CNS ANATOMY DOCTOR NOTES

LECTURE NO. 4 WRITTEN BY: Layan Abu Arja & Shahd Alahmad REVIEWED BY: Ismail Alardah In this lecture we are going to discuss the **ventricular system** part one, and in the next lecture we will complete the second part. Make sure to understand every single point because not less than 5 questions in the exam will come from these 2 lectures.

At the end of the lecture, you should be able to identify the different communications, and how the CSF does these communications.

In order to understand this lecture, you should have studied the basal nuclei very well, since most of the communications are related to it.

So in general the basal nuclei consist of caudate nucleus, lentiform nucleus, amygdala, substantia nigra inside the midbrain, subthalamic nucleus, and finally the claustrum.

4.1 The Caudate Nucleus:

So let us start with this image to see the details of the basal nuclei. The most important part of the basal nucleus is the caudate nucleus (in red), this large comma-shaped nucleus, it starts from the anterior then runs through the posterior, it is formed of head(1), body(2), tail(5).

Where is exactly this head located in the brain? The head is inside the frontal lobe . The curve of th e body is in the parietal lobe . The tail is in front of the occipital lobe so the dashed green line represents the occipital lobe, the curved tail locates posterior to the caudate nucleus, the rest part of the tail will appear again in the temporal lobe. The tail is joined with the **amygdala(8)**.

The anterior part of the **lentiform nucleus** is fused with the caudate nucleus, it is divided into **outer part** called **putamen(4)**, and **inner part** called **Globus pallidus** which is divided into internal(7) and external(6) segments.

The lentiform bridges(3) are striations of gray matter that connect between the putamen and the caudate nucleus. As we mentioned previously the corpus striatum has a striated appearance look because the internal capsule fibers appear between the caudate nucleus and lentiform nucleus, so the **dark**

gray matter of the basal nuclei, and then the **white matter** of the anterior limb of the internal capsule, and then the **dark** gray matter of the lentiform nucleus are all interconnected.

In the anterior part we can see the **nucleus accumbens** (highlighted in yellow), it has the reward center.





Figure (2): Extra

4.2 The Ventricular System:

Two lateral ventricles(in red) are located in the right and left hemispheres (one in the left and the other in the right, or vice versa it doesn't matter). **The third one** is between the right and left thalamus (in black), which is seen in coronal and horizontal sections. **The fourth one** is between the cerebellum and the back of the pons and open medulla.

There is a connection between the lateral and third ventricle called **the inter-ventricular foramen (IVF).**

A canal called **cerebral aqueduct** that runs in the midbrain connects between the third ventricle which opens into the 4th ventricle.

The CSF, runs from the 4th ventricle downward toward the central canal of the spinal cord in a circular motion. Actually, the CSF circulates around the brain and the spinal cord, this movement happens inside the sub-arachnoid space. When the CSF leaves the 4th ventricle's roof through 3 foramina; in the middle **foramen Magendie**, while in the lateral there are 2 openings called **foramina of Luschka**. This loop happens twice to three times a day in which the CSF is produced and reabsorbed.

4.3 The Lateral Ventricular System:

In the whole ventricular system we are going to focus on the sagittal section with either the horizontal or coronal section. In the coronal section we cut superiorly down to the inferior surface. In the horizontal section we cut anteroposteriorly. In the sagittal section we cut from the center. Today we will focus on the coronal section.

Anterior horn inside the frontal lobe, posterior horn inside the occipital lobe, Inferior horn inside the temporal lobe, the body inside the parietal lobe and the trigon (triangular in shape) which is shaped because of these parts' intersection.

After the age of 40, mainly the trigon will be covered by a white lesion can be seen in the MRI or the ICT, this is because of the calcification that happens <u>normally (not pathological)</u> in this part inside all the ventricles, since each one has a choroid plexus (capillaries) that produces the CSF.



Figure (4): The whole brain

These choroid plexuses are derived from the blood

vessels that supply the brain (e.g: Anterior choroidal **not a specific section** vessel comes from the internal carotid artery, posterior choroidal vessel comes from the posterior cerebral artery).

A barrier separates the CSF (Brain CSF Barrier) that is secreted by theses vessels from the blood there

(Blood Brain Barrier). Note that the extra information about these barriers on the last slides are not included in exam, they are just for our information

Ventricular System, The Cerebrospinal Fluid, and the Blood Brain Barrier

Figure (3)

Figure (5) represents <u>a sagittal section</u>. 1.Corpus callosum 2.The fornix, below the fornix we can see a v.imp foramen (might be an exam question) called the **interventricular foramen**, it is a connection between the lateral ventricle and the 3^{rd} ventricle (the CSF comes from it then goes to the 3^{rd} ventricle). A past paper question was about this information: the interventricular foramen lies **between the anterior end of the thalamus and the anterior column of the fornix**.

An **imaginary line** should be drawn from the interventricular foramen toward the corpus callosum to identify the structures there. **In front** to it we have the anterior horn, **behind** we can see the body of the lateral ventricle. The rest parts can't be seen here in the sagittal section. Actually, the whole cavity can't be seen here till we remove the **cover** which is the **septum pellucidum**.

Figure (6) represents a <u>horizontal section</u>. As we said before, by measuring the distance behind the **splenium**(in orange) which is longer than the distance in front to the **genu**(in pink), we will be able to differentiate between the anterior short part from the posterior long part.

The cavity that is labeled as (1) in green represents the **anterior horn** of the lateral ventricle, while the one that is labeled in red represents the **posterior horn** of the lateral ventricle, lastly the blue one represents the **inferior horn** of the lateral ventricle that is located in the temporal lobe.

We can see the **choroid plexus** (in yellow), these fibers are covered by 2 layers of pia matter.

Fibers that connect different parts of the cerebral hemisphere (occipital, parietal and temporal lobes) are called **tabetum of the corpus callosum**.

Figure (7) represents a <u>horizontal section</u> that is taken between the lower part of the occipital lobe and the upper

part of the temporal lobe. Note that the blue arrow represents a structure that isn't constant in any section, this structure is called the **cavity of the septum pellucidum**. Number 8 represents part of a structure that is located between two cerebral hemispheres posteriorly, and has the vermis inside, which is the **cerebellum**.





Figure (6)



Figure (7)

4.4 The Body Of The Lateral Ventricle:

Anatomical Relations: Let's begin with the body of the lateral ventricle, which is one of its major parts. To fully understand its anatomical relations, we will analyze both the <u>coronal and sagittal sections</u>.

Sagittal Section:

•The body of the lateral ventricle is located behind the Imaginary line that separates it from the frontal horn.

•It is the central portion of the ventricle, labeled as "body"

in anatomical diagrams.





Boundaries of the Body of the Lateral Ventricle in the sagittal section:

- **Roof:** The body of the **corpus callosum**, specifically its **splenium**, forms the superior boundary.(in green)
- Floor: If we imagine standing inside the cavity of the lateral ventricle:

o One "foot" would rest on the **caudate nucleus**, while the other would stand on the **thalamus**.

o The **caudate nucleus body** runs along the **lateral wall**, while the thalamus is positioned more **medially**. (both in floor but with different sites there). The groove between them contains the **stria terminalis**, an important pathway in the limbic system, , that connects the amygdala to the hypothalamus. - Dr tells you don't have to remember much details about it -

Coronal Section:

To visualize the coronal section, we must cut through the body of the lateral ventricle (in red) at a specific level. <u>This section helps correlate our understanding of the ventricle's relationships with surrounding structures</u>, So we will take it in **parietal level**.

• The coronal section can be taken at different lobes of the brain: the frontal, parietal, occipital, or temporal.

- If we take a section at the parietal lobe, we must connect it to the temporal lobe as well.
- In this section, we see the cavity of the lateral ventricle, which represents its body.

Boundaries of the Body of the Lateral Ventricle in the Coronal Section:

- Roof: The body of the corpus callosum. (in green)
- Floor:

o The **body of the thalamus** (in orange)(though the thalamus does not technically have a "body," this term used by the Dr just to make it more easy). o The **body of the caudate nucleus** (in blue), which runs along the **lateral aspect**.

o The **stria terminalis** (in black), a <u>limbic system</u> <u>pathway</u> that may also be visible here.



Figure (9)

4.5 Medial Wall Of The Lateral Ventricle:

To fully understand the medial wall, we return to the sagittal section:

• The medial wall of the lateral ventricle is covered by the septum pellucidum.

• The septum pellucidum serves as a partition between the two lateral ventricles and is attached to both the fornix and the corpus callosum.

• A portion of the body of the fornix also contributes to the medial wall.

Thus, in the coronal section, we see: **1. Septum pellucidum** in the medial wall. **2. Body of the fornix** positioned beneath it.

By integrating both sections, we now have a complete understanding of the anatomical relations of it.

4.6 Shadow In The Lateral Ventricle:

• A visible shadow inside the cavity of the lateral ventricle represents an important structure. This shadow **curves and connects to the roof of the inferior horn of the lateral ventricle**.

- The caudate nucleus follows this pathway and is related to:
 - o The anterior horn of the lateral ventricle.
 - o The body of the lateral ventricle.
 - o The tail, which extends into the temporal lobe, where it will be in the roof of the inferior horn.



Figure (10)

4.7 Anterior Horn Of The Lateral Ventricle:

• To examine its <u>coronal section</u> of **anterior horn** (in orange), the cut must pass through the <u>frontal lobe</u>.

• If targeting the **body**, the coronal section passes through the **parietal lobe**.

Boundaries in the Coronal Section: refer to figures 10,11

• **Roof:** The **corpus callosum**, specifically its **genu** (since the cut is anterior). (in blue)

• Floor: The head of the caudate nucleus (in green), which also forms the floor of the anterior horn of the lateral ventricle.

• Medial Wall: Septum pellucidum (in red), rostrum of the corpus callosum, and anterior column of the fornix.



Figure (11)

Understanding these relations makes it easier to visualize the lateral ventricle's anatomical positioning.

4.8 Relations Of The Occipital Horn:

The **occipital horn** is located within the **occipital lobe**. To better understand its relations, let's examine a <u>coronal</u> <u>section</u>.

The **medial wall** (in black in figure 12) is of particular importance in the posterior horn, along with the **floor**.

Structures forming the <u>medial wall</u> include: **1. Bulb of the Corpus Callosum,** the **splenium** (in blue) of the corpus callosum extends into the medial wall, creating a noticeable elevation known as the bulb of the splenium.

2. Calcarine Fissure (in green). Adjacent to the bulb is the calcarine fissure, which is closely associated with visual area 17. This fissure plays a crucial role in separating parts of the primary visual cortex.

- Above the fissure: The cuneus
- Below the fissure: The lingual gyrus. This anatomical arrangement has functional significance.

For instance, a **lesion** in the cuneus results in **contralateral inferior quadrant anopia**, meaning vision loss in the lower quarter of the opposite visual field. * as you remember from prev. lecs * The calcarine also pushes inward into the substance of the medial wall of the lateral ventricle, particularly in the posterior portion making (Calcar avis).

(Calcar avis) This term refers to the elevation near the calcarine fissure.

The calcarine fissure and its related elevation are situated on the <u>medial wall</u> of the lateral ventricle, specifically in the <u>occipital region</u>. * might be an exam question*

Tapetum

• Splenium of the Corpus Callosum

o The splenium of the corpus callosum is located at the midline and i responsible for arching over to connect the hemispheres of the brain.

• Forceps Major

o The fibers emerging from the splenium form the forceps major (in red), which connects with other fibers called the "tapetum" (in green).

o The tapetum contributes to the **<u>roof and lateral walls</u>** of the latera ventricle, particularly in the **posterior and inferior walls**.

4.9 Temporal Lobe and Inferior Horn:

• Structures in the Roof :

o The caudate nucleus plays a role in the roof of the inferior horn of the lateral ventricle. Specifically, **the tail of the caudate nucleus** is located here.

o **The amygdala** is another important structure related to the caudate tail and is found near the roof of the inferior horn.

• Structures in the Floor:

o The inferior hom lies within the temporal lobe and contains several structures, including:

• Hippocampus: Positioned in the floor of the inferior horn.

• **Collateral Eminence**: Adjacent to the hippocampus, <u>this structure is notable for its proximity to</u> <u>the collateral sulcus</u>.





Before continuing, let's remember Temporal Lobe Structures:

• Tentorial Surface : The tentorial surface of the temporal lobe is divided into three distinct gyri:

- 1. Medial Gyrus: Known as the parahippocampal gyrus.
- 2. Lateral Gyrus: Divided into medial occipitotemporal and lateral occipitotemporal.

•Lateral wall: Tapetum of corpus callosum

4.10 The Choroid Plexus:

• Definition:

o The choroid plexus consists of capillary tufts and is responsible for the production of cerebrospinal fluid "CSF" within the ventricles.

• Location:

o In the lateral ventricle, the choroid plexus is primarily located in the **body** and **inferior horn** and trigone. refer to figure (12) the orange structure. .. it Projects into the choroid fissure

• Arterial Supply:

o The choroid plexus is supplied by the anterior choroidal artery to inf. horn (from the internal carotid artery) and the posterior choroidal artery to body (from the posterior cerebral artery).

The Choroid Fissure: * might come in lab questions*

o It marks the boundary between the thalamus (below) and the fornix (above). refer to figure (10) the green structure.

Function: The choroid fissure accumulates and directs the flow of CSF into the lateral ventricle

CSF Flow and Ventricular System:

• CSF Movement: CSF produced by the choroid plexus in the medial wall of the lateral ventricles & the roof of the 3rd & 4th ventricles. CSF leaves the lateral ventricle through interventricular foramen to the 3rd ventricle then to the 4th ventricle through cerebral aqueduct of midbrain & leaves the 4th ventricle through its 3 apertures to the subarachnoid space forming a water cushion to protect the brain & spinal cord.

Let's review all relations :))

Part	Roof	Floor	Medial Wall	Lateral Wall
Body	Body of the corpus callosum	 Body of the caudate nucleus Body of the thalamus Stria terminalis (groove between) 	- Septum pellucidum - Body of the fornix	-
Anterior Horn	Genu of the corpus callosum	Head of the caudate nucleus	 Septum pellucidum Rostrum of corpus callosum Anterior column of the fornix 	-
Posterior Horn	Tapetum of the corpus callosum *note: Roof and lateral wall are mentioned together so they have same relation	-	- Bulb of the posterior horn (splenium of corpus callosum) - Calcar avis (from calcarine sulcus)	-Tapetum of corpus callosum - Optic radiation *dr didn't mention it though written in slides*
Inferior Horn	- Tail of the caudate nucleus - Amygdala	- Hippocampus (medially) - Collateral eminence (laterally)	-	-Tapetum of corpus callosum - Optic radiation

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