective between blood and brain, and between blood and spinal cord
  - Blood-brain barrier is intact throughout except:
  1. Portions of hypothalamus (hormones)
  2. Capillaries in posterior pituitary
  3. Capillaries in pineal gland
  4. Capillaries of choroid plexuses
**BLOOD-BRAIN BARRIER**

- Collectively, the blood vessels within the brain have a very large surface area that promotes the exchange of oxygen, carbon dioxide, amino acids, and sugars between blood and brain.

- The blood-CSF barrier is formed by active transport from the blood vessels to the brain. Epithelial cells of joined by tight junctions, form a continuous layer that selectively permits the passage of some substances but not others.

**APPLIED ANATOMY; HYDROCEPHALUS**

- *Hydrocephalus* also known as "water on the brain",

- is a medical condition in which there is an abnormal accumulation of cerebrospinal fluid (CSF) in the ventricles, or cavities, of the brain

- is caused by impaired cerebrospinal fluid (CSF) production, flow or reabsorption.

- The most common cause of hydrocephalus is a flow obstruction, hindering the free passage of cerebrospinal fluid through the ventricular system and subarachnoid space (e.g. stenosis of the cerebral aqueduct, obstruction of the interventricular foraminae - *foramen of Monro*). This can be secondary to tumors, hemorrhages, infections or congenital malformations. It can also be caused by overproduction of cerebrospinal fluid (relative obstruction).
TYPES OF HYDROCEPHALUS

• **OBSTRUCTIVE OR NON-COMMUNICATING** (OBSTRUCTION WITHIN THE VENTRICULAR SYSTEM) is caused by a CSF-flow obstruction ultimately preventing CSF from flowing into the subarachnoid space (either due to external compression or intraventricular mass lesions).

• **NON OBSTRUCTIVE OR COMMUNICATING** (MALFUNCTION OF ARACHNOID VILLI) is caused by impaired cerebrospinal fluid resorption in the absence of any CSF-flow obstruction between the ventricles and subarachnoid space.

NON-COMMUNICATING HYDROCEPHALUS
SELF ASSESSMENT

Q1. Name the ventricles marked as a, b, c and d.

SELF ASSESSMENT

• Q2. Give the location of fourth ventricle.
• Q3. Name the structure forming the floor of fourth ventricle.
• Q4. What is the normal flow of CSF?
• Q5. What is the clinical importance of CSF flow in ventricular system?
• Q6. Name and define types of hydrocephalus.