LATERAL VENTRICLE

NEUROANATOMY, & SURGICAL APPROACH

BY: ALI ADIL ALKAF AJI
Lateral ventricle are the largest cavities out of set of four interconnected cavities in the brain, where the cerebrospinal fluid (CSF) is produced.

Each lateral ventricle is a C-shaped cavity that wraps around the thalamus and is situated deep within the cerebrum.

Each lateral ventricle has five parts: the frontal, temporal, and occipital horns, the body, and the atrium.

Each of these five parts has medial and lateral walls, a roof, and a floor. In addition, the frontal and temporal horns and the atrium have anterior walls. These walls are formed predominantly by the thalamus, septum pellucidum, deep cerebral white matter, corpus callosum, and two C-shaped structures, the caudate nucleus and the fornix, that wrap around the thalamus.

It has neuronal relations with the following structures:

- Thalamus
- Caudate Nucleus
- Fornix
- Corpus Callosum
- Septum Pellucidum
1- **Frontal horn** extends from the foramen of Monro into the frontal lobe.
2- **Body** of the ventricle, extends from the foramen of Monro over the thalamus.
3- **Temporal horn**. Formed as the ventricles curves behind the thalamus in a lateral and inferior direction, and then anteriorly into the temporal lobe.
4- **Occipital horn** extends posteriorly from the junction of the body and the temporal horn.
5- **Atrium**, is a triangular expansion of the ventricle between the occipital and temporal horns.
Thalamus

- The thalamus is either of two masses of grey matter lying between the cerebral hemispheres located in the center of the lateral ventricle.
- Each lateral ventricle wraps around the superior, posterior, and inferior, surfaces of the thalamus.

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Thalamus relation to ventricular system
Caudate Nucleus

The caudate nucleus is an arched, C-shaped, cellular mass that wraps around the thalamus and constitutes an important part of the wall of the lateral ventricle. It has a head, body, and tail. The head bulges into the lateral wall of the frontal horn and body of the lateral ventricle. The body forms part of the lateral wall of the atrium, tail extends from the atrium into the roof of the temporal horn and is continuous with the amygdaloid nucleus near the anterior tip of the temporal horn.

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**Fornix:**
The fornix is another C-shaped structure that wraps around the thalamus in the wall of the ventricle. The fornix consists mainly of hippocampomamillary tract fibers that carry signals from the hippocampus to the mammillary bodies and then to the anterior nuclei of thalamus. Fornix begins in the hippocampus as a fimbria arises in the floor of the temporal horn on the ventricular surface and passes posteriorly to become the crus of the fornix. The crus wraps around the posterior surface of the pulvinar of the thalamus and arches superomedially toward the lower surface of the splenium of the corpus callosum.

At the junction of the atrium and the body of the lateral ventricle, the paired crura meet to form the body of the fornix, which runs forward along the superomedial border of the thalami in the medial wall of the body of the lateral ventricle. At the anterior margin of the thalamus the body of the fornix separates into two columns that arch along the superior and anterior margins of the foramen of Monro in their course toward the mammillary bodies.

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Corpus Callosum is a wide, flat bundle of neural fibers connects the left and right cerebral hemispheres and facilitates interhemispheric communication. It contributes to the wall of each of the five parts of the lateral ventricle.

The corpus callosum has two **anterior parts**: the rostrum and genu, a **central part**: the body, and a **posterior part**: the splenium. The rostrum is situated below and forms the floor of the frontal horn. The genu has a large bundle of fibers, the forceps minor, that forms the anterior wall of the frontal horn as it sweeps obliquely forward and lateral to connect the frontal lobes. The genu and the body of the corpus callosum form the roof of both the frontal horn and the body of the lateral ventricle. The splenium contains a large fiber tract, the forceps major, that forms wall of the atrium and occipital horn as it sweeps posteriorly to connect the occipital lobes. A nother fiber tract, the tapetum, which arises in the posterior part of the body and splenium of the corpus callosum, sweeps laterally and inferiorly to form the roof and lateral wall of the atrium and the temporal horn and occipital horn.
Septum Pellucidum

- is a thin, triangular, double membrane.
- It runs as a sheet from the corpus callosum down to the fornix.
- separates the frontal horns and bodies of the lateral ventricles in the midline.
- Attachment:
  - In the frontal horn: the septum pellucidum is attached to the rostrum of the corpus callosum below, the genu anteriorly, and the body superiorly.
  - In the body of the lateral ventricle: the septum is attached to the body of the corpus callosum above and the body of the fornix below.
- disappearing near the junction of the body and crura of the fornix where the crura and hippocampal commissure fuse with the lower surface of the corpus callosum.

### Neuronal Relation with Lateral Ventricle

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### Lateral Ventricle

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<th>Body</th>
<th>Antrum</th>
<th>Posterior horn</th>
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<tr>
<td>Septum Pellucidum</td>
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CHOROIDAL FISSURE AND CHOROID PLEXUS

- The choroidal fissure is the narrow C-shaped cleft between the fornix and the thalamus along which the choroid plexus (a network of ependymal cells involved in the production of CSF) is attached.
- extends in a C-shaped arc from the foramen of Monro around the superior, posterior, and inferior surfaces of the thalamus to its inferior termination, called the inferior choroidal point, which is located just behind the head of the hippocampus.
- The fornix forms the outer margin of the fissure, and the thalamus forms the inner margin.
- The choroidal arteries which enter the ventricles through the choroidal fissure supply the choroid plexus.
- The veins coursing in the walls of the ventricles exit the ventricles by passing through the margin of the choroidal fissure to reach the internal cerebral, basal, and great veins.
CHOROIDAL ARTERIES:

- The arteries most intimately related to the lateral ventricles.
- Are two main arteries, Anterior, and posterior, arise from the internal carotid and posterior cerebral arteries respectively.
- supply the choroid plexus in the lateral and third ventricles, as the followings:
  - **Anterior choroidal arteries**: supply a portion of the choroid plexus in the temporal horn and atrium.
  - **Posterior choroidal arteries**: divides into Lateral, and Medial branches to supply:
    - **Lateral**: supply a portion of the choroid plexus in the atrium, body, and posterior part of the temporal horn.
    - **Medial**: supply the choroid plexus in the part of that in the body of the lateral ventricle.
THE VENTRICULAR VEINS:

The ventricular veins are divided into **Medial** and **Lateral** groups based on whether they course through the thalamic or fornical side of the choroidal fissure:

- The lateral group passes through the thalamic or inner side of the fissure. And consist of Thalamostriate, Thalamocaudate, Posterior caudate veins, Lateral atrial veins.

**Drains:**
- **Lateral wall** of the frontal, temporal, and occipital horns, the body, and the atrium, the floor of the body.
- **Anterior wall** of the atrium, and the roof of the temporal horn.

- The medial group passes through the outer or fornical circumference of the fissure. Consist of the Posterior septal veins, Medial atrial veins.

**Drains:**
- Medial wall and roof of the frontal and occipital horns, body, and atrium and the floor of the temporal horn.
Part 2 : RadioAnatomy
Part 3: surgical Approach of lateral ventricle
LATERAL VENTRICULAR TUMORS:

Intraventricular neoplasms are rare and arise from periventricular structures such as the walls of the ventricular system, the septum pellucidum and the choroid plexus. Many tumour types arise from, or can bulge into the ventricular system, although there are certain lesions that are relatively restricted to ventricles, regardless of the type, the surgical approach remains the best to consider as long as no Contra indications are encountered, otherwise alternative procedures are preformed.
SURGICAL CONSIDERATIONS:

The lateral ventricle is among the most surgically inaccessible areas in the brain. Numerous operative approaches to the ventricles have been developed. The selection of the best operative approach is determined by the relationship of the lesion to the lateral ventricles and the structures involved, and the surgeon's experience.

Goals
• To completely or partially remove tumors of the lateral.
• Resolve obstructive hydrocephalus and symptoms of increased intracranial pressure (ICP) if present.

Alternate Procedures
• Radiation therapy
• Chemotherapy

Advantages
• Allows for curative and palliative removal of tumors of the lateral ventricles, resolution of hydrocephalus (present in nearly 50% of patients), management of increased ICP (present in nearly 20% of patients), and permits immediate decompression of any mass-related symptoms.

Contra indications
• High-risk medical patients or those with significant comorbidities should be strongly considered for radiation and/or chemotherapy treatment.

Preparation Preoperative Planning
• Careful history and physical exam are essential for the preoperative evaluation of patients.
• Patients over 50 years old or those with a history of pulmonary disease require a chest X-ray. Patients with known cardiac conditions, or men older than 50 and women older than 60, require preoperative electrocardiograms.
• Patients undergoing a posterior approach to a tumor of the occipital hom or atrium require formal visual field testing.
• Magnetic resonance imaging (MRI) is the preferred imaging modality because it provides the best detail of the anatomy of the tumor and domains involved.
NEURAL INCISIONS:

• It is impossible to reach the lateral and third ventricles without opening some neural structures
• Structures frequently encountered:
  frontal, parietal, or temporal lobes and the anterior or posterior part of the corpus callosum, displacement or division of the fornix, and, septum pellucidum.
• the sacrifice of other neural structures has produced variable results: varies between no deficit, and in others the deficit was transient or permanent or resulted in the loss of life.
  Callosal incisions have resulted in disorders of the interhemispheric transfer of information, Fornix Division of the on both sides may cause a memory loss.
The cerebral retraction, cortical incisions for the transventricular surgical approaches have caused convulsions, hemiplegia, mutism, and impairment of consciousness.
**OPERATIVE APPROACHES:**
The common operative approaches to the lateral ventricles are divided into anterior, posterior, and lateral approaches,

**The anterior approaches:**
- are the anterior transcallosal, anterior transcortical, and anterior frontal.
- directed to the frontal horn and body of the lateral ventricle.

**The posterior approaches:**
- are the posterior transcallosal, posterior transventricular, occipital transtentorial, and infratentorial supracerebellar
- are directed to the atrium and posterior third ventricle, and the inferior approaches are directed to the temporal horn.

**Lateral approaches**
- are the pterional, posterior frontotemporal, and subtemporal.
ANTERIOR TRANSCALLOSAL APPROACH:

- The anterior transcallosal approach is used for tumors of the **frontal horns** or the **midbody** of the lateral ventricles.
- The patient is prepped and placed in the supine position with the patient's head elevated to 30 degrees. An alternative position is the lateral position with the right side down, so that gravity will assist the retraction of the medial surface of the right cerebral hemisphere away from the right side of the falx.

Steps summery:
- A coronal skin incision is used to expose the bone flap. Burr holes are drilled on the contralateral side of the superior sagittal sinus so that the dural opening exposes the interhemispheric fissure.
- A small incision is made and the dura is opened medially at the superior sagittal sinus.
- Opening the arachnoid below the falx exposes the branches of the anterior cerebral arteries, which may cross the midline above the corpus callosum.
- The right and left cingulate gyri, which face each other, are separated to expose the corpus callosum and the pericallosal arteries, and retractors are carefully placed.
- The sectioning of the corpus callosum, which lies deep to the pericallosal arteries, must be done with great care. The incision in the corpus callosum must be 5 mm lateral to the midline, up to 2 cm in length, and extending anteriorly to the genu. The tumor is subsequently resected or debulked.
Anterior Transcallosal Approach

- Coronal Suture
- Superior Sagittal Sinus
- Cut edge of Callosum
- Foramen of Monro (F)
- Thalamus
- Choroid Plexus
- Septum pellucidum
- Falx
- Frontal Lobe
- Fornix
- Thalamus
- Bridging Vein
ANTERIOR TRANSCORTICAL APPROACH

- This approach, directed through the interhemispheric fissure and the anterior part of the corpus callosum, is suitable for lesions in the anterior part of the lateral ventricle and especially if the tumor is situated predominantly in the lateral ventricle on the side of the approach.
- With the patient in the supine position, the head is rotated slightly to the side opposite the frontal lobe through which the ventricle is to be approached.
- The scalp and bone flaps are positioned over the central part of the middle frontal gyrus of the nondominant hemisphere.
- The dominant hemisphere is selected only if there is a major extension of the tumor into the lateral ventricle of the dominant hemisphere. If the approach is through the dominant hemisphere, care is taken to place the cortical incision above and anterior to the expressive speech centers on the inferior frontal gyrus and anterior to the precentral motor strip. The dilated frontal horn is reached through a small cortical incision located in the long axis of the middle frontal gyrus.
Anterior Transcortical Approach
POSTERIOR APPROACHES:

- The approaches suitable for lesions in the posterior part of the lateral ventricles.
- The posterior transcortical and transcallosal approaches are best suited to atrial lesions, but may be used for selected lesions that involve the medial wall of the atrium.
- Lesions situated entirely within the atrium and posterior part of the body of the lateral ventricle are best exposed using the posterior transcortical approach. Selected lesions may be exposed by the posterior transcallosal or occipital interhemispheric approaches.
  - The transcallosal approach is considered if the lesion involves the splenium of the corpus callosum and extends into the lateral ventricle from the roof or the upper part of the medial wall of the atrium.
  - The occipital approach directed along the occipital pole and interhemispheric fissure would be used if a lesion involving the medial wall of the wall of the atrium extended into the third ventricle.
**POSTERIOR TRANSCORTICAL APPROACH:**

- This approach, directed through a cortical incision in the superior parietal lobule, exposes the interior of the atrium and the posterior part of the body and may be the preferred approach for a lesion situated entirely within the atrium, or arising in the glomus of the choroid plexus.
- The patient is positioned in the three-quarter prone position with the face turned toward the floor so as to place the parietal area to be operated uppermost. A high posterior parietal bone flap, centered behind the postcentral gyrus over the superior parietal lobule, is elevated.
- The cortex is incised in the long axis of the superior parietal lobule in the region behind the postcentral gyrus, preferably in a sulcus crossing the lobule. This cortical incision avoids the visual pathways traversing the parietal lobe and the speech areas at the junction of the parietal and temporal lobes.
- The lateral ventricle is entered above the junction of the body and atrium
- This approach will expose the bulb of the corpus callosum in the medial wall, the pulvinar in the anterior wall, and the collateral trigone in the floor
- The retraction should be carefully applied, Retraction of the pulvinar should be minimized to prevent language and speech disturbances in the dominant hemisphere, because the pulvinar is the main site of origin of the thalamic fibers to the association cortex and the junction of the parietal, temporal, and occipital lobes that are involved in speech and vision.
Posterior Transcortical Approach
POSTERIOR TRANSCALLOSAL APPROACH:

- This approach is best suited to lesions that extend upward from the atrium or third ventricle through the posterior part of the splenium or that arise in the splenium and extend into the atrium and third ventricle.
- Although, the operation is commonly performed in the three-quarter prone position with the parietal region to be operated uppermost, a better alternative with some lesions is to place the side of the approach downward so that the medial surface of the hemisphere will fall away from the falx, thus reducing the need for retraction.
- The parieto-occipital scalp flap and the craniotomy extend to or across the superior sagittal sinus and have their anterior margin behind the postcentral gyrus and vein. The dura is reflected toward the sagittal sinus. Usually, no more than one vein entering the superior sagittal sinus behind the postcentral gyrus is divided so that the medial surface of the hemisphere may be retracted away from the falx.
- Opening the arachnoid below the falx The posterior part of the corpus callosum is incised in the midline.
Posterior Transcallosal Approach
Case 1
Diagnosis: Glioma (malignant oligodendroglioma) of the lateral ventricles and the septum pellucidum
Approach: Transcallosal
Position: Supine, head turned laterally
The patient is placed supine, with head turned horizontally and elevated approximately 30 degrees. The midline and scalp incision are outlined.
Case 2
Diagnosis: Intraventricular meningioma
Approach: Transcallosal
Case 2
Diagnosis: Intraventricular meningioma
Approach: Transcallosal
THANK YOU FOR YOUR ATTENTION