

MORIA ONORIODE

18/MHS02/160

NURSING

ASSIGNMENT

Discuss the physiology of balance

Answers

- Vestibular system
- Sense of body position
- CNS sensory-motor coupling • Eye movements
- Position of the head

Balance – Bone and Membraneous Labyrinth

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Balance – Vestibulocochlear nerve (CN VIII)

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Sense of balance – Semicircular Canals

Sense of balance – Otholit organs

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Sense of balance – Sensory epithelium

Otolithic Membrane

Macula

Sense of balance – Vestibular hair cells

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Sense of balance – Generation of receptor potential

- 1) K^+ influx through the cilia for depolarization
- 2) Ca^{++} influx through voltage-gated channels
- 3) K^+ outflux for repolarization

Sense of balance – Primary afferent signal

Note: Hair cells slightly polarized at rest, causing a resting discharge from the primary afferent fibers.

Sense of balance – Striola

Sense of balance – Detecting the Acceleration

Sense of balance – Semicircular Canals

Vestibular System

Semicircular canals

Vestibular Neuclei

Vestibulo- cerebellum

Extraocular muscles (VOR)

Thalamus and Cortex

Reticular Formation

Nerves of the trunk and limbs

Sense of balance – Semicircular Canals

Central Pathways for Balance

- CNs III-IV ve VI via medial long. fasciculus
 - Vestibulocerebellum
 - Medial vestibulospinal tract
 - Lateral vestibulospinal tract
 - To sensory cortex via the thalamus
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- 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

The vestibular system is the sensory apparatus of the inner ear that helps the body maintain its postural equilibrium. The information furnished by the vestibular system is also essential for coordinating the position of the head and the movement of the eyes. There are two sets of end organs in the inner ear, or labyrinth: the semicircular canals, which respond to rotational movements (angular acceleration); and the utricle and saccule within the vestibule, which respond to changes in the position of the head with respect to gravity (linear acceleration). The information these organs deliver is proprioceptive in character, dealing with events within the body itself, rather than exteroceptive, dealing with events outside the body, as in the case of the responses of the cochlea to sound. Functionally these organs are closely related to the cerebellum and to the reflex centres of the spinal cord and brainstem that govern the movements of the eyes, neck, and limbs.

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.