



Physiology of Sleep

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Points of discussion

- Introduction
- Importance of sleep
- Duration of sleep
- Phases of sleep
 - NREM
 - REM
- Variation of sleep with age
- Neural mechanisms in wakefulness and sleep
- Sleep promoting substances
- Sleep hygiene
- Sleep disorders
- Sleep lab at MGMIHS for Polysomnography(PSG)

Introduction

- Definition: Sleep is defined as a reversible ,altered state of consciousness from which a person can be aroused by sensory stimuli
- Coma :state of unconsciousness , cannot be aroused by even a painful stimulus
- Shakespeare : Sleep , not a suspension of life, but a chance to dream.

Is Sleep essential?

Sleep matters

- Sleep is indispensable .
- It provides rest to the body and helps to restore metabolic functions.
- It plays an important role in homeostatic mechanisms
- It helps in learning
- It is important for mental wellbeing

Benefits of Sleep

- Sleep helps to be alert throughout the day
- Improves cognitive abilities (Poor sleep results in poor cognitive skills)
- Improves physical performance
- Helps to be emotionally stable
- Maintain a healthy weight (Poor sleep results in obesity)
- Organs function optimally (Poor sleep results in organ dysfunction)
- Boosts immunity (Poor sleep results in infections)
- Helps skin and hair glow

Alert and focused



Improves cognitive abilities



Physical fitness and performance improves



Emotionally stable



Maintain healthy weight



Makes the right choices in life



Glowing skin and hair



What is the required duration of sleep?

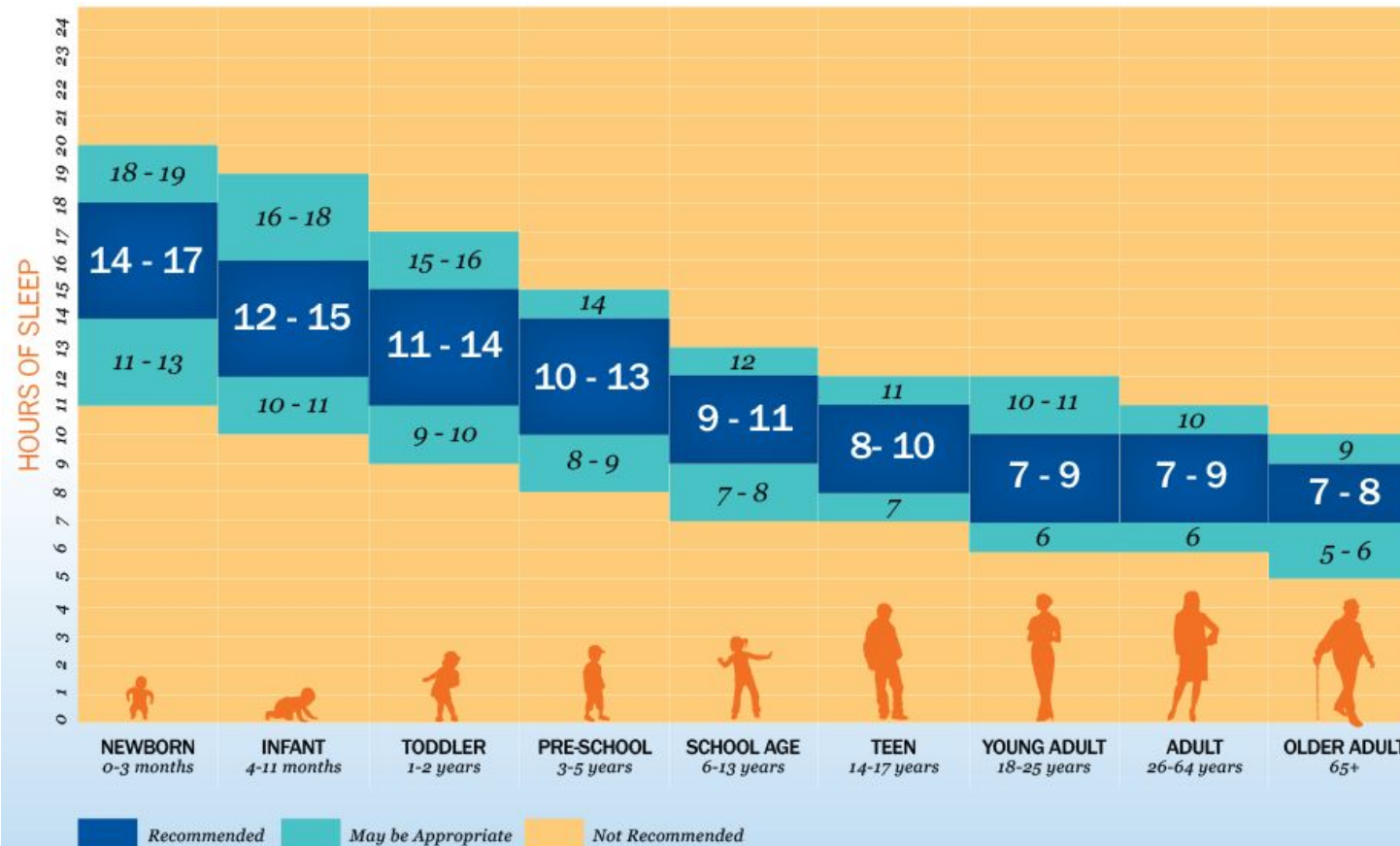
Duration of sleep

- 1/3rd of our life is spent in sleep
- Sleep and wakefulness follows a circadian rhythm of 24 hours
 - 16-17 hours wakefulness
 - 7-8 hours sleep
- Suprachiasmatic nucleus of hypothalamus is our internal biological clock which is responsible for various rhythms.

It is entrained by light through retinohypothalamic pathway. It helps to stimulate melatonin in the dark that induces sleep

Other cues entraining circadian rhythm: temperature, social.

SLEEP DURATION RECOMMENDATIONS



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Types of sleep

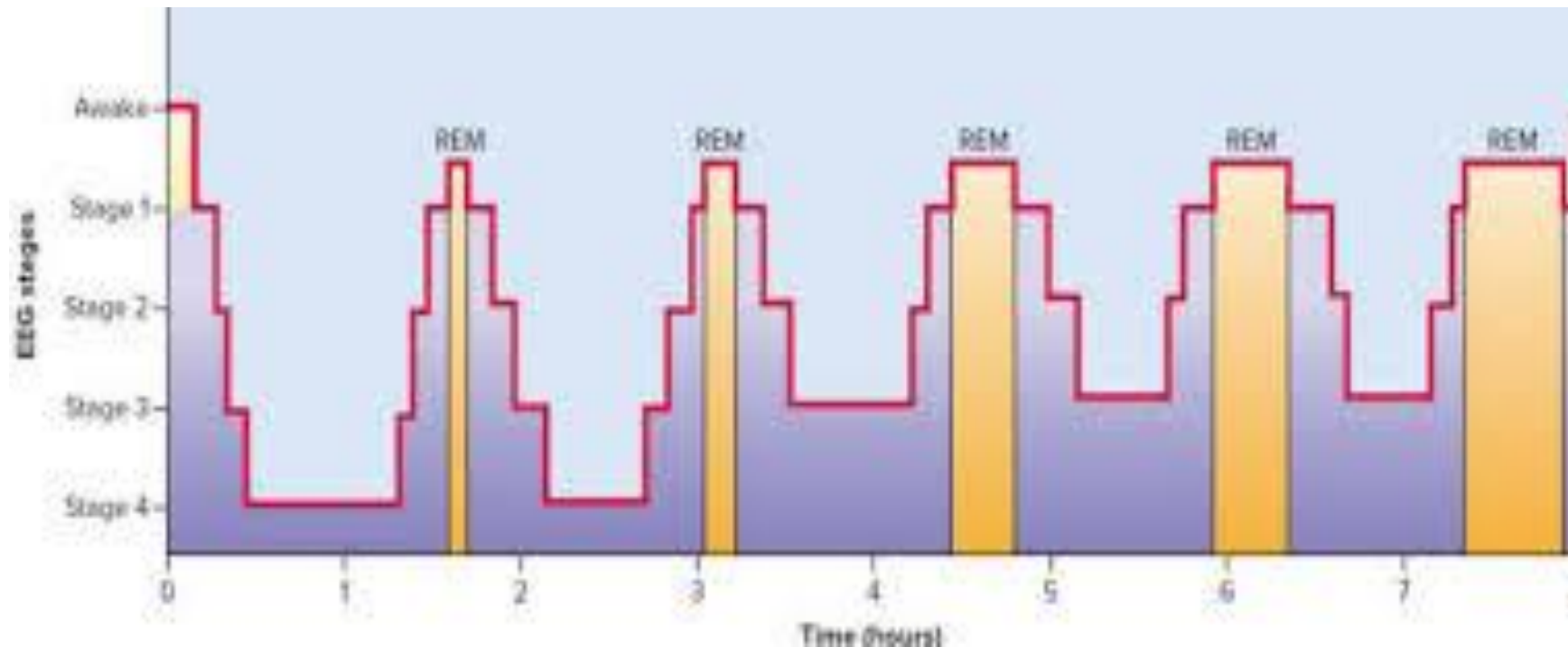
- Non REM (Slow wave sleep)
- REM (Rapid eye movement)
- They alternate each other
- Sleep is initiated through NREM sleep

Sleep cycle

- We spend 60-70 minutes in NREM and then 20 minutes in REM
- One cycle (NREM +REM)lasts for 90 minutes
- We have 4-6 such cycles each night
- As the sleep progresses REM duration increases. REM is for a longer duration towards morning hours

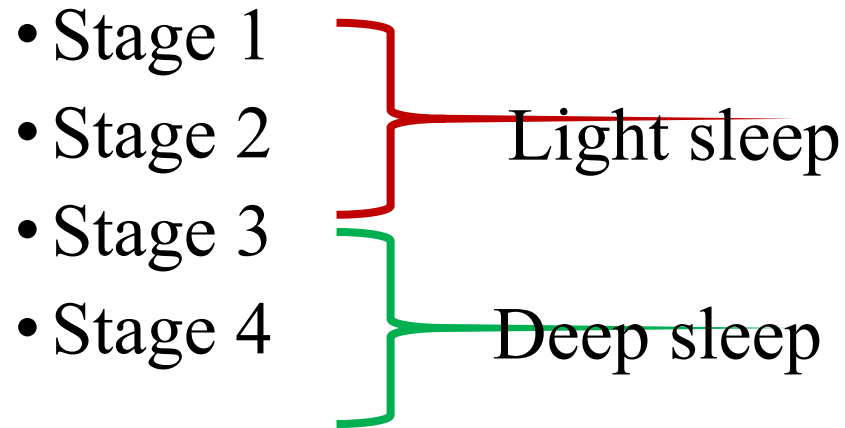
Sleep Architecture

- Identified when William Dement and Nathaniel Kleitman recorded whole night EEGs



Stages of sleep

- NREM as 3-4 stages



- Sleep progresses from stage 1-4 , after 1 hour it reverses from 4 to 1
- Followed by REM sleep
- As sleep progresses there are only stages 1 and 2 of NREM

Physiological changes in NREM sleep

- Parasympathetic system is active compared to sympathetic
- Overall excitability of nervous system is low.
- Body metabolism is lowered
- Muscle tone decreases
- BP and heart rate decreases
- Respiratory rate decreases
- GI motility is increased
- Pupils are constricted
- There is release of Growth hormone

REM sleep

- Paradoxical sleep, fast wave , desynchronized sleep, dream sleep
- Accounts for 20-25% of total sleep time in adults, 50% in newborn and 60-65% in premature
- Though the person is asleep his EEG shows awake pattern of Beta waves. Also some body functions are increased .
- (Called paradoxical as person is asleep but EEG and some body functions resemble awake state)
- It is difficult to arouse

Physiological changes in REM sleep

- Rapid eye movements (Saccadic eye movements)
- Metabolic rate of the brain increases by 20%
- Muscle tone reduces further
- BP and heart rate increase
- Respiratory rate increases
- Reduced GI motility
- Dreaming
- Penile erection occurs (Hence in circumcision ,patient wakes up in pain in REM sleep)
- Teeth grinding (Bruxism) is seen
- Reduced ability to maintain body temperature.

Importance of REM for brain development

- REM sleep is responsible for maturation of nervous system and has been compared to exercise required for the development of skeletal system
- In REM there is rehearsal of movements so that there is no clumsy movement when he actually performs
- It is important for consolidation of Memory

Are dreams remembered?

- Only the morning dreams from which you wake up are remembered.
- The other dreams of the night are forgotten by morning.

Interesting fact

- Painter Salvador Dali often slept on a sofa with a spoon in his hand and a tin plate on the ground .
- His creativity was at its peak during dreams.
- When in REM sleep due to hypotonia the spoon fell and the sound woke him.
- He then sketched out his ideas that he dreamt

Variation of sleep with age

- The total sleep duration decreases with age.

After 60 years of age

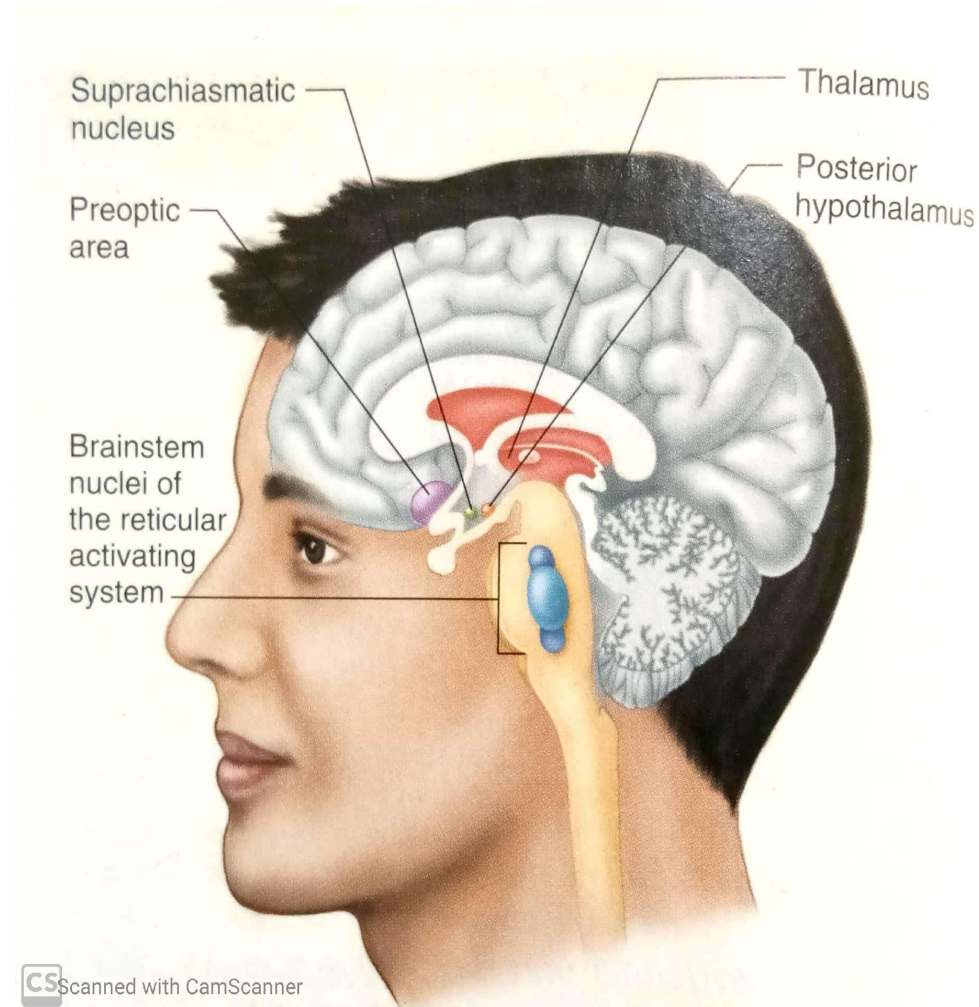
- Stages 3 and 4 disappear
- REM declines rapidly

So basically in sleep they spend their time in stage 1 and 2

Wakefulness

- The ascending reticular activating system (ARAS) of the brainstem tonically activates the cerebral cortex
- The non specific thalamic nuclei are involved in the activation
- Posterior hypothalamus act as a waking center
- Sleep promoting peptides keep accumulating

Some brain areas involved in sleep wake cycle



What happens in Sleep ?

Neural structures involved in sleep and wakefulness

■ Sleep

- Serotonergic fibres from raphe nucleus of Pons induce sleep
- Acetylcholine from pontine reticular formation is increased in REM sleep
- Preoptic area also induces sleep through inhibitory GABA neurons

■ Wakefulness

- Nor adrenaline from locus ceruleus in pons is reduced in REM
- Posterior hypothalamus releases histamine & through ARAS causes wakefulness

Sleep producing substances

- Henry Pieron in 1913 on experiments in dogs.
- Sleep deprived dogs had some chemicals increased in the CSF
- Accumulated muramyl peptides promote sleep
- Interleukin 1 (IL-1) induce sleep (IL-1 also ▲ GHRH –which▲REM sleep)

In Infections

- Bacteria have muramyl peptide in their cell walls which induces sleep
- It also stimulates IL-1 that induces sleep in infections.

How do heavy meal and rocking induce sleep?

Why does a person feel sleepy after a meal?

- Distention of the stomach stimulates vagus nerve that induces sleep

Why does patting ,rocking cradle or travelling in vehicle induce sleep?

- Stimulation of some cutaneous nerves at low frequency (3-8 /sec) induces sleep

Factors affecting sleep

Factors reducing stimulation of our sense organs help to induce sleep

- Like darkroom
- Silence
- Comfortable temperature
- Relaxed body and mind

- Low frequency stimulation

Disturbed sleep

- Severe exercise
- Caffeine
- Alcohol
- Emotional disturbances
- Organic diseases
- Barbiturates produce sleep of that of an 60 year old(reduced Stage 3 and REM) even in young persons

Sleep Hygiene

- Regular sleep and wake up time
- Reduce all the sensory stimuli 1-2 hours before going to sleep(stop using the gadgets-light and sound affect onset of sleep,good ambient temperature)
- Unwind before sleeping to help your body and mind relax
- Avoid caffeine after 2 pm
- Alcohol induces sleep but reduces REM sleep

Sleep disorders

- Insomnia
- Parasomnia
 - Somnambulism
 - Night terrors
 - Nightmares
- Narcolepsy
- RBD (REM behavioural disorder)
- Sleep Apnea

Polysomnography is the investigation done to
diagnose most sleep disorders

It is conducted in a sleep laboratory

At MGMIHS

- In collaboration with the Division of Sleep Medicine, University of Pennsylvania, USA



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Sleep Laboratory –Control room



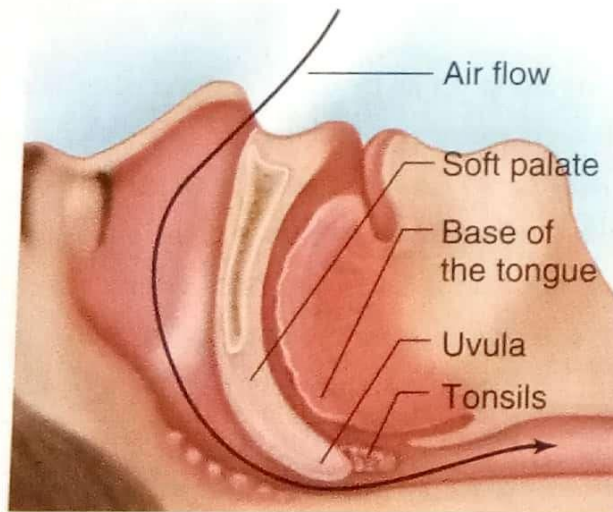
Sleep Laboratory-Resmed equipment



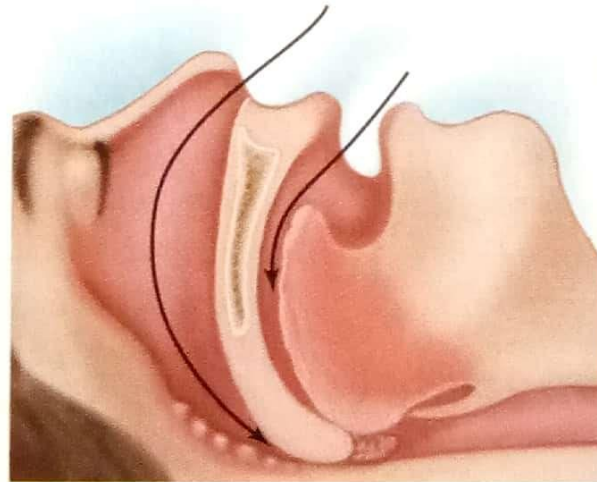
Patient – For Polysomnography



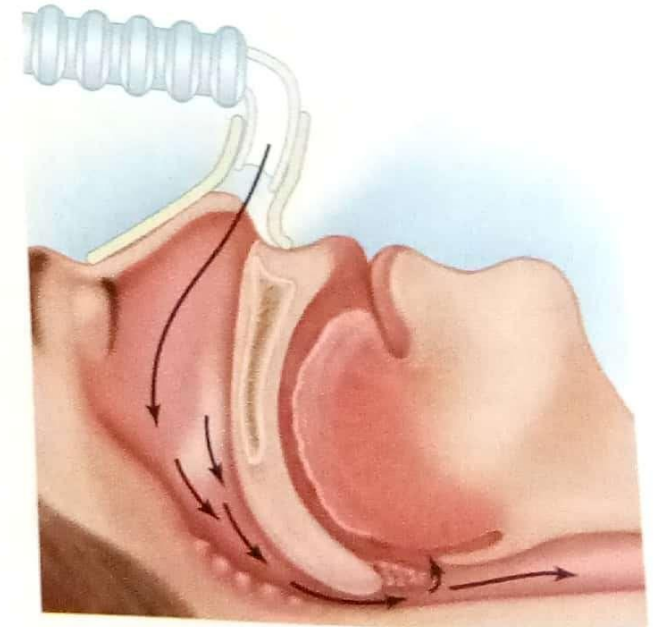
Obstructive sleep Apnoea (OSA) –CPAP used



During normal sleep, air flows freely past the structures in the throat.



During sleep apnea, air flow is completely blocked.



With CPAP, a mask over the nose gently directs air into the throat to keep the air passage open.

Next Class 2.6.2020

EEG Wave forms

