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COURSE: Renal Physiology

Assignment

1. Discuss the physiology.

2. Discuss the role of basal ganglia in coordinating movement.

**PHYSIOLOGY OF SLEEP**

Sleep can be defined as unconsciousness from which a person can be aroused by sensory or other stimuli. It can also be defined as a natural periodic state of rest for mind and bodywith closed eyes characterized by partial orcomplete loss of consciousness.

There are two types of sleep and they include:

i. Rapid Eye Movement (REM sleep): This is the type of sleep in which the brain is quite active and there is also rapid movement of the eyes. However the person is not fully aware of his or her surroundings. It can also be called paradoxical, desynchronized or rapid wave sleep. REM sleep occurs in episodes that occupy about 25% of sleep time in young adults: each episode occurs about every 90mins. This type of sleep is not so restful and it is often associated with rapid dreaming. Also the heart rate and respiratory rate usually become irregular, the brain becomes highly active.

During REM sleep, electroencephalogram (EEG) shows irregular waves with high frequency and low amplitude. These waves are desynchronized waves.

ii. Slow- wave sleep: it can also b e called non-rapid eye movement sleep (NREM) . This type of sleep is exceedingly restful and is associated with decreases in both peripheral vascular tone and many other vegetative functions of the body.

The NREM sleep is divided into four stages, based on the EEG pattern. During the stage of wakefulness, i.e. while lying down with closed eyes and relaxed mind, the alpha wavesof EEG appear. When the person proceeds to drowsy state, the alpha waves diminish.

**Stage I: Stage of Drowsiness:** in this stage, alpha waves are diminished and abolished. EEG shows only low voltage fluctuations and infrequent delta waves.

**Stage II: Stage of Light Sleep:** Stage II is characterized by spindle burstsat a frequency of 14 per second, superimposed by low voltage

**Stage III: Stage of Medium Sleep**: During this stage, the spindle bursts disappear. Frequency of delta waves decreases to 1 or 2 per second and amplitude increases to about 100μV.

**State IV: Stage of Deep Sleep:** Delta wavesbecome more prominent with low frequency and high amplitude.

**Mechanism of Sleep**

Sleep occurs due to the activity of some **sleep-inducing centers** in brain. Stimulation of these centers inducessleep. Damage of sleep centers results in sleeplessnessor persistent wakefulness called **insomnia.**

 **SLEEP CENTERS**

Complex pathways between the reticular formation of brainstem, diencephalon and cerebral cortex are involved in the onset and maintenance of sleep. However, two centers which induce sleep are located

in brainstem:

1. Raphe nucleus

2. Locus ceruleus of pons.

**1. Role of Raphe Nucleus** Raphe nucleus is situated in lower pons and medulla. Activation of this nucleus results in non-REM sleep. It is due to release of serotoninby the nerve fibers arising from this nucleus. Serotonin induces non-REM sleep.

**2. Role of Locus Ceruleus of Pons** Activation of this center produces REM sleep. Noradrenalinereleased by the nerve fibers arising from locus ceruleus induces REM sleep.

**Applied Physiology**

1. INSOMNIA: Insomnia is the inability to sleep or abnormal wakefulness. It is the most common sleep disorder. It occurs due to systemic illness or mental conditions such as psychiatric problems, alcoholic addiction and drug addiction.

2. Hypersomnia: is the excess sleep or excess need to sleep. It occurs because of lesion in the floor of the third ventricle, brain tumors, encephalitis, chronic bronchitis and disease of muscles. Hypersomnia also occurs in endocrine disorders such as myxedema and diabetes insipidus.

3. NARCOLEPSY AND CATAPLEXY: Narcolepsy is the sudden attack of **uncontrollable sleep.** Cataplexy is sudden **outburst of emotion.** Both the diseases are due to hypothalamic disorders.

4. SLEEP APNEA SYNDROME**:** Sleep apnea is the temporary stoppage of breathing repeatedly during sleep. Sleep apnea syndrome isthe disorder that involves fluctuations in the rate and force of respiration during REM sleep with short apneic episode. Apnea is due to decreased stimulation of respiratory centers, arrest of diaphragmatic movements, airway obstruction (Chapter 127) or the combination of all these factors. When breathing stops, the resultant hypercapnia and hypoxia stimulate respiration. Sleep apnea syndrome occurs in **obesity,** myxedema, enlargement of tonsil and lesion in brainstem. Common features of this syndrome are **loud snoring** (Chapter 127), restless movements, nocturnal insomnia, daytime sleepiness, morning headache and fatigue. In severe conditions, hypertension, right heart failure and stroke occur.

5. SOMNAMBULISM**:** Somnambulism is getting up from bed and walking in the state of sleep. It is also called walking during sleepor sleep walking(somnus = sleep; ambulare = to walk). It varies from just sitting up in the bed to walking around with eyes open and performing some major complex task. The episode lasts for few minutes to half an hour. It occurs during non-REM sleep. In children, it is associated with bedwetting or night terror without any psychological disturbance. However, in adults it is associated with psychoneurosis.

6. NOCTURNAL ENURESIS: Nocturnal enuresis is the involuntary voiding of urine at bed. It is also called or bedwetting**.** It is common in children.

**2. ROLE OF BASAL GANGLIA IN CONTROLLING MOVEMENT**

The basal ganglia refer to a group of subcortical nuclei responsible primarily for motor control, as well as other roles such as motor learning, executive functions and behaviours and emotions. The basal ganglia control movement by: i. Determine how rapidly the movement is to be performed ii. Control how large the movement will be.

The basal functions in close association with the cerebral cortex, especially the posterior parietal cortex which is the locus of the spatial coordinates for motor control of all parts of the body, as well as for the relation of the parts of the body to its surroundings.

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