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**MARIC NUMBER; 18/MHS02/077**

**COURSE CODE; PHYSIOLOGY**

### **DISCUSS THE PHYSIOLOGY OF BALANCE**

The semicircular canals and the vestibule (utricle and saccule) are concerned with balance. Any change of position of the head causes movement in the perilymph and endolymph, which bends the hair cells and stimulates the sensory nerve endings in the utricle, saccule and ampullae. The resultant nerve impulses are transmitted by the vestibular nerve which joins the cochlear nerve to form the vestibulocochlear nerve. The vestibular branch passes first to the vestibular nucleus, then to the cerebellum.

The cerebellum also receives nerve impulses from the eyes and proprioceptors (sensory receptors) in the skeletal muscles and joints. Impulses from these three sources are coordinated and efferent nerve impulses pass to the cerebrum and to the skeletal muscles. This results in awareness of body position, maintenance of upright posture and fixing of the eyes on the same point, independently of head movements.

Balance is the ability to maintain the body's center of mass over its base of support. A properly functioning balance system allows humans to see clearly while moving, identify orientation with respect to gravity, determine direction and speed of movement, and make automatic postural

adjustments to maintain posture and stability in various conditions and activities, balance is achieved and maintained by a complex set of sensorimotor control systems that include sensory input from vision (sight), proprioception (touch), and the vestibular system (motion, equilibrium, spatial orientation); integration of that sensory input; and motor output to the eye and body muscles. Injury, disease, certain drugs, or the aging process can affect one or more of these components. In addition to the contribution of sensory information, there may also be psychological factors that impair our sense of balance.

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
- the brain senses the direction and speed of rotation of the head by the movement of fluid in the semicircular canals.

balance is maintained by the interactions between the labyrinth and other systems in the body, such as the visual and skeletal systems, 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 central vestibular system unites the peripheral signals from both ascending pathways to elicit eye, head, and body motor responses for control of balance and orientation.

The vestibular system is a complex set of structures and neural pathways that serves a wide variety of functions that contribute to our sense of proprioception and equilibrium. These functions include the sensation of orientation and acceleration of the head in any direction with associated compensation in eye movement and posture. These reflexes are referred to as the vestibulo-ocular and vestibulospinal reflexes, respectively. The centrally located vestibular system involves neural pathways in the brain that respond to afferent input from the peripheral vestibular system in the inner ear and provide efferent signals that make these reflexes possible. Current data suggest that the vestibular system also plays a role in consciousness, and dysfunctions of the system can cause cognitive deficits related to spatial memory, learning, and navigation.