**بسم الله الرحمن الرحيم**

**The visual pathway :refer to slide 41**

**The** nerve that carry the visual information is: the optic nerve.-

**The general** pathway of optic nerve is: -

**Optic nerve** 🡪 (some of its fiber crosses inside the optic chiasma) 🡪 and the fibers that haven't crossed complete their way through **optic tract** 🡪then those reach to lateral geniculate nucleus ( located in the thalamus )🡪then it will go to the cortex through fibers called (radiat fiber ) –( optic fiber ) 🡪 primary visual area of cerebral cortex located in the ( posterior occipital lobe )

The information go to the cortex to be processed.-

Actually information from eye go to more than one pathway **, "slides 42-44"**:

\* on our sleeping, the light cycle "day-night cycle",, we depend on our information about the light that reach our eyes then our brains; because of that we have some optic fibers go to Hypothalamus which are responsible to day /light cycle .

1. **Superior colliculus** 🡪 visual reflex "which should be done before processing>>so we will not wait the pathway to make processing the return back>>it has another target: the reflex on tectum and pretectum area that the superior colliculus trans the information from " and then give information to the cortex .
2. **Hypothalamus** 🡪 make processing for circadian rhythm>>responsible to day /light cycle; about the rhythm of sleeping and day rhythm.
3. **Mid brain** 🡪 (pretectal area) 🡪 control puple size to control the amout of light enter the eye
4. **Thalamus** 🡪 then to cortex 🡪 to understand what we see .

**\*"slides 45-54"**

\*\*\*\* We know that right side of the brain controls the left side of body , and the left side of the brains controls the right side of the body .

it's mean that the vision from the right field (side) go to the left side of brain , and vision from left field (side) go to the right side of brain .

**We don't say right eye give information to the left side of brain , and the left eye give information to the right side of the brain because right eye can see from both right and left field and the left eye can see the right and left field**

When we are talking about right eye as an example :

Right eye will receive light from left and right fields , and it will send information to the right and left parts of the brain .

(((( right eye ))))

crossing

Light from right side 🡪 nasal part of the eye------------------> go to the left part of brain

Light from Left side 🡪 temporal part of eye ------------------> right part of brain

No need for crossing

**Conclusion (FOR THE RIGHT EYE): nasal part ((RIGHT,RIGHT,CROSS TO THE LEFT)) of each eye must cross to reach the opposite part of brain "the nasal side of the right eye get light from the right side ,so it has to cross to the left side of the brain" *BUT* the temporal part ((LEFT, RIGHT, STILL RIGHT)) of the eye does not have to cross; cause its information go to the same side of brain "the temporal side of the right eye get light from the left side then send it to the right eye then to the right brain"….cause each eye must see BOTH LIGHT FROM BOTH DIRECTIONS.**

* **Now we will apply this at the picture in slide #52, ☺**
* This is the **main** rule that we should apply: The **red light** which is at the right side must **go to the left side of the brain**, whereas the **blue light** which is at the left side must **go to the right side of the brain**.
* The temporal part of the right eye will receive the blue light and does NOT make crossing>> SO **the blue light go to the right brain**.
* The temporal part of the left eye will receive the red light and does NOT make crossing>> SO **the red light go to the left brain**.
* The nasal part of the right eye will receive the red light ,, SO it must cross to the left side of the brain>>SO **the red light go to the left brain**.
* The nasal part of the left eye will receive the blue light ,, SO it must cross to the right side of the brain>> SO **the blue light go to the right brain**.
* **Look at slide #53:**

The lower part of the vision field "inferior visual field" will reach the upper part of the eye "superior retina" and it will go to the upper part of brain.

The upper part of the vision field "superior visual field" will reach the lower part of the eye "inferior retina" and it will go to the inferior part of brain.

\*\*\*in this case we will NOT see anything in the brain "NO picture will be formed" and we **won't** see the picture go upside down "there is no pic."…….THE Dr does not care about this information.

* **Look at slides #54+55:**
* If the right optic radiation has been damaged>> the patient will NOT see the left field>> so I will see just half of the picture "left hemi-anopia".
* In slide 54: the right optic radiation had been cut>> I will not be able to see the blue light>> so half of the picture we can not see.
* **Look at slides #56+57:**
* The lower cortex in the brain see the upper vision field…and the right cortex in the brain see the left vision field **"and vice versa".**
* **SO** if the right cortex had been damaged, I will have **left hemi-anopia** "cannot see the left part of the picture"**,** and if the inferior vision field had been damaged, I will not be able to see the upper part of the picture>>>>this called **"superior left cuadrant anopia"**
* **Look at slide #58: notice that: all lesions are in the right side.**
* If I have cut in the right optic nerve>> blindness in the right eye will result.
* If I have cut in the optic ciasma "which take the nasal part">> bitemporal hemi anopia will result.
* If I have cut in the optic tract>> left hemianopia will result.
* If I have cut in the upper and right parts of vision cortex>> left inferior quadrant anopia.

Now we will talk about the adaptation of eye :

By Size of papilla 🡪 when we are in a place with strong light the papilla will constrict to prevent photoreceptors damage and maturation. so it prevents damage in the eye .

The size of papilla controlled by Iris muscle

Iris muscle controlled by sympathetic and para sympathetic .

At rest the sympathetic system is stronger than the parasympathetic>> so the papilla will dilate .

When we expose the eye to strong light we must activate the parasympathetic system to constrict the eye and decrease the amount of light that enters the eye .

* **Slide #61:**

The information come from the eye by **optic tract** 🡪 go to the pretectal area 🡪 to the para sympathetic nucleus "edinger-westphal nucleus" 🡪 this will activate the iris muscle to constrict through oculo motor nerve .

This reflex like any reflex in the body it is a cycle of sensory arch and motor arch .

The sensory arch🡪from eye to edinger –westphal nuclues through optic tract

And the motor arch 🡪 from edinger westphal nuclues to iris muscle through oculomotor .

\*\*\* the information come from one eye will go to two edinger wesphal nucleus which control the construction of both eyes; the sensory information from one eye will result in motor order for **both** eyes>> so when we make the pupil reflex test: if you make shining for one of his eyes; both eyes will be constrict,,, this will help us to know if we have a problem in vision pathway or the midbrain.

\*The points A,B and C are shown in slide 61…..

Cutting in (A) 🡪 When we put light in the **right** eye🡪 **NO** constriction.

Cutting in (A)🡪 When we put the light in the **left** eye 🡪 constriction in **both** eyes.

Cutting (B )🡪 when we put light in the **right** eye 🡪 constriction in **both** eyes.

Cutting in ( B ) 🡪 when we put light in the **left** eye 🡪 constriction in **both** eye

Cutting in (C) 🡪 the right eye will not constrict.

* The cut in optic tract does not affect the pupillary reflex in either sides.
* **Look at slides 64+65:**

Adaptation in the eye:

1. Size of pupil
2. Neural adaptation ( by changing in action potential frequency per second- changing in receptor –changing in the amount of neurotransmitters that will exit).
3. Photoreceptor adaptation.

* Important notes about **Photoreceptor adaptation**:

\*\*Remember that (rhodopsin) which is protein

rhodopsin is the responsible for converting light signal to neuronal signal and it convert the retinal from cis to trans

\*In our body there is enzyme responsible for converted retinal from –trans to cis- again.

\*Our sensitivity to the light depend on the amount of cis retinal because cis retinal sensitive to the light.

\*\*When the light is low -------the amount of cis retinal will be high ( because the enzyme effect is more than the effect of rhodopsin )

\*\*When the light is high-------the amount of trans retina is low (because the light is convert quickly and overcome the effect of enzyme).

\*\*if we was in a place with high light, the light will convert quickly and overcome the effect of enzyme>> for that when we exit from a place with low light to a place with high light>> after a time we will adapt and see in a good way….and vice versa.

* The difference between rod and cons:

The rods have less amount of retinal its mean that the adaptability is low; they will not adapt that much,

But the cons have more amount of retinal, so it will adapt better.

This the reason for ( in low light 🡪 we see with the help of rods )

and in the( high light 🡪 we with the help of cons)

* vitamin A -> is the sorce of retinal.

no vitamin A🡪 no retinal 🡪 bad adaptation 🡪 in dark place I can't make good amount of cis 🡪 I can't see in the night \*\*this called **NIGHT BLINDNESS**\*\*

LAST PART OF SPCIAL SENSATION ::::

Vestibular system :

**NOW** you will refer to **vestibular system** slides….

Vestibular system located in the ear and its consist of

"look at slides(2-4)":

1. 3 semicircular canals which arranged>>( lateral –anterior-posterior)>> to cover the 3 planes of axis "longitudinal, horizontal, and Z-axis".
2. Utricle.
3. Saccule.

* The vestibular is an extend to the cochlear, so it is heart shell, contain fluid inside it which is similar to the fluid in the rest of the body.
* **Look at slide #5**: When we make cut in one of the semicircular canals we will see the bony part, perilymph, and in the inside we have a canal contain another type of fluid "the endolymph which is hypotonic".
* The function of vestibular system to feel the head movement and its direction

**Slide #7**: We said that we have 3 semicircular canal and each canal has (a swelling called ambula of canal) and the sensory part for each canal located in ambula

Sensory part consist of ( hair cell"عاملين سبايكي" :with a gelatinous part around them to facilitate their movement which is called capula ).

* **Slides #8+9**: When we make any rotation movement our head -🡪 the fluid around the capula will move🡪capula will move 🡪hair cell will bind 🡪 it will open potassium ion channel 🡪

Depolarizing 🡪calcium channel will open🡪 calcium release.

* As we said there is 3 semicircular canals each one with a certain direction to cover all movements in all directions.
* **Slide #10:**
* Know we must remember that the hair cell has tall and

short hair when it rotate toward the short hair it make inhibition and when it rotate toward the tall hair it will make excitation.

* When we move our head to right side the fluid will move to the right on the vestibule, the hair cells which located at the right side will rotate>> (away from central) and the hair cells which located at the left side will rotate (toward center).
* One toward (tall hair cell ) (excitation) --and one toward (short hair cell) (inhibition)
* We have other type of movement like : (downward tilt –backward tilt –acceleration-when I in the elevator"المصعد" ) any movement against the gravity, utricle and saccule response about these movements, this movement has receptor in utricle and saccule inside utricle and saccule there is part called **mackula** contain hair cells covered with gelatinous layer, but here we need something to put as a weight "force" on the gelatinous part to bind it, NOT like the semi circular canal; cause the rotation make the fluid rotate in the canal and give force to has the ability to bind the gelatinous part >>this weight will be the **otoliths**…..look at slide #12 to understand ☺.
* Note that saccule is almost vertical its responsible for elevation and the utricle is almost horizontal its responsible for acceleration and binding head.
* Equilibrium Pathway:

The pathway in the vestibular system will go to more than one destination, it will move in the vestibular system and enter the brain stem specifically enter the \* \* **slides #16-23**:vestibular nucleus, there it will go to more than one destination:

1. The first part it will go to is the part which response about the **processing** which is the cortex.
2. The part response about the **eye movement** "the eye move with the help of 3 nerves: oculomotor, trochlear and abducent">> so a direct information will go to the nucleus and the nerve which response about eye movement.
3. To the accessory nucleus "which response about the movements of trapezoid and sternocledomastoid muscles which **move the head**".
4. To vestibulospinal tract: We have to **move the body** to make body balance so I have to send a message to the axial and trunk muscles "involuntary tract response about the posture and balance: vestibulospinal tract" .
5. To cerebellum: which is the part response about the balance teaching.

