



PHYSIOLOGY

☒ Sheet

☐ Slide

☐ Handout

Number

22

Subject

SLEEP

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Price:

- RAS (reticular activating system) is located in the reticular formation of the brain stem . It is called activating as it activates the cerebral cortex, usually through thalamus as each area of it projects to one area of the cortex. And as the cortex is active, the person is awake.
- RAS is an ipsilateral system
- RAS has two areas as follows ;

☞ Excitatory (bulboreticular facilitatory area);

As it excited, it activates the thalamus to awaken the cortex.

It has both ascending and descending fibers;

- Ascending : to the thalamus
- Descending (reticulospinal fibers): supplies antigravity muscles.

☞ Inhibitory; for sleep initiation, its stimulation inhibits the excitatory area (bulboreticular fibers) and the person goes into sleep.

☞ Reticular formation (RF) activation ;

✚ What is the difference between sleepy and comatose person?

Both are unconscious, but sleepy one can be awoken (aroused) by any kind of sensory stimulation (even hearing) , especially slow pain as 75% of its pathway fibers stop at the RF and stimulate it.

✚ Still can be stimulated by descending fibers through corticospinal tract (i.e. walking , and that's applied in many situations as with guards or students studying during night , as they keep walking to keep themselves awake).

✚ Also ascending fibers can stimulate the RF.

➔ By these we keep constant input to the cerebral cortex to remain active.

☞ Clinical correlation: facilitatory area destruction in a brain stem lesion causes coma that can be tested by pinch and talk. These patients rarely wake up again as the damage is permanent in contrast to edema for example. Also these patients need cardiopulmonary resuscitation (CPR) and ICU.

∞ Transmitters secreted in these two areas;

- ACh : from the excitatory area
- Serotonin: from inhibitory area (i.e. raphe magnus nucleus), which is included in the **endogenous pain suppression system**.
- Enkephalins (Met and Leu) : inhibitory pentapeptides secreted from descending fibers of PAG (periequeductal gray) and periventricular areas to raphe magnus that ↓ serotonin .
- Norepinephrine: from locus ceruleus, which is involved in the REM sleep.
(REM will be discussed later in this sheet)

➤ Raphe magnus descending and ascending fibers as follows ;

- Descending: pre-synaptically to pain pathway, and it synapses through inhibitory interneurons that secretes enkephalins, suppressing pain transmission both pre-synaptically and post-synaptically.
 - Enkephalins are endogenous opioids, as well as endorphins which are secreted from the pituitary and hypothalamus from POMC (proopiomelanocorticotropin).
Dynorphins are also endogenous opioids that is 200X more active than morphine.
- Ascending

☞ Clinical correlation :

Drugs that keep you awake; prevent serotonin release or synthesis or competitive inhibitors for serotonin receptors.

∞ Sleep is divided into 2 types ;

- **Slow wave / deep / nREM sleep** :
slow as it records slow waves theta and delta.
deep as the person is restful and deep in sleep
and nREM as there's no rapid eye movements
- **Rapid / round / paradoxical / REM sleep** :
It records rapid beta waves with rapid eye movements with brain activity that contradicts the sleep concept, that's why it's called paradoxical.

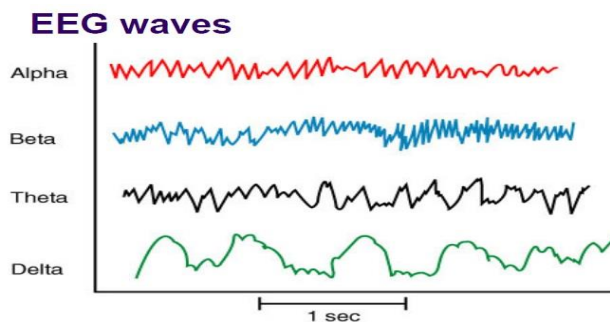
⌘ **EEG** ; used to diagnose abnormalities as epilepsy and epi-seizures .

excitatory post-synaptic potentials , and not action potentials . Easier to read than ECG, but difficult to do as it may needs 20 leads. It records waves of different frequencies as follows;

1. Alpha waves : 8-13 /s \gg recorded in nREM
2. Beta waves : 14-80 /s , which is very rapid \gg recorded in rapid sleep/ REM
3. Theta waves : 4-7 /s , usually recorded in children (in temporal and parietal regions)
4. Delta waves : 3.5 /s , recorded from other regions .

- Both theta & delta are recorded in slow wave sleep / nREM

AS we get lower frequencies, the amplitude of the wave increases & vice versa.



⌘ Sleep cycle ;

usually when the person is tired and goes to sleep the first part is slow sleep /nREM that remains around 90mins , then the brain goes into REM sleep only for very short time around 5-10mins , and as the brain enters another cycle , the 2nd nREM is shorter ,while the 2nd REM is longer These cycles continue to an extent where slow waves constitute around 75% of the sleeping time and 25% for the REM.

☞ In children, REM constitutes around 50% of the sleeping time. It is believed that this is important for cerebral cortex development. (REM here constitutes > nREM)

🌈 Now let's talk about each sleep type in details :

A. Slow wave sleep :

- The brain is not active here, so the dreams is not memorable and not recorded, also the dreams here are nightmares.
- Minor reduction in; HR, RR, BP and core body temperature.
- Sympathetic system is suppressed and the parasympathetic is excited.

- Reduced muscle tone , and so there's sleep walking.
- Slow wave sleep consists of 4 stages as follows :
- 1. 1st , records **alpha** waves , and the person is restful and relaxed without stress.
It's called day dream stage (هون أول ما تمام وتصير تفكر لو بعمل هيك ولو اصحى بدري واروح افطر بجريل ولو..)
- 2. 2nd , records **theta** waves with lower frequency and higher amplitude , and the person is stressful with mental or physical activities.
- 3. 3rd , records lower **theta** waves , and the person goes into more deep sleep than the 1st and the 2nd stages.
- 4. 4th , records delta waves , and it's hardest stage to awake the person through.

As we go down , we get more deep sleep and harder to awake through.

B. Rapid / REM sleep :

- Rapid eye movements with active brain. (β waves are recorded from occipital area)
- Dreams are memorable and vivid (producing powerful feelings or strong, clear images in the mind).
- Irregular HR, RR and BP
- Atonia : tone is completely suppressed as paralysis , so no sleep walking.

⌘ Mechanism of sleep : unknown ;

- Probably as we mentioned previously; serotonin inhibits the excitatory area.
- The doctor rejects the theory that suppose the sleep is caused by fatigue of excitatory areas to induce sleep and fatigue of inhibitory areas of the lower brain to awaken.
- It's probably an active process , due to accumulation of sleeping factors as muramyl peptide which is found in CSF and urine of animals keep awake for prolonged periods, this peptide will cause sleep when injected into third ventricle , also a peptide isolated from the blood of sleeping animals induces sleep.
- Solitary nucleus in the brain stem may be included in sleep, only if the raphe magnus is intact.
- Suprachiasmatic area is important as it receives information about the night and circadian rhythm .

☞ Physiology effects of sleep :

- Little effect on the body itself :
 - ↓ vegetative functions (as in nREM) ;
decrease in sympathetic tone, muscle tone, fall in arterial pressure
- Profound effect on the brain ;
 - Lack of sleep can lead to altered mental states(paranoia, psychoses)
 - Sleep probably functions to balance the activity of the
 - Various areas of the brain, to reset/re-zero/reboot neuronal circuits

☞ Clinical correlation : anesthesia ;

When the doctor anesthetize the patient, usually he ask him to count to 10. During that, he goes through the 4 stages of sleep till he reaches the 4th stage with complete relaxation, where the surgeon can start the operation.

CHARACTERISTIC	TYPE OF SLEEP	
	Slow-wave sleep	Paradoxical sleep
EEG	Displays slow waves	Similar to EEG of alert, awake person
Motor Activity	Considerable muscle tone; frequent shifting	Abrupt inhibition of muscle tone; no movement
Heart Rate, Respiratory Rate, Blood Pressure	Minor reductions	Irregular
Dreaming	Rare (mental activity is extension of waking-time thoughts)	Common
Percentage of Sleeping Time	80%	20%
Other Important Characteristics	Has four stages; sleeper must pass through this type of sleep first	Rapid eye movements

Good luck for all of you ☺

HBD Omar Alsaffar, long lives the king.

