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**Course:** Physiology

**Question**

Discuss the physiology of balance

**Answer**

*The physiology of balance*

The *vestibular part* or non-auditory part of the internal ear is concerned with the Physiology of Balance and Equilibrium. The receptor apparatus in the ampulla is crista-ampullaris. It consists of the cupola which is a gelatinous wedge shaped structure running fully across the cross-section of the ampulla. Into the thick end of this wedge projects a ridge carrying many hair cells whose processes are embedded in cupola. The utricle and saccule have a patch or macula of hair cells that are also projecting into and embedded in gelatinous mass. This also contains above the hairs an otolith composed of a mass of calcium carbonate crystals called otoconia.

The vestibular system is affected by linear and rotational movements of the head. Classically, semicircular canals respond to angular accelerations and the otolith organs of the utricle and saccule respond to the direction of gravity force and to linear acceleration.

*FUNCTIONS OF VESTIBULAR SYSTEM:*

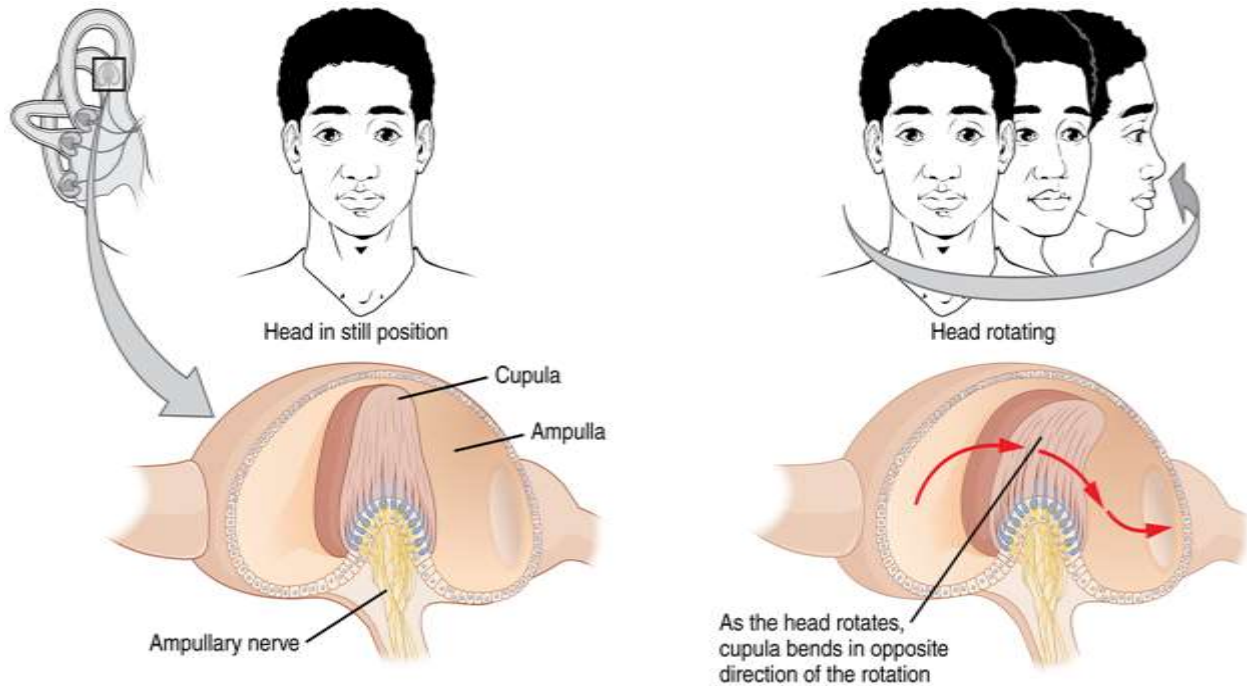
- It contributes to the sensation of motion and of spatial orientation of the head.
- During head movement, it helps to maintain a stable image on the retina by causing compensatory eye movements.
- It contributes to the maintenance of balance and various postures.

Movement of the head cause flow of endolymph and deflection of cupola of crista-ampullaris. As a result of these hairs get bend. As a result impulses are generated in hair cells and are passed on through vestibular branch of VIII cranial nerve to the brain. Similarly flow of endolymph in otolith organ of utricle and saccule causes the movement of hairs of the hair cells. This causes generation of action potential discharge which is passed on to the brain through vestibular branch of VIII cranial nerve. In brief static equilibrium is the orientation of the body relative to the pull of gravity. The macule of utricle and saccule are the sense organs of static equilibrium. Dynamic equilibrium is the maintenance of body position in response to movement. Crista ampullaris is the sense organ for the dynamic equilibrium.

*VESTIBULAR DISEASE:*

There are a variety of diseases of the inner ear which are characterized by vertigo, severe dizziness, and tinnitus or ringing in the ears and deafness. The vertigo is often so severe that there is nausea and vomiting, blurred vision, a tendency to fall in a certain direction and nystagmus. Nystagmus is characterized by rapid, involuntary movement of the eyeballs. Electronystagmography is a diagnostic

test that is useful in identifying vestibular diseases. Electrodes are placed on each side of the face to measure movement of the eye while they are closed.



### How does the ear maintain balance?

The semicircular canals of the inner ear help you with balance. This movement of the fluid moves the hairs of the canals, creating nerve impulses that travel up to your brain and let it know that your head is off balance. You don't fall over because your brain tells your muscles to support you.

### What is responsible for balance?

- 1) The cochlea is responsible for hearing.
- 2) The semicircular canals have function associated with balance.
- 3) The vestibule which connects the two and contains two more balance and equilibrium related structures, the saccule and utricle.

### What is the function of equilibrium within the sensory nervous system?

The vestibular system is a sensory system that is responsible for providing our brain with information about motion, head position, and spatial orientation; it also is involved with motor functions that allow us to keep our balance, stabilize our head and body during movement, and maintain posture.

### What is the neural pathway for equilibrium and balance?

Balance is coordinated through the vestibular system, the nerves of which are composed of axons from the vestibular ganglion that carries information from the utricle, saccule, and semicircular canals. The system contributes to controlling head and neck movements in response to vestibular signals.

**Note these key points**

- balance is mediated by the vestibular nuclei in the brain stem
- the labyrinth (a part of the inner ear), is a major organ of our vestibular (balance) system
- the three semicircular canals of the labyrinth is associated with sensing rotary motion (1)
- the brain senses the direction and speed of rotation of the head by the movement of fluid in the semicircular canals (1)
- balance is maintained by the interactions between the labyrinth and other systems in the body, such as the visual and skeletal systems (1)
- the main inputs into the balance system are the:
  - ✓ vestibular labyrinths
  - ✓ visual system (eyes)
  - ✓ somatosensory system, especially proprioception
- the main outputs from the vestibular nuclei are:
  - ✓ vestibulo-ocular:
    - ✓ permitting reflex eye movements related to posture
  - ✓ vestibulo-spinal which supply:
    - anti-gravity muscles in the lower limbs
    - reflex arcs which control gait