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DEPARTMENT :NURSING

COURSE : PHS ASSIGNMENT

QUESTION: DISCUSS ON PHYSIOLOGY OF BALANCE

Introduction: The Physiology Of Balance: Vestibular Function

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 organs and the cochlea are derived embryologically from the same formation, the otic vesicle, their association in the inner ear seems to be a matter more of convenience than of necessity. From both the developmental and the structural point of view, the kinship of the vestibular organs with the lateral line system of the fish is readily apparent. The lateral line system is made up of a series of small sense organs located in the skin of the head and along the sides of the body of fishes. Each organ contains a crista, sensory hair cells, and a cupula, as found in the ampullae of the semicircular ducts. The cristae respond to waterborne vibrations and to pressure changes.

Mechanisms of Action :

Postural balance is controlled by intricate connections between the vestibular, visual and proprioception system. Among these, the vestibular system is one of the key factors in coordinating and maintaining balance. The peripheral apparatus for the vestibular system consists of the semicircular canals, which sense head rotation; and the otoliths, which sense gravity and linear acceleration. The central vestibular pathways form a large network from the vestibular nuclei, ocular motor nuclei, integration centers in the pons and rostral midbrain, vestibulocerebellum, thalamus, to the multisensory vestibular cortex areas in the temporoparietal cortex. The most important structures for the central vestibular pathways are those mediating the vestibulo-ocular reflex (VOR), and the descending pathways into the spinal cord along the medial and lateral vestibulospinal tract which mediate postural control. The cortical structures involved in vestibular function are the parietoinsular vestibular cortex, the retroinsular cortex, the superior temporal gyrus and the inferior parietal lobule. Activation of the cortical network during vestibular stimulation is not symmetrical; dominance is stronger in the nondominant hemisphere, in the hemisphere ipsilateral to the stimulated ear and in the hemisphere ipsilateral to the slow phase of the vestibular caloric nystagmus. Disorder of the vestibular pathway, anyway along its various tracts, may result in balance and coordination impairments and lead to misperception of motion.

Functions:

Routine tests of vestibular function traditionally have involved stimulation of the semicircular canals to elicit nystagmus and other vestibular ocular reflexes. Rotation, which can cause vertigo and nystagmus, as well as temporary disorientation and a tendency to fall, stimulates the vestibular apparatus of both ears simultaneously. Because otoneurologists are usually more interested in examining the right and left ears separately, they usually employ temperature change as a stimulant. Syringing the ear canal with warm water at 44 °C (111 °F) or with cool water at 30 °C (86 °F) elicits nystagmus by setting up convection currents in the horizontal canal. The duration of the nystagmus may be timed with a stopwatch, or the rate and amplitude of the movements of the eyes can be accurately recorded by picking up the resulting rhythmical variations in the corneoretinal direct current potentials, using electrodes pasted to the skin of the temples—a diagnostic process called electronystagmography. An abnormal vestibular apparatus usually yields a reduced response or no response at all.

The vestibular system may react to unaccustomed stimulation from the motion of an aircraft, a ship, or a land vehicle to produce a sense of unsteadiness, abdominal discomfort, nausea, and vomiting. Effects not unlike motion sickness, with vertigo and nystagmus, can be observed in the later stages of acute alcoholic intoxication. Vertigo accompanied by hearing loss is a prominent feature of the periodic attacks experienced by patients with Ménière disease, which, until the late 19th century, was confused with epilepsy. It was referred to as apoplectiform cerebral congestion and was treated by purging and bleeding. Other forms of vertigo may present the otoneurologist with more difficult diagnostic problems.

Since the advent of space exploration, interest in experimental and clinical studies of the vestibular system has greatly increased. Investigators are concerned particularly about its performance when persons are exposed to the microgravity of spaceflight, as compared with the Earth’s gravitational field for which it evolved. Investigations include the growing use of centrifuges large enough to rotate human subjects, as well as ingeniously automated tests of postural equilibrium for evaluating the vestibulospinal reflexes. Some astronauts have experienced relatively minor vestibular symptoms on returning from spaceflight. Some of these disturbances have lasted for several days, but none have become permanent.