17/MHS01/085

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MBBS

300L

PHYSIOLOGY ASSIGNMENT

1. **Discuss the physiology of sleep**

Sleep is the natural periodic state of rest for the mind and body with closed eyes characterized by partial or complete loss of consciousness. Loss of consciousness leads to decreased response to external stimuli and decreased body movements. Depth of sleep is not constant throughout the sleeping period. It varies in different stages of sleep.

Sleep requirement is not constant. The average sleep requirement per day at different age groups includes:

. Newborn infants- 18 to 20 hours

. Growing children- 12 to 14 hours

. Adults- 7 to 9 hours

. Old persons- 5 to 7 hours.

Changes in the body during sleep.

1. Plasma volume decreases by 10%.
2. Cardiovascular System: During sleep, the heart rate reduces. It varies between 45 and 60 beats per minute. Systolic pressure falls to about 90 to 110 mm Hg. Lowest level is reached about 4th hour of sleep and remains at this level till a short time before waking up. Then, the pressure commences to rise. If sleep is disturbed by exciting dreams, the pressure is elevated above 130 mm Hg.
3. Respiratory System: Rate and force of respiration are decreased. Respiration becomes irregular and Cheyne-Stokes type of periodic breathing may develop.
4. Gastrointestinal Tract: Salivary secretion decreases during sleep. Gastric secretion is not altered or may be increased slightly. Contraction of empty stomach is more vigorous.
5. Excretory System: Formation of urine decreases and specific gravity of urine increases.
6. Sweat Secretion: It increases during sleep.
7. Lacrimal Secretion: It decreases.
8. Muscle Tone: Tone in all the muscles of body except ocular muscles decreases very much during sleep. It is called sleep paralysis.
9. Reflexes: Certain reflexes particularly knee jerk, are abolished. Babinski signbecomes positive during deep sleep. Threshold for most of the reflexes increases. Pupils are constricted. Light reflex is retained. Eyeballs move up and down.
10. Brain: Brain is not inactive during sleep. There is a characteristic cycle of brain wave activity during sleep with irregular intervals of dreams. Electrical activity in the brain varies with stages of sleep.

**TYPES OF SLEEP**

1. Rapid eye movement sleep (REM) is the type of sleep associated with rapid conjugate movements of the eyeballs, which occurs frequently. Though the eyeballs move, the sleep is deep. So, it is also called paradoxical sleep.It occupies about 20% to 30% of sleeping period. Functionally, REM sleep is very important because, it plays an important role in consolidation of memory. Dreams occur during this period.
2. Non-Rapid Eye Movement Sleep (NON-REM): It is the type of sleep without the movements of eyeballs. It is also called slow-wave sleep. Dreams do not occur in this type of sleep and it occupies about 70% to 80% of total sleeping period. Non-REM sleep is followed by REM sleep.

**STAGES OF SLEEP AND EEG PATTERN**

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

. Non-Rapid Eye Movement Sleep: 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**

Alpha waves are diminished and abolished. EEG shows only low voltage fluctuations and infrequent delta waves.

**Stage II: Stage of Light Sleep**

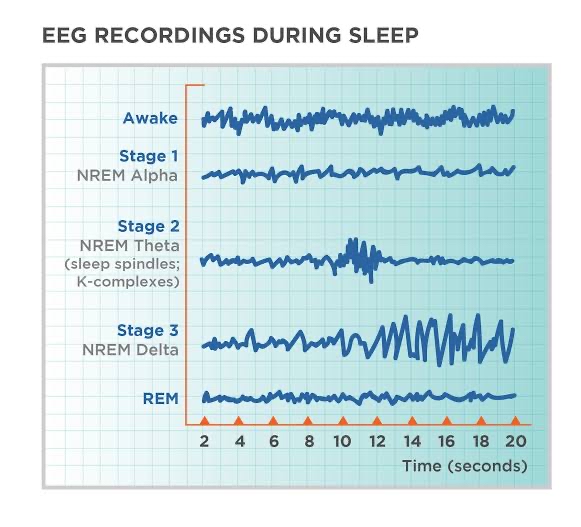
Stage II is characterized by spindle burstsat a frequency of 14 per second, superimposed by low voltage delta waves.

**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 100 μV.

**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 centersin 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.

reticular activating system also results in sleep.

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.

**SLEEP DISORDERS**

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

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 is the 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 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, restless movements, nocturnal insomnia, daytime sleepiness, morning headache and fatigue. In severe conditions, hypertension, right heart failure and stroke occur.

5. NIGHTMARE

Nightmare is a condition during sleep that is characterized by a sense of extreme uneasiness or

discomfort or by frightful dreams. Discomfort is felt as of some heavy weight on the stomach or chest or as uncontrolled movement of the body. After a period of extreme anxiety, the subject wakes with a troubled state of mind. It occurs mostly during REM sleep. Nightmareoccurs due to improper food intake,

digestive disorders or nervous disorders. It also occurs during drug withdrawal or alcohol withdrawal.

6. NIGHT TERROR

Night terror is a disorder similar to nightmare. It is common in children. It is also called pavor nocturnusor sleep terror.The child awakes screaming in a state of fright and semi consciousness. The child cannot recollect the attack in the morning. Nightmare occurs shortly after falling asleep and during non-REM sleep. There is no psychological disturbance.

7. SOMNAMBULISM

Somnambulism is getting up from bed and walking in the state of sleep. It is also called walking during sleep or sleep walking. 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.

8. NOCTURNAL ENURESIS

Nocturnal enuresis is the involuntary voiding of urine at bed. It is also called bedwetting. It is common in children.

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

Regulation of Voluntary Movements

Movements during voluntary motor activity are initiated by cerebral cortex. However, these movements are controlled by basal ganglia, which are in close association with cerebral cortex. During lesions of basal ganglia, the control mechanism is lost and so the movements become inaccurate and awkward.

Basal ganglia control the motor activities because of the nervous (neuronal) circuits between basal ganglia and other parts of the brain involved in motor activity.

Neuronal circuits arise from three areas of the cerebral cortex:

a. Premotor area

b. Primary motor area

c. Supplementary motor area.

All these nerve fibers from cerebral cortex reach the caudate nucleus. From here, the fibers go to putamen. Some of the fibers from cerebral cortex go directly to putamen also. Putamen sends fibers to globus pallidus. Fibers from here run towards the thalamus, subthalamic nucleus of Luys and substantia nigra. Subthalamic nucleus and substantia nigra are in turn, projected into thalamus. Now, the fibers from thalamus are projected back into primary motor area and other two motor areas, i.e. premotor area and supplementary motor area.

Regulation of Conscious Movements

Fibers between cerebral cortex and caudate nucleus are concerned with regulation of conscious movements. This function of basal ganglia is also known as the cognitive controlof activity. For example, when a stray dog barks at a man, immediately the person, understands the situation, turns away and starts running.

Regulation of Subconscious Movements

Cortical fibers reaching putamen are directly concerned with regulation of some subconscious movements, which take place during trained motor activities, i.e. skilled activities such as writing the learnt alphabet, paper cutting, nail hammering, etc.