Mechanism of Nerve Impulse Conduction

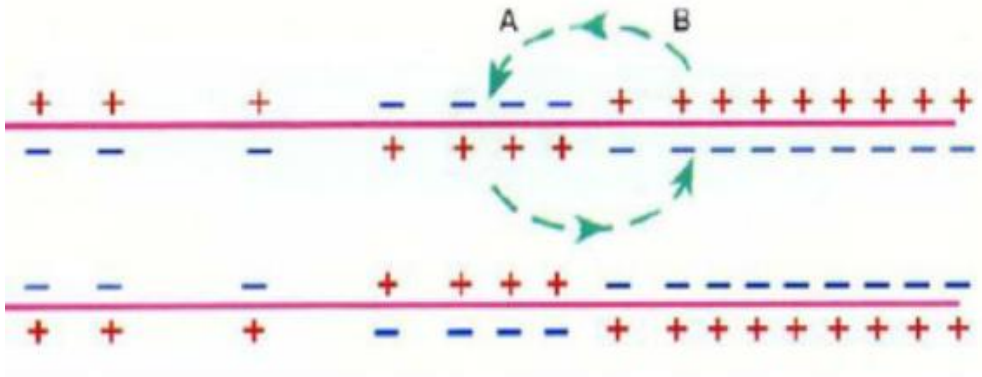
- **A. In the unmyelinated nerve fibers:**

During rest, membrane is polarized. (+ve outside).

At site of stimulation the membrane is depolarized (-ve outside).

Then a **local current flow** occurs between the depolarized area and surroundings areas:

- *In the inner surface:* +ve charges migrate from the point of depolarization to the surrounding sites. Rest
- *In the outer surface:* +ve charges migrate from the surrounding sites to point of depolarization.



- **The results are:**

➢ Point of stimulation begins to repolarize.

➢ The surrounding sites being to depolarize partially till they reach the firing level ⇨ action potential.

This is repeated. So, conduction occurs along the nerve fiber.

It is called the (**Current sink**).

The speed of propagation is directly proportional to the diameter of the nerve.

B. In the myelinated nerve fibers

The same mechanism as in the unmyelinated But the impulse jump from one node of Ranvier to the other because the myelin is insulator for current

So, it is called (**Jumping** or **Saltatory** or **Node to node**) conduction

It is characterized by:

1) The rate of conduction in the myelinated nerve is 50 to 100 times faster than in the unmyelinated.

2) It occurs with less energy . More efficient.

❖ ***Rate of rise of intensity of the stimulus:***

If a **subthreshold** stimulus is applied to the nerve and increased **slowly**, the nerve accommodate itself to the passage of the current ⇨ **no response**.

If intensity increased **rapidly**, accommodation is not observed ⇨ **response**

★ Strength-duration curve

It is a relationship between the **intensity** of the stimulus & the **time** of its application to the nerve to give a response.

Within limits, **the stronger** the stimulus, **the shorter** its duration

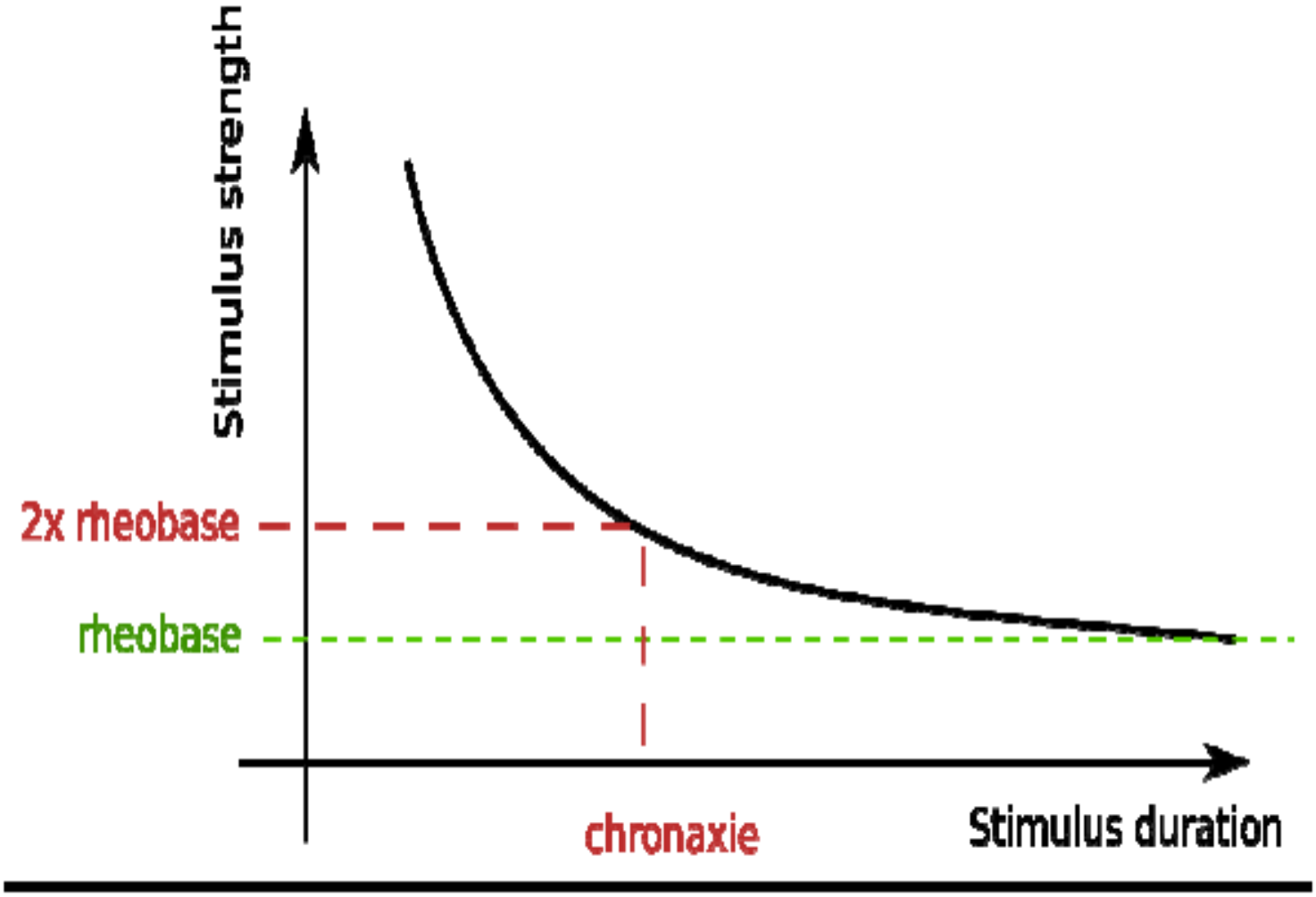
From the curve

- **Rheobase**

It is the minimal strength of current that can excite the nerve (threshold).

- **Utilization time**

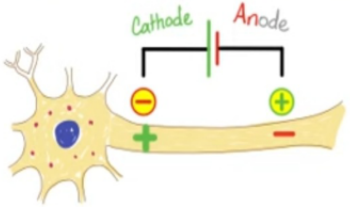
It is the time needed for excitation by **Rheobase**


Stimulus strength
2x rheobase
rheobase
chronaxie
Stimulus duration

Electrotonic Potentials

Medicosis

Catelectrotonus



Anelectrotonus

	Catelectrotonus	Anelectrotonus
Site	@ the Cathode.	@ the Anode.
	Partial depolarization due to addition of (-ve) charges by the cathode @ the outer surface of the nerve fibers.	Hyperpolarization due to addition of (+ve) charges by the Anode @ the outer surface of the nerve fibers.
Excitability	is increased.	is decreased
Threshold	is lowered.	is elevated
Membrane Potential	gets closer to the firing level.	moves away from the firing level.

Medicosis

Anelectrotonic potential (or AN- electrotonus)

- This is the potential change that occurs when using anodal (+ve) currents for stimulation. It is a state of **hyperpolarization** caused by net addition of +ve charges at the outer surface of the nerve membrane.
- It is associated with **a decrease of excitability** of the nerve so, the nerve excitability may be completely lost **(anodal block).**

Catelectrotonic potential (CAT –electrotonus)

- This is the potential change that occurs when using cathodal (–ve) currents for stimulation. It is a state of **partial depolarization**
- Caused by net addition of –ve charges at the outer surface of the nerve membrane It is associated with **an increase of excitability** of the nerve.
- However, the decrease of the membrane polarity leads to

an increase in both **K+ efflux** & **Cl- influx** which repolarizes the membrane and restores the resting membrane potential.

N.B.: Stimulation at the cathodal end resulted in three types of depolarization:

	catelectrotonus	*local response*	*firing level*
-Stimulus	Subthreshold	Subthreshold	Threshold or more
-Depolarization	Less than 7mv.	From 7 to 25	25 or more
-Mechanism	Passive	Passive and partial active)	active
-Forces affect the membrane	Repolarization mask this effect	Repolarization mask this effect	Depolarization force is more& action potential resulted

1-Eye:

-Motor to dilator pupillae muscle → mydriasis (dilatation of the pupil)

-Motor to the superior and inferior tarsal muscles → widening of the palpebral fissure. Thus widening the field of vision.

-Motor to Muller's muscle (in animals) → exophthalmos (forward protrusion of the eye ball)

-Relaxation of the ciliary muscle, decreasing the power of the lens to prepare the eye for far vision.

2-Glands:

- -Lacrimal glands : little secretion of tears and vasoconstriction.

- -Salivary glands: **trophic** secretion (small in amount, viscid and concentrated) from the submaxillary gland.

3-Skin

- -Sweat glands : copious secretion eccrine glands
- -Erector pilae muscles→ erection of hair .
- -Bloods vessels vasoconstriction.

4-Cerebral vessels:

- -Mild vasoconstriction. Still during sympathetic excitement, cerebral blood flow increase due to the rise in arterial blood pressure.

1-The heart

a- They stimulate all the properties of the cardiac muscle (contractility, rhythmicity, conductivity and excitability) and increase its metabolism & O_2 consumption .

b- Coronary vessels: Direct effect is vasoconstriction, but coronary vessels dilate due to increased metabolism of the heart that decrease O2 concentration (indirect effect). The metabolites itself cause direct dilatation

2-The Lung

- **a-Bronchi**

  Bronchodilation and inhibition of bronchial secretions.

- **b- Pulmonary vessels**

  vasoconstriction (**VC**)

  This widens the air passages lead to better ventilation

[C] Splanchnic division

to abdominal and pelvic viscera

- **Abdominal division**
  - **Preganglionic fibers:**

    arise from the **lower 8 thoracic segments** and pass without relay in sympathetic chain to form

    The **greater splanchnic nerves**

    relay in celiac, renal and superior mesenteric ganglia

  - The postganglionic fibers supply

1-Gastrointestinal tract (GIT):

relaxation of the wall, but constriction of the sphincters. Leading to delayed evacuation of food.

2-GIT secretions inhibition

3-The splanchinic vessels

- vasoconstrictor and vasodilator the effect is mainly vasoconstriction)

4-The spleen

- motor to smooth muscle fibers of the capsule and trabeculae → 250 mL of stored blood is poured into the circulation. This action is more prominent in animals

5-The liver

- to stimulate metabolism ,glycogenolysis with increase blood glucose level , lipolysis with elevation of the blood lipid level and dilatation to its vessels.

6-The endocrine pancreas

- usually inhibition of insulin secretion.

7- The Kidney

- Vasoconstriction of renal blood vessels, decreased renal blood flow, decreased urinary output and stimulation of renin secretion.

The adrenal medulla

- preganglionic fibers
- secretion of catecholamines, adrenaline (80%) and noradrenaline (20%) hormones
- The released adrenaline stimulates lipolysis, thermogenesis and enhances blood clotting by releasing blood clotting factors from the liver. It stimulates the reticular formation of the brainstem → increased alertness with lack of sleep (insomnia)
- **Modified sympathetic ganglia**

- Pelvic division

- **The preganglionic fibers**

fibers arise from upper 2 lumbar segments and pass without relay to form

lesser splanchnic nerves

- The lesser splanchnic nerves on both sides unit to form the **presacral nerve** which **relay** in the **inferior mesenteric ganglion.**

- **The postganglionic fibers supply**

- **The urinary bladder**

inhibitory to the wall and motor to the internal urethral sphincter

→ retention of urine

- **The rectum**

inhibitory to the wall and Motor to the internal anal sphincter

→ retention of feaces

Desire of micturition and defecation disappear

- **The sex organs**

In female It is mainly **inhibitory** on uterus and fallopian tubes, **but** late in pregnancy it is excitatory to the uterus

In male It is mainly **excitatory** on the smooth muscles of epididymis, vas deferens, seminal vesicles and prostate motor fibers with emission of semen during sexual intercourse leading to **ejaculation**.

Fibers going to the skin supply

- **Sweat glands**

Eccrine copious secretion. i.e. found in skin all over the body

Apocrine thick odoriferous secretion.. i.e. found in axilla and genital areas

- **Cutaneous blood vessels** vasoconstriction

- **Erector pilea muscles** Contraction

→ piloerection, i.e. hair erection. This is more prominent in animals like cats during fighting or cold whether.

Fibers going to the skeletal muscles supply:

- **1-Blood vessels of skeletal muscles causing vasodilatation**
- **2-This vasodilatation increases the blood flow and stimulates metabolic processes needed for energy production leading to increase power of contraction, delay of fatigue and early recovery after exhaustion**
- **This effect is known as "Orbelli phenomenon"**

General function of sympathetic N.S

- **I-During rest**

It causes sympathetic tone on the blood vessels leading to continuous mild vasoconstriction to maintain the blood pressure.

Sympathetic tone to the Adrenal medulla

Maintains basal amount of catecholamine secretion in blood.

& this is important for regulation of blood pressure & blood glucose level.

Occluolomotor nerve (III)

- **arise** From the Edinger-Westphal nucleus in the midbrain

- The preganglionic fibers relay in the ciliary ganglion.

- The postganglionic fibers run in the short ciliary nerves. These fibers produce:

a) Contraction of the constrictor pupillae

→ narrowing of the pupil. (miosis).

b) Contraction of the ciliary muscle:

→ relaxation of suspensory ligaments, causing increased power of the lens which is very useful in near vision accommodation.

facial nerve (VII)

- **Supply : the lacrimal, nasal and submaxillary salivary glands.**

Preganglionic fibers: arise from the Superior salivary nucleus in pons.

- **Relay : Fibers that supply the lacrimal and nasal glands relay in The Sphenopalatine ganglion (collateral).**

Fibers that supply the submaxillary gland relay in the Submandibular ganglion (collateral).

Functions:

- **These fibers supply the salivary glands and produce True secretion (Large in volume, less in enzymes and watery) also produce vasodilatation.**

The glosso-pharyngeal (IX)

- **Supply the parotid salivary gland**
  - **Preganglionic fibers**

    arise from the inferior salivary nucleus (in medulla)

    relay in the otic ganglion (collateral)

- **Postganglionic fibers**

  supply the parotid (largest) salivary gland.

  Functions:

  a) **True secretion (Large in volume, less in enzymes and watery)**
  b) **Vasodilatation.**

So, nerve supply to salivary glands arise from facial nerve (to submaxillary and sublingual glands) and from glosso-pharyngeal nerve (to parotid gland)

-The vagus nerve (X)

Arise from the vagal nucleus in medulla oblongata

- **The preganglionic fibers relay in terminal ganglia situated in the organs supplied**

From the terminal ganglia short postganglionic fibers arise and pass to supply the organs.

The vagus nerve have the following functions:

1-Inhibition of all properties of atrial cardiac muscle.

N.B Ventricles receive very few vagal parasympathetic efferent fibers. (this is called *the ventricular vagal escape phenomenon*)

2- Decrease of the coronary blood flow and O2 consumption of the heart

(indirect v.c in coronary due to the increased O2 concentration & decreased metabolic activity.

- **Constriction** of the bronchi and bronchioles **(Bronchoconstriction)**
- **Increased secretion** from bronchial glands.
- **VD** of blood vessel. This leads to **narrowing of air passages**.

- **Motor** to **GIT wall** (contraction).

oesophagus, stomach, small intestine and proximal part of large intestine.

but inhibitory to sphincters leading to rapid evacuation of food.

- (↑) Secretory to **digestive glands** of stomach, pancreas and liver enhancing (↑) **insulin** hormone release.

- **Motor (↑)to gall bladder and inhibitory to sphincter of Oddi** .

- **Vasodilatation** to the **splanchnic** vessels.

Parasympathetic sacral outflow

- The sacral parasympathetic fibers **arise from L.H.C of 2, 3, and 4th sacral** segments of the spinal cord

- They run as preganglionic fibers in the **pelvic sacral nerve** or the **nervi erigentes** to relay in **terminal ganglia** in the organs they supply.

- The sacral parasympathetic fibers supply :

* the rest of the digestive tract that is **the descending colon, the rectum the anal canal.**
* The urinary bladder
* the **blood vessels** of the external genitals.

This Sacral flow have the following functions:-

- **Defecation**

  contraction of the wall of the rectum and relaxation of internal rectal sphincter.

- **Micturition**

  contraction of the wall of the bladder and relaxation of the internal uretheral sphincter.

- **Erection**

  vasodilatation of the blood vessels of the erectile tissue of the penis in the male and clitoris in the female.

Parasympathetic tone

*a) Vagal tone to the **heart***

- Decreases the rhythm of the SAN from **110** to only **70** beats / minute.
- This greatly spares excess energy & effort in the heart.

*b) Vagal tone to the **gastrointestinal tract***

- Prevents GIT distention and maintain basal amount of secretion.
- This is very important to complete the digestive process.

*c) Vagal tone to the **bronchi***

- Maintains constant distribution of air during ventilation.
- Protects the bronchial wall during cough.

Functions of the iris:

1. Control amount of light entering the eye, via controlling the diameter of the pupil.

- The pupil of the human eye can become as small as 1.5 mm and as large as 8 mm in diameter.
- Therefore the quantity of light entering the eye may vary 30 times.

2. It prevents light rays from falling on the periphery of the lens to decrease the spherical and chromatic aberrations.

3. Constriction of the pupil increases the depth of focus of the eye

Depth of focus is the distance the object can move but its image still focused on the retina without new change in accommodation.

Structure of the retina

The retina is formed of ten layers, these from outside to inside are:-

1- The pigmented cell layer in direct contact with the choroid and contain dark melanin pigment.

Functions :-

a- The pigmented epithelium absorb excess light rays which are not absorbed by the rods and cones. If this excess light is not absorbed it will stimulate large number of photoreceptors leading to blurred vision.

b- Store large amounts of vitamin A which is the precursor of visual pigments.

c- Phagocytic action to debris of photoreceptors.

2- Layers of rods and cones (receptor layer).

- There are about 120 millions rods and only 6 millions cones.
- Rods are concentrated in the periphery of the retina and less in the middle.
- Rods are more sensitive to light than cones but less accurate in visual acuity and function more in dim (night vision).
- Rods can't determine color vision.
- Cones are more concentrated in the middle of the retina (fovea centralis contains cones only).
- Cones are less sensitive to light than rods
- It is more accurate in determining visual acuity.
- Cones are specialized in color vision and day vision".

3- Outer limiting membrane.

4- Outer nuclear layer. Contains inner segments of the rods and cones.

5- Outer plexiform layer

in which horizontal cells connect receptor cells to other cells.

6- Inner nuclear layer

which contains bipolar cells (first order neuron in visual pathway).

7- Inner plexiform layer

contains the synapse between the bipolar cells and the ganglion cells.

8- Ganglion cell layer

(second order neuron in visual pathway).

9- Layer of optic nerve layer

(axons of ganglion cells).

10- Inner limiting membrane.

The optic disc:

- It the site of the optic nerve exit from the retina, it is about 1.5 mm diameter and located about 3 mm to the nasal side.
- It does not contain photoreceptors, hence it is the cause of the physiological blind spot in the visual field which is not noticed because the two blind spots of both eyes do not lie in corresponding retinal points.
- Also using one eye the blind spot is not appear because the continuous fine movement of eye ball.

The macula lutea

- It is a yellowish spot located about 3 mm to the temporal side of the optic disc opposite to the posterior pole of the eye.
- The central part of the macula contains the fovea centralis
- The fovea is composed of cones only while the other nervous elements are shifted to its surrounding area, thus the light falls directly on the receptors (cones) without passing through many layers.
- In the fovea each one cone is connected to one bipolar cell and this bipolar cell is connected to one ganglion cell which its axon form separate fiber in the optic nerve.
- The pigmented epithelium layer is highly developed in the fovea.

Structure of rods and cones:

Each rod or cone consists of :

1- Outer segment:

contains discs or shelves which contain the visual pigment (rhodopsin in rods and iodopsin in cones).

2- Inner segment contains mitochondria and nucleus.

3- The Synaptic zone which is the area of junction between rods or cones and the dendrites of the bipolar cells.

Mode of stimulation of the photoreceptors

- The outer segment of the rods contain rhodopsin
- This rhodopsin consists of protein part called "Scotopsin" and an aldehyde of vitamin A called (11- cis retinal)
- The outer segment of the cones contain iodopsin
- This iodopsin consists of protein part called "photopsin" and an aldehyde of vitamin A called (11- cis retinal)
- There are three types of the photopsin , each one is sensitive to one of the three primary colors i.e. red, blue and green.

PHOTORECEPTOR POTENTIAL

I– In the dark,

- Na^+ is continuously pumped from the inner segment of the rods and cones to flow inside again at the outer segment in which its Na^+ channels remain opened by cGMP.
- The continuous inflow of Na^+ ions inside outer segment of rods decreases negativity inside them and thus the resting membrane potential (r.m.p) of them becomes low (only –40 mv).
- The movements of Na^+ from inner segment to enter into outer segment is called "dark Na^+ current".
- The low r.m.p causes continuous release of an inhibitory chemical transmitter that inhibits synaptic transmition.

The Eye is the only organ which is activated in hyperpolarized state and inactivated in De.pol

II- On exposure to light

- When light stimulates the photoreceptors and activated rhodopsin is formed it leads to activation of cGMP phosphodiesterase enzyme which transform cGMP into 5'GMP
- lowering concentration of cGMP in the cytoplasm of photoreceptors causes closure of Na+ channels in the outer segment.
- Thus, Na+ is continuously pumped from inner segment but now is accumulated outside at the outer segment leading to hyperpolarization reaching up to -70 mv instead of -40 mv.

continue

- This hyperpolarization leads to reduction of the release of the inhibitory chemical transmitter (glutamate) which facilitates synaptic transmition of the visual pathway.

- Thus the only receptor in the body which its receptor potential is generated by state of hyperpolarization instead of normal depolarization is the photoreceptors.

On removal of light

- Re synthesis of cGMP occurs with subsequent opening of Na+ channels and the membrane potential returns back to –40 mv which causes release of glutamate again

THE INNER EAR (Cochlea)

The cochlea is a coiled tube which in human is **35mm long**

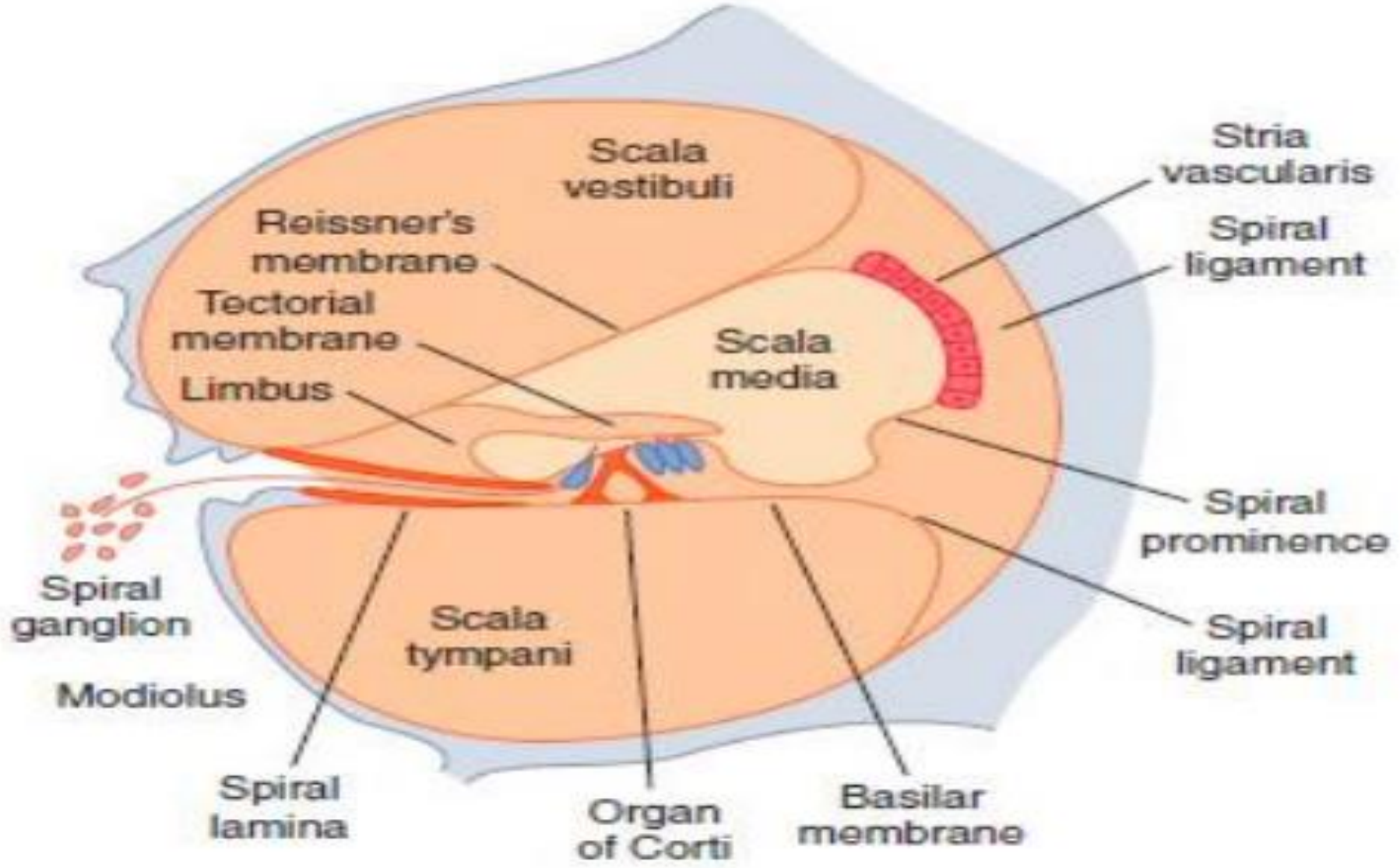
The **basilar membrane** and **Reissner's membrane** divide it into **3** chambers (scalae).

The **upper Scala vestibuli** and the **lower Scala tympani** contain perilymph (which resembles in structure the extracellular fluid i.e. rich in Na+ and poor in K+) and communicate with each other at the apex of the cochlea.

The **Scala vestibuli** ends at the **oval window**, which is closed by the foot plate of the stapes.

The **Scala tympani** ends at the **round window**, a foramen on the medial wall of the middle ear that is closed by the flexible secondary tympanic membrane.

The **Scala media**, the middle cochlear chamber, does not communicate with the other 2 scalae. It contains endolymph (which resembles in structure the intracellular fluid, it is rich in K+ (135mEq/L) and poor in Na+ (15mEq/L)


Scala vestibuli
Stria vascularis
Reissner's membrane
Spiral ligament
Tectorial membrane
Scala media
Limbus
Spiral prominence
Spiral ganglion
Scala tympani
Spiral ligament
Modiolus
Spiral lamina
Organ of Corti
Basilar membrane

Auditory pathway

1st. order neuron: - Found in the spiral ganglia (bipolar cells)near modulus in the cochlea

2nd. order neuron: - Ventral & dorsal cochlear nuclei at the junction of pons with medulla

Most of 2nd order neurons cross to the opposite side passing through the trapezoid body to relay in the superior olivary nucleus.

3rd. order neuron: - Superior Olivary nucleus , 3rd order neurons ascend in the lateral lemniscus then reach the inferior colliculi of the mid brain

4th. order neuron: - Inferior colliculi of the mid brain then 4th order neurons ascend to relay in the Medial geniculate body of the thalamus (MGB) .

5th. order neuron: - Medial geniculate body of the thalamus (MGB) Axons of the 5th order neurons arise from MGB and run as the auditory radiation pass in the retro-lenticular part of the internal capsule to relay finally in the auditory cortex in the temporal lobe.

Discrimination of Sound

Sound must be discriminated according to 4 items:-

1- Frequency or "pitch". 2- Intensity or "loudness" 3- Regular or noise 4- Sound localization

1-Frequency discrimination of sound theories that explain discrimination of sound frequencies are:-

A- Place or Helmholtz theory

- It was put in consideration after studying the detailed examination of the basilar membrane structure.
- This membrane consists of nearly 20.000 transverse parallel fibers which differ in thickness and tension. The fibers are short and highly stretched near the base of the cochlea but becomes gradually longer and more lax as they become nearer to the apex of the cochlea i.e. the basilar membrane is wider near the apex.

- It was found that high frequencies sound cause vibration of those fibers that lie near the base of the cochlea (short, tense fibers) while low frequency sound waves cause resonance or vibration of lax long fibers near the apex of the cochlea. Such different vibrations in the basilar membrane will excite different groups of hair cells which would excite the auditory cortex at different localities. According to these different localities the brain can differentiate between high and low pitched sounds.
- This theory was proved by histological examination of the basilar membrane as well as destruction of that membrane at certain sites makes the animals "deaf "to certain frequencies. Also prolonged exposure to high frequency sounds cause damage of the basilar membrane at certain localities.

B-Traveling wave theory of Von Bekesy

- It assumes that the sound vibrations when reach the foot plate of the stapes that move the oval window produce a pattern like traveling waves in the perilymph of the Scala vestibuli that run from the base towards the apex of the cochlea.
- Sound of high frequency waves produce maximum height near the base of the cochlea, while sounds of low frequencies produce maximum height near the apex of the cochlea.
- Because the basilar membrane is not under tension, it is readily depressed into the Scala tympani by the peaks of waves in the Scala vestibuli. Therefore, sound waves produce distortion of the basilar membrane and the site at which this distortion is maximal is determined by the frequency of the wave.
- Thus according to the pitch of the sound the basilar membrane is moved maximally at certain site, stimulating specific hair cells that also reach certain localities in auditory cortex which can determine these frequencies.

2-Discrimination of the intensity (loudness)

The stronger the intensity .of the sound, the larger the portion of the basilar membrane that is vibrated and the more the number of action potentials that travel the auditory nerve fibers. These are interpreted by the auditory cortex as an increased intensity of sound

3- Determination of sound locality (source of the sound)

Near sounds usually are heard stronger than far sounds.

Also the direction is determined by the time differences in the sound waves striking the two ears.

4-Determination of sound patterns

It is the ability to recognize combination and sequence of tones and to differentiate regular sound from noisy sound. This is appearing to be a cortical function. Ear can discriminate two separate sounds if the interval time between them is more than 1/10 second.

Mechanism of action

- Bending the cilia of hair cells to side of Kinocilium → depolarization of hair cells and increase its discharge in the vestibular nerve.
- Bending the cilia to the opposite side causes hyperpolarization of hair cells and inhibition of afferent impulses.
- As the hair is stimulated when otoconia pull on them, each group of hair is oriented in a different direction so, each position of head detected by a particular group of hair .

سؤال محاضرة الvestibular

All of the following are true **except**?

الجواب كان: Bending the cilia to the opposite side causes depolarization

Q1:The neuropathway of olfactory and taste involved :

1. Foramina of olfactory and taste

Olfactory : cribriform plate of ethmoid bone
Taste : Facial : Internal acoustic meatus , Glossopharyngeal and vagus : Jugular foramina

2. Cranial nerves of olfactory and taste

Olfactory : olfactory nerve
Taste : Facial (chorda tympani) Ant 2/3 , Glossopharyngeal post. 1/3 , vagus (pharynx,epiglottis,esophagus)

3. Neurotransmitters of olfactory and taste

Taste: ATP , Serotonin
Olfactory : excitatory and inhibitory (GABA released by granular cells)

4. Type of olfactory cells

Olfactory cells , mitral cells, glomerulus , granular cells

5. Brain lobe of olfactory and taste

Taste : Gustatory cortex (frontal lobe) ,Insula lobe
Olfactory : Temporal lobe , insula lobe

6. Nucleus of the thalamus

Taste : ventral posteriomedial nucleus of thalamus
Olfaction : Don't relay in thalamus

Q2:Causes of anosmia?

1) Nasal infection
2) paranasal sinus infection
3) olfactory groove meningiomas
4) trauma
5) Vagus reflex

Q3:What increases and decreases sateity?

INCREASE :
Increase fat storage
Increase leptin
Increase alpha - msh
Increase insulin level
Increase glucose level
Increase CRH
DECREASE :
Increase orexin
Increase neuropeptide y
Increase aguti-regulating peptide

Q4:Component of longitudinal fasicules?

Craniosacral :
Cranial nuclei
Sacral:
(S2-S4)

Q5:The causes of bell's palsy and shingles?

Shingle : reactivation of varicella zoster virus
Bell's palsy : unknown cause (damage of facial nerve) , lead to loss of taste of Ant2/3 of the tongue

sateity: feeling of fullness

Q6:The connections between hypothalamus and limbic system?

1) Mamillothalamic tract : hippocampus to fornix to mamillary body to ant. thalamic n. to cingulate to hippocampus (papez circuit)
2) By stria terminalis : between hypothalamus and amygdala
3) Ventral amygdalofugal pathway
4) Fornix

Q7:The component of epithalamus?

1) pineal gland
2) Habenula
3) Posterior commisure

Q8:Disease caused by damage of ventral medial nucleus, mamillary body, dorsal medial nucleus, lateral hypothalamus nucleus?

1)VMN : obesity (hyperphagia)
2) Mamillary body : Wernicke's encephalopathy
3) DMN : Savage behavior
4) Lateral hypothalamus : Anorexia nervosa (adult) , Infants failure to thrive (FTT)