Neural Science for Engineers
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Lecture - 20
Brain Anatomty 3D - II

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So, reiterating where I stopped. So, two thalami interthalamic adhesion anterior pointed part, posterior flattened part, flattened part is pulvinar. So, there is a small space between the two thalami and that actually communicates with the aqueduct of sylvius ok. So, we will see how it progresses from here on.

The next part of the structure is something called as caudate nucleus now caudate nucleus is C shaped. So, it is not only big, it has got its own parts. So, it is the parts which are important and so, we have a caudate head then there is a body, and then there is a tail.

The tail is small thin ok. See remember these are deep structures within the head not something which is very obvious a bit of cartoonish for the sake of understanding and slightly maybe I think it's fairly big it is an alien head. So, you have to excuse me for that for the purpose of understanding.

Now, the caudate head actually drapes around the thalamus and then goes all the way down across the thalamus to the anterior and lateral. See, remember I was telling about what the importance is of knowing the coordinate system. When it reaches there it ends up in another structure called as the amygdala.

The amygdala is a fairly large nucleus. So, these are examples of deep gray right. So, now, we have realized that the caudate head is there, caudate body is there and the caudate tail is there. This is a bit too big, but the rest of it is in fairly in proportion to the caudate.

And so, the caudate head and amygdala now you can make out a fairly near to each other. It is lateral this is lateral and that is the way. So, where is another space building up there is a space which is building up between the caudate and the thalamus. So, there was a space between the two thalamus, there is a space between the caudate and the thalamus.

So, one side caudate over other side caudate. These are grey structures. So, they predominantly consist of nuclei and not white fibres which are basically the axons. So, one more caudate nucleus ready. So, caudate nucleus ready on the surface then it is going anteriorly what next is required is the amygdala on this side.

So, we put the amygdala over here lateral close to the caudate head from the front. So, what is happened? So, this is the way in which this structures become. Now I need to increase the size of the caudate head because the next part of the story requires a little more space. So, C shaped structure surrounding the thalamus is the caudate.

Now, the caudate has so, much of space developing in between the caudate and the thalamus. So, we initially saw only space between the thalamus. Now we are seeing space in between the caudate thalamus versus caudate thalamus on the opposite side.

Now these spaces when enclosed by the copper thalamus which we had to see form the ventricles. So, the space between the two thalamus is the third ventricle the third ventricle communicates with the aqueduct in the prior discussion. So, aqueduct is in the midbrain, opens into the third ventricle posterior surface and CSF from the third ventricle goes into aqueduct fourth ventricle and the foramen of Luschka and Magendie; so, that is clear.

So, what all we have replicated? We have replicated three deep structures and how they are rolled across each other and how they are related to each other and how they are connected to each other. Now, the third and most important structure is the next important structure is something called as the hippocampus.

Now hippocampus is tricky because not only is it similar to having a head body and tail as the caudate, but hippocampus is something like the it is like the memory generating center of the brain. We do cut out hippocampi of patients. What is necessary is to understand, head body tail then it thins out further becomes something called as the fornix and the fornix in turn goes somewhere else.

So, first we will start with the assembly, complex assembly because now we had introduced the amygdala earlier. So, the head of the hippocampus is closely related to the amygdala goes along the medially, on the roof midline of the lateral ventricle and then rolls anteriorly. So, that is the picture. So, the hippocampus is more lateral, it is in relation to the amygdala, this region is called as the ankus and its part of the temporal lobe.

So, all of this is deep gray, this is temporal lobe within the temporal lobe is the hippocampus. There is space in above the hippocampus which is within the temporal lobe as opposed to the thalamus which is completely within the central brain. Now the space around the hippocampus constitutes the temporal horn.

Now temporal horn is thus in relation to the hippocampus, it goes around behind the hippocampus and forms the atrium and through the atrium comes anteriorly. Now, what happens anteriorly is something which I think I will have to break down this stuff. So, we see that the phonics is formed here. So, this is hippocampus cut in the midline endothalamic adhesion, thalamus.

So, comes to the midline it creates an opening over here. So, the opening is important because that opening is the opening is the foramen of monro, exaggerated views. So, this actually curves down and goes into something called as the mammillary bodies.

So, this is mammillary body here one side remember this is one side, I have cut the stuff to showcase this foramen of Monro. Foramen of Monro is actually formed here like this. So, that is because the fornix which was which is in the temporal horn goes to the surface

of the thalamus then again comes to the midline. Remember it is medial to the caudate head which is this side.

So, when it comes central towards the center it is in the center arcs over and then dips back front. So, when it dips back front it creates an opening and that opening is the foramen of Monro. Now remember when I discussed earlier, I was telling that the caudate head and the thalamus are in the lateral ventricle. So, the lateral ventricle is this here, this is exaggerated. So, the lateral ventricle is this, foramen of Monro is here and this forms the fornix which is an out port of the hippocampus.

So, hippocampus in the temporal horn goes over the posterior surface of the thalamus ,goes to the midline forms fornix, arcs around to form a opening which is the foramen of Monro and then goes and meets something called as the mammillary bodies which is seen from the base.

So, there are basically these three structures which form this complex anatomy. So, when you see these structures on imaging, when you see these structures on any other dissection it is almost impossible to identify how these things are connected to each other. Takes a lot of reading to comprehend this stuff which is why I thought that I am showing it through a very different technique.

So, the different technique ensures that you understand these as separate entities and these separate entities are interlinked like that. So, that is now one very complex stuff. So, what this build shows is how the thalamus, caudate and the hippocampus are crisscrossing structures across the thalamus and how these are responsible for forming structures within the third ventricle and the foramen of Monro.

So, these this forms the complex anatomy surrounding the ventricle. There are so many structures, but topologically they are very simple. So, topologically this is just about it, there are two three structures they go around and that is about it. Why these things are like this god knows? So, now, we finished set of entities.

Now, if you look at this space between the head of the thalamus and the caudate head you would find that there is a pyramidal space which is over there. So, this is the space which is generated between the caudate head, thalamus and lower part of course, the

amygdala which is just about there. So, there is some space over here. Now this is the location of what we call as the internal capsule.

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So, internal capsule is a set of fibers which sort of come together from various parts of the brain and then converge on to the cerebral peduncle which had earlier highlighted in my midbrain. So, the midbrain, these two peduncles are formed of fibers which are over here. Now these fibers are between into this cavity. So, this cavity is between caudate head and the thalamus and then they form a V shaped structure over here.

So, this forms the basis of the formation of the internal capsule. So, this set of white fibers which go across from top to bottom. So, I think I need to clarify it once more, the anatomy is complex. So, this is superior, inferior, temporal lobe is here now this is the deeper structures thalamus, caudate head here, lower down is the hippocampus.

Hippocampus is going towards midline this is towards midline, forms the phonics and the foramen of monro and goes into the mammillary body, laterally we have this space. So, this space is occupied by another structure. So, that structure forms the lentiform nucleus.

So, that is almost a pyramid because you have an apex you have a base, and you have something in the junction between the chordate head and the thalamus. So, if you look at MRI imaging, you would find that the lentiform nucleus is an outer smooth surface and

then you have a triangular pouching on the medial surface. Medial is towards center remember.

And this triangular portion sort of impinges onto this area. So, and the lower half actually is in relation to the amygdale. And so, that forms the outer margin of the central gray of the one half of the brain. So, this is how the structure is, if you look at the internal capsule.

So, this would form the structure. So, the internal capsule goes in through this central gray, it is in between the lentiform nucleus. The lentiform nucleus and the inner part is called globus pallidus.

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So, we would go through this through imaging also to clarify the structures. So, these things form the central gray, this is the organization of the central gray. I will reiterate the whole stuff back again because; obviously, I am pretty sure with all the clay around I do not know how many of you would have actually understood anything, but it is easy to reconstruct the whole stuff.

So, this time we will go from outside to inside which makes it different. So, there is an outer entity called lentiform nucleus, towards the center of it is the globus pallidus. So, globus pallidus, centre smooth outside, this is anterior, this is posterior. Now somewhere

here is the amygdala closely associated with it, closely associated with anterior inferiorly.

Now amygdala forms the roof of the temporal horn. Temporal horn is the part of the lateral ventricle, which is the CSF containing space within the brain, ventricle is CSF containing space within the brain. So, lentiform nucleus lower part anterior inferiorly connected to amygdala, centrally is the globus pallidus externa and interna which are two parts of this.

So, there are two spaces over here. So, one space is the thalamus. So, we are doing this part of the build again. So, the build starts from outside to inside. So, I am starting from the lentiform nucleus, globus pallidus in the centre. So, the globus pallidus which is a pyramid and this whole thing is a pyramid results in two areas front and back towards the back we can place the thalamus.

Now, the remaining area is to be covered with the caudate head. So, caudate head is big, tubular and it tapers to the body, there is a caudate body, and then there is a tail. So, caudate head goes back. So, that goes like that on the surface of the thalamus and goes on like that and goes up to the region of the amygdala, very close to the amygdala it sort of apparently communicates with the amygdala.

So, the junction between the lentiform and the caudate is where the internal capsule fibers come out. So, reiterating superior, inferior, medial, lateral; lateral is away from midline, medial is towards midline. So, this junction between this cavity between the caudate head and the lentiform nucleus and the thalamus is the place where the internal capsule fibres go all the way up to the midbrain.

Now, this surface between the caudate head and the thalamus is the surface of the lateral ventricle. Now the third structure which needs to be built is the hippocampus. So, hippocampus again it is in relation to amygdala, because the hippocampus has a head body and tail again. So, hippocampus in relation to amygdala and it goes medial. So, medial as in towards midline.

Now, remember hippocampus is not in association with the other parts of these structures, the hippocampus is in the temporal horn which is in the temporal lobe;

whereas, this is in the main part of the cerebrum. So, frontal lobe and the deep part of the frontal lobe and the parietal lobe.

So, hippocampus curves around the thalamus, again medial to this one. Forms a tubular structure called fornix. Tubular structure called fornix, loops back over the front of the thalamus in the bargain separating the lateral ventricle which is over here and the third ventricle which is in between the two thalami, creating a hole creating a hole which is called the foramen of Monro, which connects between the lateral ventricle and the third ventricle.

So, that describes the central gray. So, this is the complex anatomy of the central gray. The caudate head along with the lentiform in general is called as a basal ganglia. So, basal ganglia has several important functions we will deal with that later the thalamus as I told you it is a relay station for all signals going to and fro from the cortex that is from the cerebrum down to the brain stem to the spinal cord to the periphery and all things and it is a relay station this is also responsible for consciousness.

So, this constitutes the description of the various entities called as central gray. Now what we will proceed on is the next discussion; I think I will take a break over here because I have to prepare this stuff.