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LECTURE (13)

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If there is any mistake please feel free to contact us:

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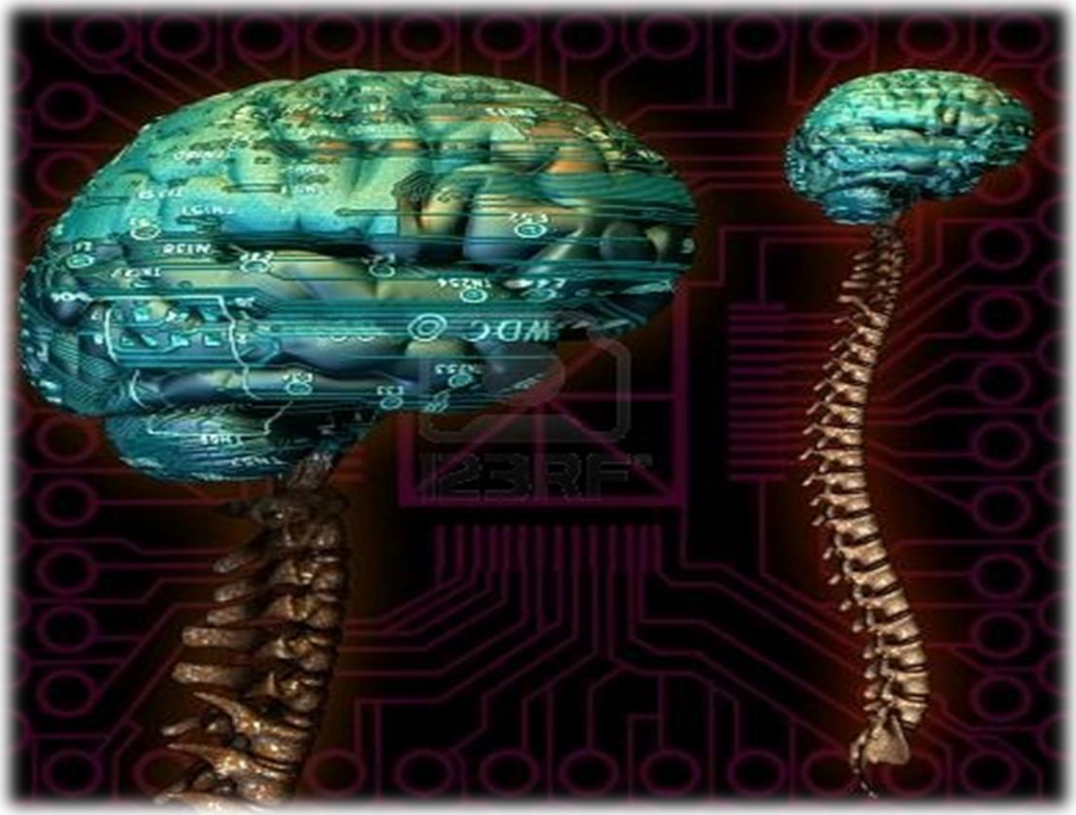
CNS Block

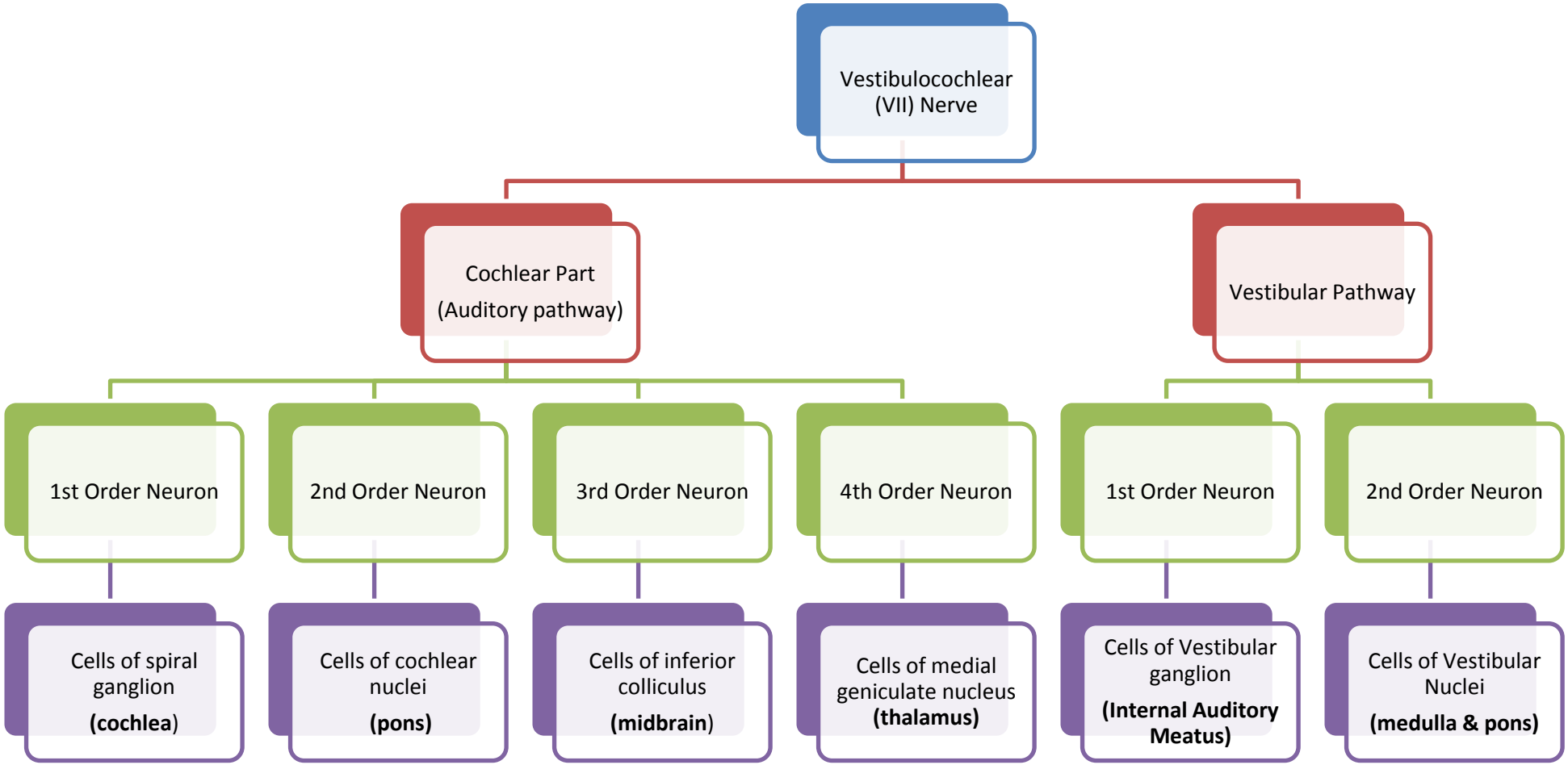


Both - Black
Male Notes - BLUE
Female Notes - GREEN
Explanation and additional notes - ORANGE
Very Important note - Red

Objectives:

- List the **nuclei** related to vestibular and cochlear nerves in the brain stem.
- Describe the **type** and **site** of each nucleus.
- Describe the **vestibular pathways** and its **main connections.**
- Describe the **auditory pathway** and **its main connections.**

MIND MAP


Vestibulocochlear (VII) Nerve
Cochlear Part (Auditory pathway)
Vestibular Pathway
1st Order Neuron
2nd Order Neuron
3rd Order Neuron
4th Order Neuron
1st Order Neuron
2nd Order Neuron
Cells of spiral ganglion (cochlea)
Cells of cochlear nuclei (pons)
Cells of inferior colliculus (midbrain)
Cells of medial geniculate nucleus (thalamus)
Cells of Vestibular ganglion (Internal Auditory Meatus)
Cells of Vestibular Nuclei (medulla & pons)

Vestibulo-Cochlear Nerve

Type: Special sensory (SSA)
Components:
- Vestibular part
- Cochlear part

Vestibular & cochlear parts leave the ventral surface of brain stem through the *pontomedullary sulcus* (lateral to facial nerve), → run laterally in posterior cranial fossa and → enter the **internal acoustic meatus** along with 7th nerve.

Vestibular nuclei belong to ***special somatic afferent*** *column in brain stem.*

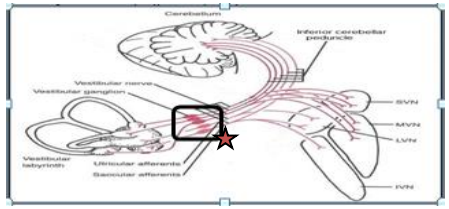
Vestibular part:

conveys impulses associated with balance of body (position & movement of the head)

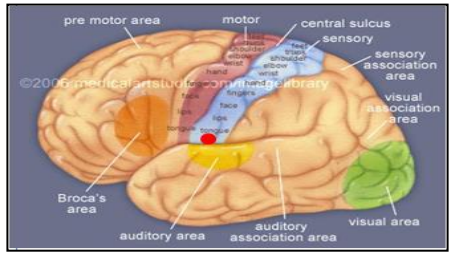
Afferent :

- The vestibular nerve fibers make dendritic contact with hair cells of the membranous labyrinth. (**the receptors**)
- Their cell bodies (**1st order neurons**) are located in the **vestibular ganglion** within the internal auditory meatus. ★
- Their central processes:

1. Mostly end up in the *lateral, medial, inferior and superior vestibular nuclei* (**2nd order neurons**) of the rostral medulla, located beneath the lateral part of the floor of 4th ventricle
2. Some fibers *go to the cerebellum* through the inferior cerebellar peduncle



Vestibular Cortex ●
- Located in the lower part of postcentral gyrus (head area).
- Responsible for *conscious awareness of vestibular sensation*.

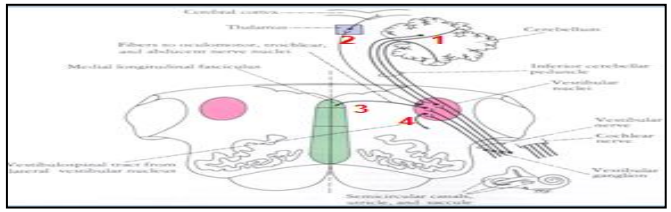


Efferent:

from the vestibular nuclei project to number of other regions for the control of **posture, maintenance of equilibrium, co-ordination of head & eye movements and the conscious awareness of vestibular stimulation** .

The **efferents** from the vestibular nuclei project:

1. To *ipsilateral* **flocculonodular lobe of cerebellum** through inferior cerebellar peduncle
2. *Bilaterally* to **ventral posterior nucleus of thalamus**, which in turn project to the cerebral cortex.
3. *Bilaterally* to **motor nuclei of cranial nerves** through medial longitudinal fasciculus
4. **Motor neurons of the spinal cord** (**vestibulospinal tract**).
   - Vestibulospinal fibers influence the activity of spinal motor neurons concerned with the *control of body posture and balance*.
   - Two tracts: lateral & medial
   - Lateral arises from lateral vestibular (Deiter's) nucleus, descends ***ipsilaterally***
   - Medial is the descending part of the medial longitudinal fasciculus, projects ***bilaterally***

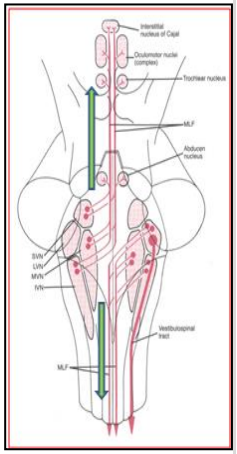


Medial Longitudinal Fasciculus
- Extends through out the brain stem and formed of both descending & ascending fibers
- Projects bilaterally

- Has two components:

➢ The ascending component establishes connections with the nuclei of the ***Occulomotor, Trochlear & Abducent*** nerves (motor nuclei for extraoccular muscles) for ***coordination of head & eye movements***.

➢ The descending component extends into the spinal cord as the medial ***vestibulospinal*** tract



Cochlear part:

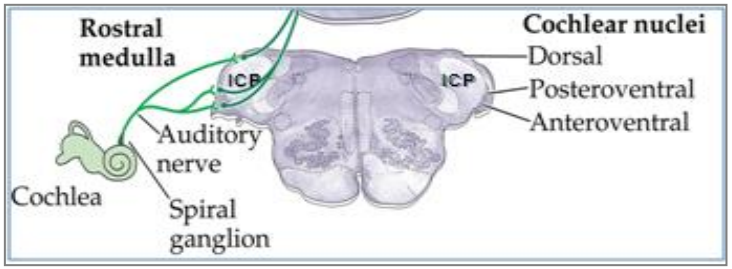
conveys impulses associated with hearing

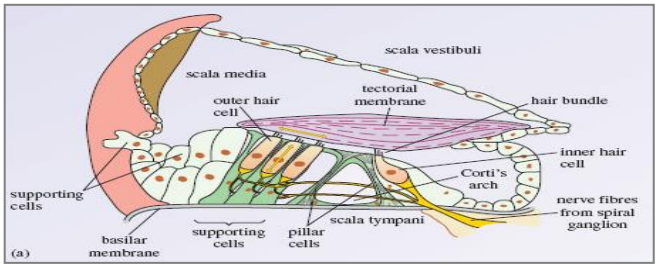
Cochlear (Auditory) Nerve

Auditory Pathway

- It is a **multisynaptic** pathway
- There are several locations between medulla and the thalamus where **axons may synapse and not all the fibers behave in the same manner.**
- Representation of cochlea is **bilateral** at all levels above cochlear nuclei.

Cochlear nuclei belong to ***special somatic afferent*** *column in brain stem*





The cochlear nerve fibers make *dendritic contact with hair cells of the organ of Corti* within the cochlear duct of the inner ear.
(**the receptors**)

→ Their cell bodies **(1st order neurons**) are located within the cochlea in the *spiral ganglion*.

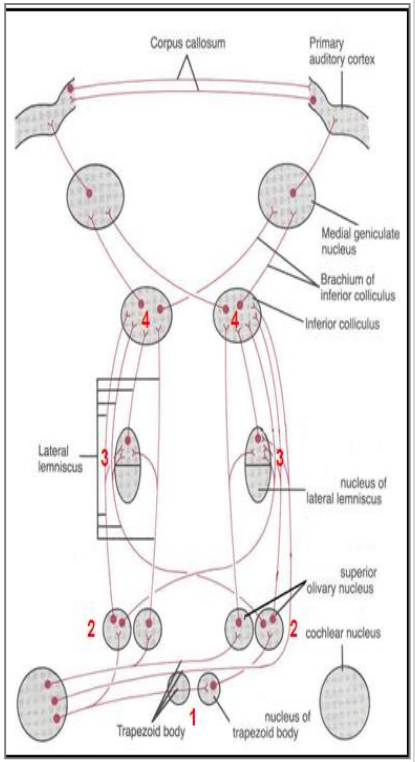
→ Their central processes terminate in the *dorsal and ventral cochlear nuclei* **(2nd order neurons)**, which lie close to the inferior cerebellar peduncle (ICP)

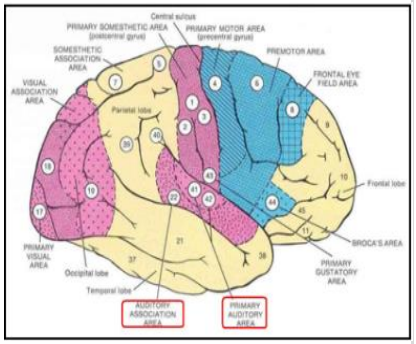
→ From the cochlear nuclei, 2nd order neurons ascend into the *pons*, where:

Some fibers *cross* the midline in trapezoid body (1) and terminate in the **nucleus of trapezoid body** or in the **contralateral superior olivary nucleus** (2)

Some fibers run *ipsilaterally* and terminate in the **superior olivary nucleus**

From the superior olivary nuclei, ascending fibers comprise the **lateral lemniscus** (3), which runs through tegmentum of pons and terminate in **the inferior colliculus** (4) of the mdibrain





- The region surrounding the primary auditory cortex is known as **the auditory association cortex** or Wernick's area (Brodmann's areas 22)
- Wernick's area is related to recognition and processing of language by the brain

Cochlear (Auditory) Nerve

Cochlear part:

- **Superior olivary nucleus** sends olivocochlear fibers to end in **organ of Corti** through the vestibulocochlear nerve. These fibers are inhibitory in function and serve to modulate transmission to the cochlear nerve
- **Superior olivary nucleus & the nucleus of the lateral lemniscus** establish reflex connections with **motor neurons of trigeminal and facial motor nuclei** mediating *contraction of tensor tympani and stapedius muscles in response to loud noise*
- **Inferior colliculi** establish reflex connections with **motor neurons in the cervical spinal segments** (tectospinal tract) for the *movement of head and neck in response to auditory stimulation*

Clinical Notes

- **Lesion** of vestibulocochlear nerve produces deafness (disturbnce of cochlear nerve functions),
  tinnitis, vertigo, dizziness, nausea, nystagmus, loss of balance and ataxia (disturbnce of vestibular nerve functions)
- **Acoustic neuroma**: a benign tumour of 8th nerve leads to compression of the nerve leading to attacks of dizziness, and profound deafness and ataxia
- The representation of cochlea is essentially **bilateral** at all levels rostral to the cochlear nuclei
- Lesions anywhere along the pathway usually have no obvious effect on hearing.
- Deafness is essentially only caused by ***damage to the middle ear, cochlea, or auditory nerve***.

Definitions

Ataxia : lack of voluntary coordination of muscle movements

Tinnitus : ringing of the ears

nystagmus : fast, uncontrollable movements of the eyes that may be:

- Side to side
- Up and down
- Rotary

Depending on the cause, these movements may be in both eyes or in just one eye. The term "dancing eyes" has been used to describe nystagmus.

SUMMARY

- Ganglia related to vestibulocochlear nerve are located in the inner ear.
- Vestibular & cochlear nerves pass through internal auditory meatus to the cranial cavity then enter pons at pontocerebellar angle, lateral to facial nerve.
- Cochlear & vestibular nuclei are of the special somatic afferent type, and are located in pons & medulla.
- Inferior colliculi, medial geniculate nucleus and finally auditory cortex are stations in cochlear pathway.
- Hearing is bilaterally represented.
- Vestibular nuclei are connected to: spinal cord (directly or through medial longitudinal fasciculus, flocculonodular lobe of cerebellum and to vestibular area of cerebral cortex.

QUESTIONS

Q1.The fourth order neurons of the auditory pathway are found in:

A. **Mid brain.**
B. **Thalamus.**
C. **Pons.**
D. **Cerebral cortex.**

Q2. The vestibular nuclei are connected to the occulomotor nuclei through:

A. **The lateral leminiscus**
B. **The lateral vestibulospinal tract**
C. **The medial longitudinal fasciculus**
D. **The vestibular nerve**

Q3.The Vestibular & cochlear parts enter the pons through pontocerebellar angle:

A. **Lateral to facial nerve**
B. **Medial to facial nerve**
C. **Medial to Abducent Nerve**
D. **Superior to Trigeminal**

Q4. Cochlear nuclei belong to:

A. **special somatic afferent**
B. **general somatic efferent**
C. **special visceral affrent**
D. **general visceral effrent**

Answers: B,C,A,A

GOOD LUCK

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