

**NAME: FAKROGHA LATRICIA**

**LEVEL:300L**

## **PHYSIOLOGY OF SLEEP**

**Sleep is the natural periodic state of rest of mind and body in total or partial loss of consciousness, where one has decreased response to external stimuli and decreased body movements.**

### **PHYSIOLOGICAL CHANGES DURING SLEEP**

During sleep, most of the body's physiological functions are reduced. The changes include:

1. **PLASMA VOLUME:** During sleep, it decreases by about 10%.
2. **CARDIOVASCULAR SYSTEM:** Sleep affects two(2) aspects; Heart rate and blood pressure.
  - a. **HEART RATE:** The heart beats between **45-60** minutes, signaling a reduction.
  - b. **BLOOD PRESSURE:** Systolic blood pressure decreases to about **90-110mmHg**. The lowest level is reached at about the 4<sup>th</sup> hour of sleep until a few minutes before one wakes up when the pressure starts to rise.
3. **RESPIRATORY SYSTEM:** Rate and force of respiration decreases with respiration becoming irregular.
4. **GASTROINTESTINAL SYSTEM:** Salivary secretion decreases. Gastric secretion may or may not be altered. Contraction of the stomach becomes vigorous.
5. **EXCRETORY SYSTEM:** Urine formation decreases and specific gravity of urine increases.
6. **BRAIN:** It is active with a cycle of brain wave activities and irregular intervals of dreams during sleep.
7. **MUSCLE TONE:** Muscular tone in all parts of the body decreases apart from the ocular muscles. It is called SLEEP PARALYSIS.
8. **REFLEXES:** The following reflexes are noticed during sleep; Babinski sign, pupil reflex, light reflex.
9. **SWEAT:** Sweat secretion increases.
10. **TEARS:** Lacrimal secretion increases.

### **TYPES OF SLEEP**

There are two types of sleep:

1. Rapid eye movement sleep(REM)
2. Non-Rapid eye movement sleep(NREM)

## **RAPID EYE MOVEMENT SLEEP/ PARADOXICAL SLEEP**

According to the name, this type of sleep has to do with a deep sleep with rapid eye movements. It is very important because it plays a vital role in the consolidation of memory. Because of this role, dreams occur here. Muscle twitches occur. Physiological changes like the ones aforementioned (heart rate, blood pressure, etc) fluctuate. The neurotransmitter, NORADRENALINE, is produced in this type of sleep.

## **NON-RAPID EYE MOVEMENT SLEEP/ SLOW-WAVE SLEEP**

This is the period of sleep associated with non-rapid eye movements. It is followed by REM sleep. Dreams and muscle twitches do not occur here. The physiological changes remain stable. Serotonin is produced here.

Sleep has different stages varying with its depth and these stages are being recorded by the **ELECTROENCEPHALOGRAM(EEG)**.

- ❖ For REM sleep, the EEG shows irregular waves with high frequency and low amplitude. They are **desynchronized waves**.
- ❖ For NREM sleep, the EEG records four stages. Before one drifts into sleep, the person is in the wakefulness stage and it is signified by the **alpha waves** in the EEG. The 4 stages are:
  1. DROWSINESS STAGE: Alpha waves disappear and there are low voltage fluctuations and infrequent delta waves.
  2. LIGHT SLEEP STAGE: There are spindle bursts with frequency of 14/s superimposed by low voltage delta waves.
  3. MEDIUM SLEEP STAGE: Spindle bursts disappear. There is a decrease in the frequency of delta waves to 1 or 2 /sec and amplitude increases to about 100microvolts.
  4. DEEP SLEEP STAGE: Delta waves are more prominent here with low frequency and high amplitude.

## **SLEEP MECHANISM**

Sleep occurs due to the stimulation of some sleep-inducing centers in the brain. Damage to these centers can lead to sleeplessness or insomnia. They are:

1. Raphe nucleus
2. Locus coruleus nucleus
3. Accessory system: Ascending Reticular Activation System

- **RAPHE NUCLEUS:** It is located in the **lower pons and medulla** and its activation would result in NREM sleep. The activation of the nucleus results in the production of **serotonin** from its nerve fibres which causes NREM sleep.
- **LOCUS CORULEUS NUCLEUS:** It is located in the pons. Activation of this nucleus causes the release of **noradrenaline** from its nerve fibres and results in REM sleep.
- **ASCENDING RETICULAR ACTIVATION SYSTEM:** This regulates wakefulness by means of its afferent and efferent connections with cerebral cortex. Inhibition of this system induces sleep and lesion to it causes coma.

### **APPLIED PHYSIOLOGY**

1. **SOMNAMBULISM:** Also called SLEEP-WALKING. This is a situation where one becomes mobile during sleep, that is, walking from one place to another. It occurs during NREM sleep. In children, it is associated with bedwetting or night terror without any psychological disturbance. In adults, it is associated with psychoneurosis.
2. **NIGHTMARE:** This is a condition of sleep where one experiences uneasiness or discomfort mostly due to frightful dreams. It occurs during REM sleep. Some other causes include digestive disorders, nervous disorders and drug withdrawal.
3. **INSOMNIA:** An abnormal state of wakefulness or inability to sleep. It could be due to mental disorders or systemic problems.

## **ROLE OF BASAL GANGLIA IN MOTOR COORDINATION**

Basal ganglia (basal nuclei) are scattered masses of gray matter submerged in the subcortical substance of cerebral hemisphere. They are strongly connected with the cerebral cortex, thalamus and other areas of the brain. It forms part of the extrapyramidal system, concerned with motor activities. These activities include:

1. **CONTROL OF MUSCLE TONE:** Gamma motor neurons in the spinal cord are responsible for the development of muscle tone. But the basal ganglia decrease the muscle tone by inhibiting the gamma motor neurons in the spinal cord through descending reticular system in the brainstem. Lesion of the basal ganglia leads to muscle tone rigidity.
2. **CONTROL OF MOTOR ACTIVITY:** The basal ganglia regulate three things here:
  - Voluntary movements
  - Conscious movements
  - Subconscious movements

- **VOLUNTARY MOVEMENTS:** They are initiated by the cerebral cortex but they are controlled by the basal ganglia which are closely associated with the cerebral cortex. They are able to control these movements due to its nervous circuits with other parts of the brain involved in motor activity. The nervous circuits arise from the 3 areas of the cerebral cortex:

- ✓ Premotor area
- ✓ Primary motor area
- ✓ Supplementary motor area

From the cerebral cortex, these nerve fibers are connected between the basal ganglia (caudate nucleus, putamen and globus pallidus), thalamus and back to the motor areas of the cerebral cortex. Lesions to the basal ganglia would result in awkward and inaccurate movements due to the loss of its control effect.

- **CONSCIOUS MOVEMENTS:** This is regulated by fibers between the caudate nucleus and cerebral cortex. This control is cognitive by the basal ganglia.
- **SUBCONSCIOUS MOVEMENTS:** This is regulated by fibers between the putamen and cerebral cortex. It takes place during trained motor activities e.g typing, writing etc.

3. **CONTROL OF REFLEX MUSCULAR ACTIVITY:** Basal ganglia controls and integrates impulses for reflex activities like the visual and labyrinthine reflexes. Lesions of the basal ganglia renders the reflexes abnormal due to rigidity. The rigidity is caused by the absence of inhibitory impulses from the cerebral cortex to the spinal cord via the basal ganglia.
4. **CONTROL OF AUTOMATIC ASSOCIATED MOVEMENTS:** These are movements that take place simultaneously with other motor activities. E.G, swinging the arms while walking.

### APPLIED PHYSIOLOGY

1. **PARKINSON'S DISEASE:** This is a progressive degenerative disease of the nervous system that occurs due to the destruction of the dopamine-producing cells in the substantia nigra and nigro-striatal pathway of the basal ganglia. The destruction could be caused by viral infections, antihypertensive drugs etc.  
**SYMPTOMS:** Tremor, rigidity, akinesia, postural instability etc.
2. **CHOREA:** Abnormal involuntary movement, **RAPID JERKY MOVEMENT**, caused by damage to the caudate nucleus and putamen.
3. **ATHETOSIS: Slow, rhythmic, twisting movements** caused by lesion to the caudate nucleus and putamen.

