CENTRAL NERVOUS SYSTEM

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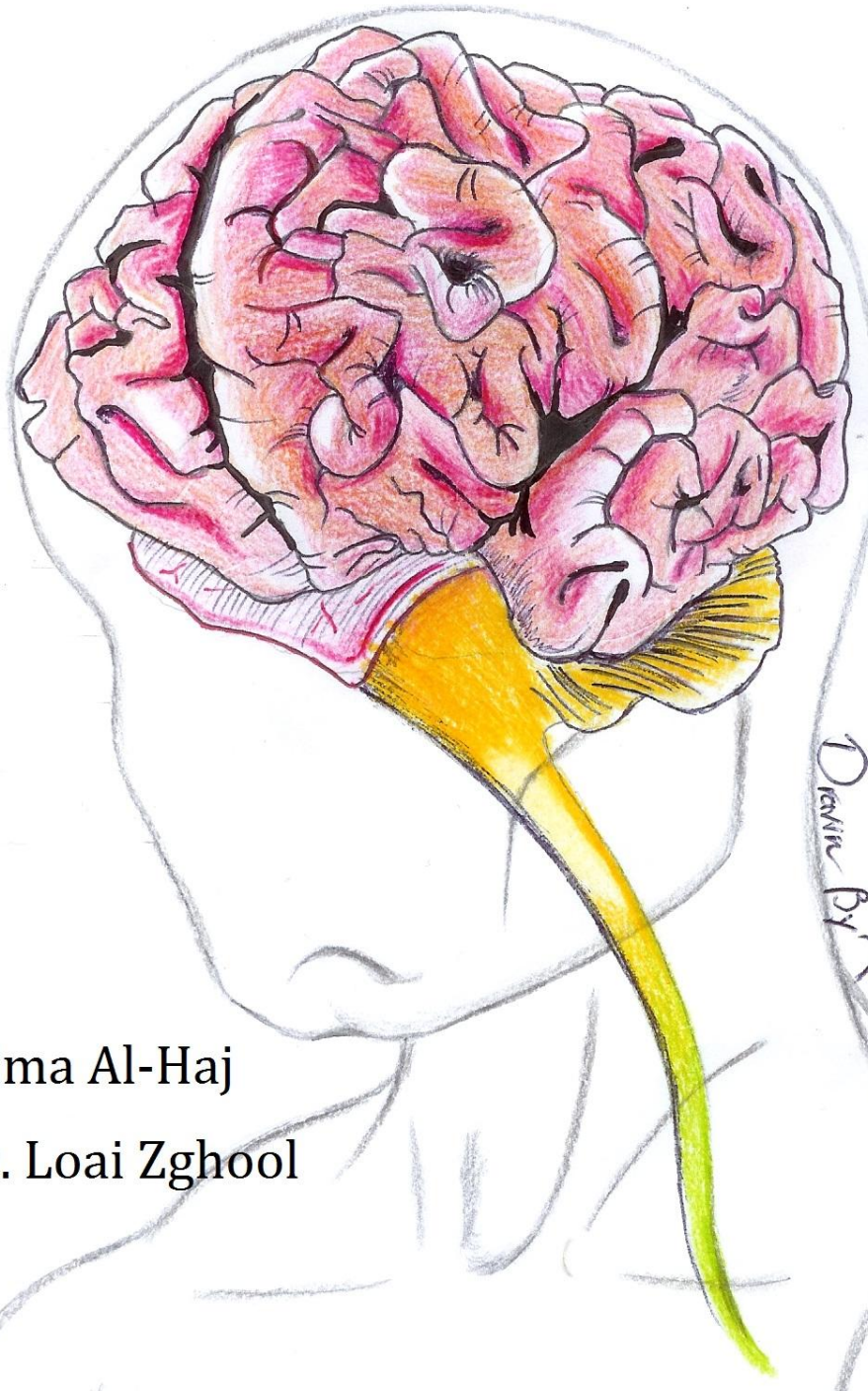

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Lec #: 16

Visual pathway

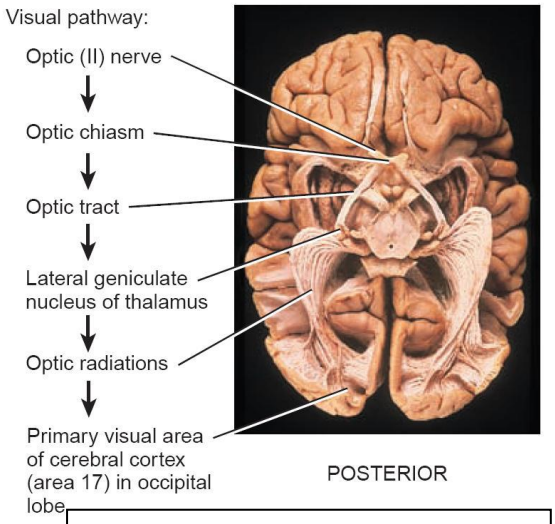
I wrote this sheet according to section 2 record

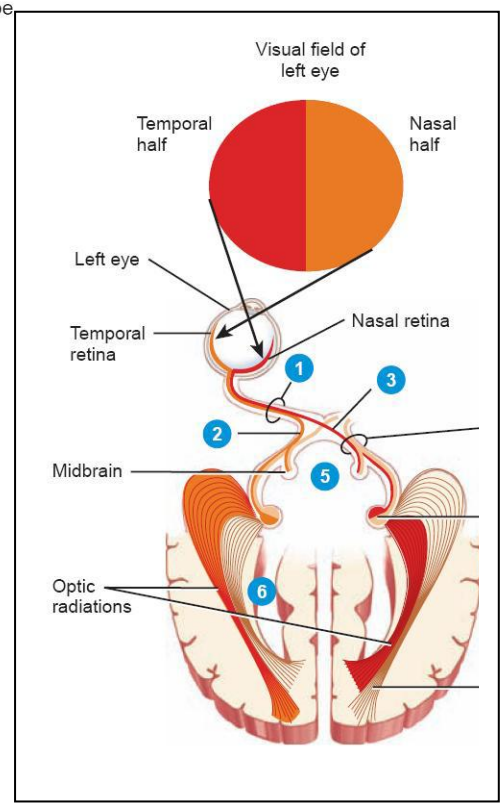
Vision transmits the information from eye , we have nerve cells that transmit the information to CNS, axons of the ganglion cells form the optic nerve which goes to cortex ,but it has to pass through the thalamus before .

In the thalamus it has to go to specific nuclei which is the lateral geniculate nucleus , from the thalamus it continues to the occipital lobe of the cortex which contains the primary visual area (17) around the calcarine sulcus .

The sensations from the right side of the body usually go to left side of the cortex , so the vision makes sense that what I see in right side, the left brain is responsible about it and which I see in the left side go to right cortex.

The eye is spherical in shape , notice that each eye has to see right and left so there are two parts; nasal part see same side of the eye (the left nasal is to see the left part of the visual field) so it has to cross , while the temporal part of the eye is to see from other side of the visual field and it stays at the same side of cortex and does not cross .





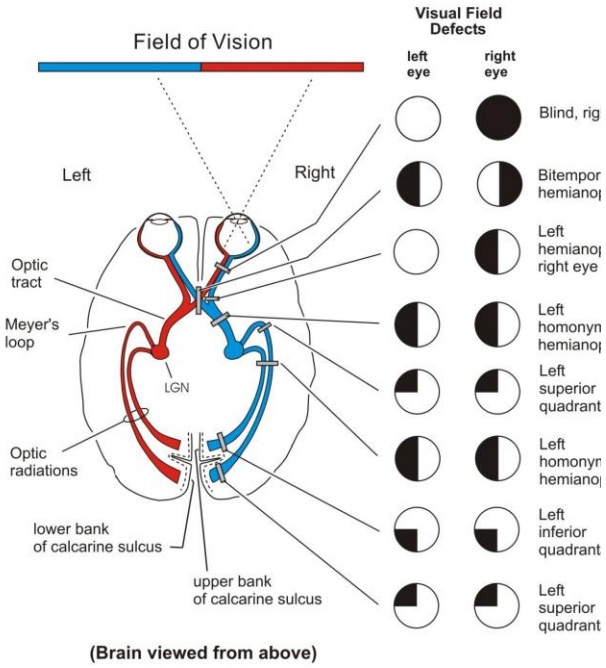
Each eye will make half crossing and the other half will not cross , the nasal part always crosses while the temporal does not cross , so the optic nerve crosses to give optic chiasm which give optic tract that goes to thalamus and from thalamus (lateral geniculate) the fibers make optic radiation that will go to primary visual area (area 17).

Defect in the pathway will lead to defect in vision proportional with the region that will be affected , that means if the optic nerve was cut , it leads to blindness in the ipsilateral side but the patient still see right and left by the other eye , the visual field will decrease a little .

If the cut is in optic tract, in this case the nasal part in the opposite side and the temporal part in the same side will be both affected and the patient cannot see most visual field in the other side this case is called hemianopia.

Any defect, usually complete defect, after chiasm, either defect to optic tract or thalamus or optic radiation or cortex in one side will cause loss in half of visual field that we call it hemianopia on the contralateral side , in this case damage on right side cause left homonymous hemianopia .

If the chiasm is damaged the patient will not see the periphery because the nasal part will be lost which are responsible about the peripheral visual field in this case bitemporal hemianopia .



The eye is sphere where the upper part of retina is responsible for the vision in the lower part of the visual field , and the lower half of the retina is responsible for the vision in the upper half of the visual field , when they go to the lateral geniculate they are still upper and lower , there when they form optic radiation , the upper will make the upper fiber that go to upper bank of calcarine sulcus , whereas the lower fibers stay lower and go to lower bank of calcarine sulcus .

If the upper half of optic radiation has been damaged or upper calcarine sulcus this means the patient will loss the half of the half which is quadrant because of that, this case is called quadrant hemianopia . If the upper fibers are damaged this make lower quadrantanopia and If the lower fibers are affected this cause upper quadrant hemianopia .

Finally , an important thing in the anatomy notice that the lower fibers mainly do not go straight , they go first anterior inferior then backward so they form a hock that's called Meyer's loop which extends very anterior and very inferior and goes over a large part of temporal lobe so lesion in temporal lobe may cause superior quadrantanopia .

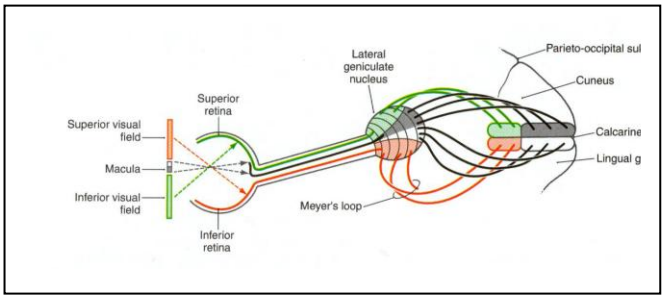
Damages in Meyer's loop which is common in stroke , accidental damage in this case causes quadrant hemianopia , stroke affects the temporal lobe which contains hippocampus, a little a bit above the hippocampus there is Meyer's loop , so a stroke there although it is very anterior to optic radiation but this patient will have superior quadrantanopia .

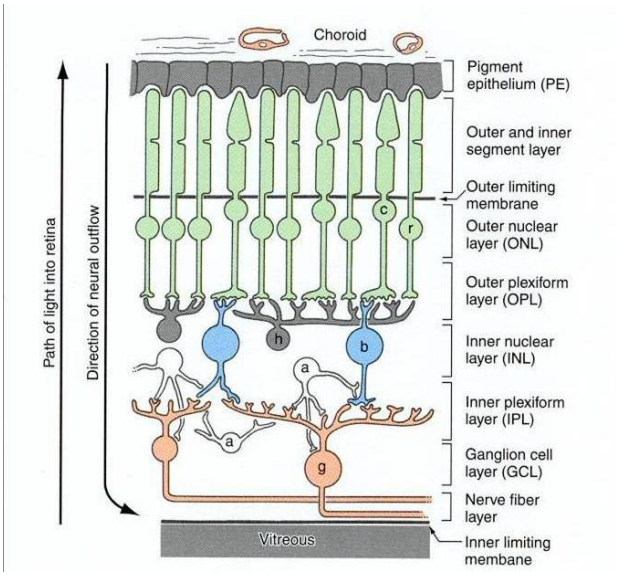
*dr. Loay adviced us to see a lot of MRIs and to know the area and detect the lesions on them .

In retina there are receptors and bipolar cells and ganglion cells . The ganglion cells are the only cells that make action potential and they function to send information to the cortex . whereas receptors and bipolar cells make graded potential that's related to the strength of the stimulus which permits them to make signal processing …

There were two additional cells : Amacrine and horizontal cells their main function is to help processing at the level of the retina , so the retina and ganglion cells process formation .

What will happen if the light fall on the receptors ? The receptors will become hyperpolarized.





And there will be less amount of neurotransmitters released, especially glutamate.

We know that stimulus produce an AP and light is a stimulus to the retina , how does the absence of glutamate do an AP? How do they activate the post synaptic neurons (bipolar cells)?

The post-synaptic receptors are inhibitory we said that not all glutamate receptors are excitatory and the example we have about inhibitory glutamate receptors are found in retina . So when the glutamate is decreased because of light, this will lead to inhibition of the AP postsynaptically.

Actually , not all bipolar cells have inhibiting receptors , some have inhibitory receptors and these are activated at light and this type is called activated bipolar cells . Whereas there are other bipolar cells that have NMDA and AMPA receptors which are excitatory glutamate receptors at dark so the light falls, no NT will be released, these are not active which means they are inhibited and we calls them inhibitory bipolar cells, so the retina has both activated bipolar and inhibited bipolar depending on the receptors .

At the end the bipolar cells send the information to the ganglion cells that become activated when the light fall on receptors that supply it by bipolar cells we call them ON Center Cell or (ON ganglionic cell) .Whereas when these are not excited they will become OFF Center .

So the retina has ganglionic cells, when the light falls on the receptors that supply them this leads to excitation and forming AP whereas others are opposite when the light falls on them they become inhibited and we call them Off center .

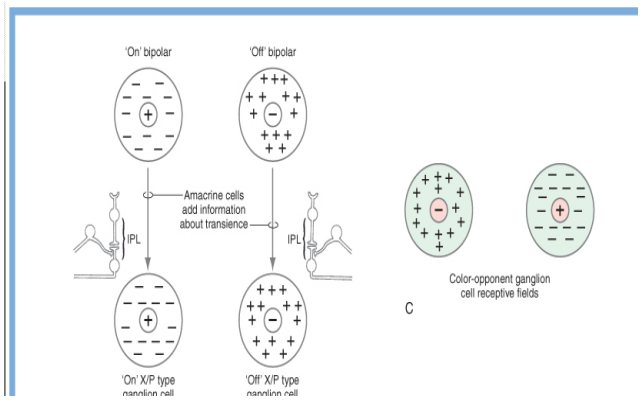
These cells and this complicate type of connection help with processing , notice that some cells are OFF while others are ON and this helps us to see details and to see clear images and also helps us to detect direction .

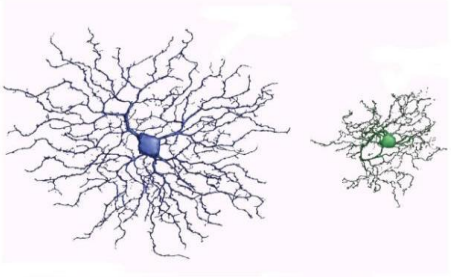
We have different types of ganglion cells and the most common are three types :

1.**X- ganglion cells**, they have a small cell body with small distribution of dendrites., and its visual field have smaller amount of receptors and small covered size.

2.**Y- cells**, they have a big cell body with widely distributed dendrites , and they have a big receptive field that covers a large area from the retina. These receive blood supply from bipolar cells.

3-**W-cells,** they resemble the y-cells in their anatomy, with big dendrites distribution. Their blood supply is directly from amacrine cells.





Which gives bigger details? X- cell .

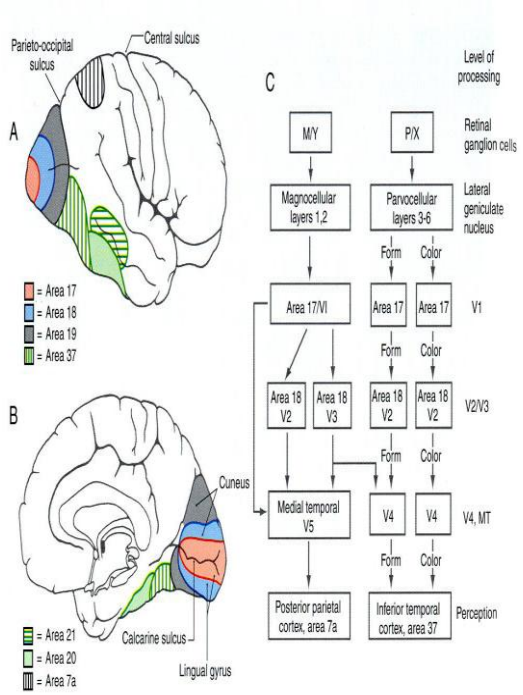
X- cells are in the center of retina while the Y-cells cells are mainly in the periphery and they have better ability to detect movements because they are in the periphery and quicker. The W-cells are ganglionic cells in the periphery and are active when the light moves in one direction , and others are active when it moves in a different direction, so they are responsible for detecting movement and **direction** because they are quicker and bigger .

Now the retina has more than one type of ganglionic cells and they do not share their information with each other to avoid mixing them, so they stay as separated fibers. The axons of the X and Y cells will form the optic nerve which will then form the optic radiation, when it goes to the lateral geniculate nucleus.

The laternal geniculate nucleus in the thalamus is formed of 6 layers , The magnocellular layers forms the first 2 layers of the lateral geniculate which are related to the Y-cells but the other 4 layers are specific for the smaller X- ganglion type which are the parvocellular layers .

The <u>left</u> lateral geniculate nucleus receives input from both eyes, so when I have two bipolar cells , two ganglion cells one from the ipsilateral eye and one from the contralateral eye .

If the lateral geniculate takes information from two eyes the information are not mixed and they stay seperated until reaching the cortex where there will be areas for ipsilateral eye and areas for contralateral eye then the information will be integrated .



Same thing with the four types of cellular, two will be from ipsilateral X- ganglion cells and two from contralateral X- ganglion cells , so the information stay separated until reaching the cortex.

In the cortex each X-cells from each side give details about information and colour vision and each one of two pathway have a separate processing then they are integrated with each other to form one image .

*Dr. answered a student's question : W- mainly does not go to lateral geniculate , but they are mainly to detect movement and they go to part of the brain that's responsible of movement which is sub cortical . So y-cells mainly go sub cortical not to the cortex.

Actually we have two pathways and both reach area 17 and from that the cortex starts information processing until it extracts the information .Again, the information are not mixed directly in the cortex and they are processed separately .

The "What "pathway transmits the information in details and it extends from bipolar cells to the ganglionic cells and take their visual part from the cortex of area18 and 19 and continue inferiorly and medially where it will analyzes the information that are related to shape and color and detailed information .

The "Where" pathway starts from the magnocellular layer , where y-cells take superior route of processing continuing to areas 17,18 and 19 and go to dorsal parts of cortex and reaches the posterior parietal lobe.

The Where pathway analyzes information related to color , shape , movement, direction, position and three dimension .

From dr. loay last year slide:

Ventral "What" pathway:

Carries information about static object properties such as colour, luminance, stereopsis and pattern recognition.

•Slow pathway from P-ganglion cells (through laminae 3-6 of LGN, V1) to V2, V4 and inferior temporal cortex .

Dorsal "Where" pathway:

Information about dynamic object properties-motion and spatial relationships

•Fast pathway for transient visual signals

•Pathway to V1, V2, MT, medial superior temporal and parietal lobe

One last note about area 17, the lower path of the optic radiation gets information from upper visual field while the upper path gets from the lower visual field and both of them go to the calcarine sulcus and the surrounding gyri. Now the fovea centralis and macula lutea (central of vision) have more density of receptors and these take up 2/3 of the space of the calcarine sulcus and they're found more posteriorly while the peripheral vision is found more anteriorly.

I TRIED MY BIST TO WRITE THIS SHEET

PLEASE FORGIVE ME FOR ANY MISTAKE

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