BEHAVIOR SCIENCES

MD 3

BEHAVIOR SCIENCES

SLEEP AND SLEEP DISORDERS

SLEEP AND SLEEP DISORDER

Learning Objectives

❑❑ Demonstrate understanding of the sleep stages and their associated waves

❑❑ Answer questions about how sleep deprivation can affect the body

❑❑ Demonstrate understand of the different sleep disorders and how to treat

SLEEP AND SLEEP DISORDER

SLEEP ARCHITECTURE

Sleep consists of 2 distinct states: NREM and REM.

SLEEP AND SLEEP DISORDER

Nonrapid Eye Movement (NREM) alternates with REM sleep throughout the sleep period. It is divided into 3 stages on the basis of EEG criteria:

- Slowing of the EEG rhythms
- Higher muscle tone
- Absence of eye movements
- Absence of “thought-like” mental activity

NREM is an idling brain in a movable body.

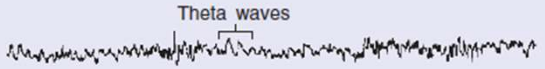
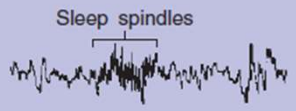
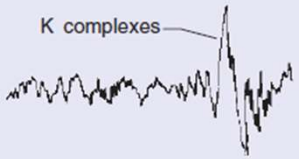
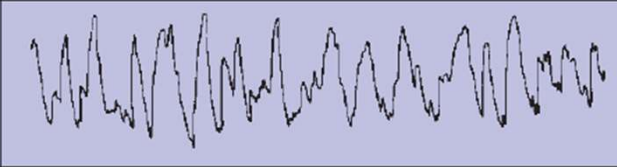
SLEEP AND SLEEP DISORDER

Rapid Eye Movement (REM) is an awake brain in a paralyzed body:

- Aroused EEG pattern
- Sexual arousal
- Saccadic eye movements
- Dreaming

SLEEP AND SLEEP DISORDER

NREM

Stage of Sleep	Wave Associated with Stage	EEG Pattern Associated with Waves
1	Theta	
2	Sleep spindles	
2	K complexes	
3	Delta	

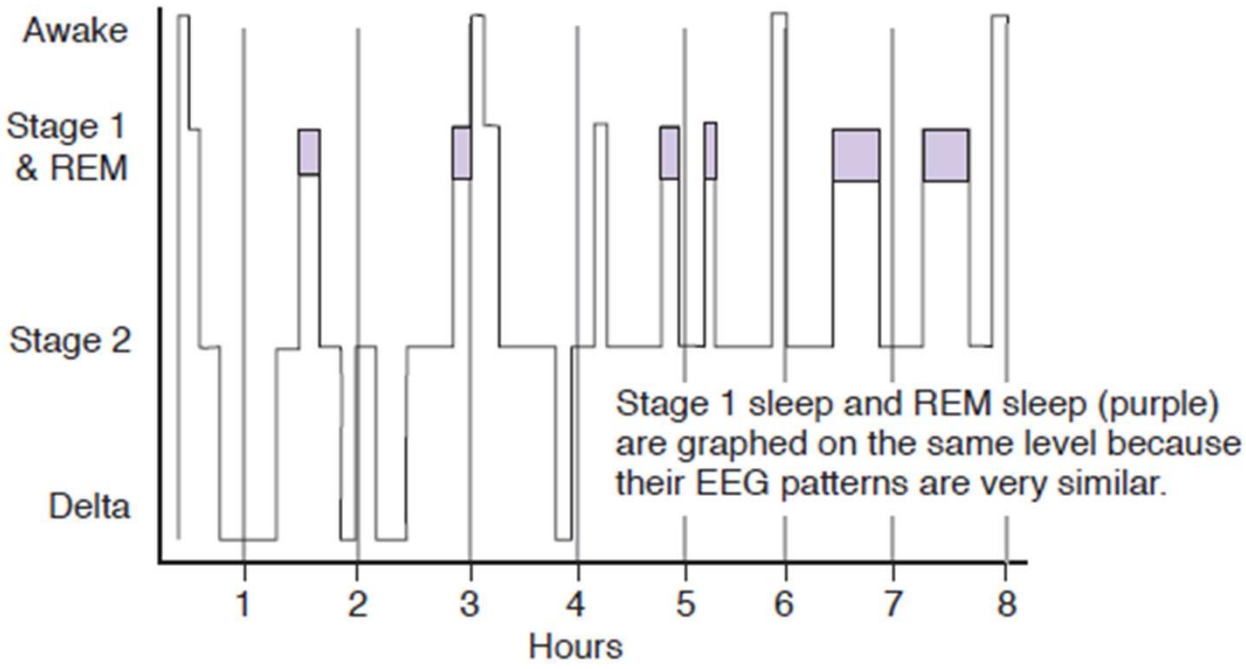
SLEEP AND SLEEP DISORDER

Sleep Facts

Stage 2	Longest stage of sleep
Stage 3	• Deepest stage of sleep; delta sleep is restorative • Tends to decrease in the elderly
Sleep latency	About 5–15 min from time one goes to bed and falls asleep
REM latency	About 90 min from time one falls asleep to first REM period
REM	• First REM period of night is 5–15 min and last one is 20–40 min • REM increases as night goes on • Greater amounts in second half of night • Easiest to arouse • Memories are consolidated by hippocampus
NREM	Greater amounts in first half of night

SLEEP AND SLEEP DISORDER

Sleep cycle



SLEEP AND SLEEP DISORDER

Sleep Deprivation

The cerebral cortex shows the greatest effects of sleep deprivation but has the capacity to cope with one night's sleep loss. In sleep-deprived individuals:

- Cortisol levels rise
- Blood pressure rises
- Glucose tolerance is reduced
- Greater amygdala activation
- Lower prefrontal cortical activity
- Increased negative mood

SLEEP AND SLEEP DISORDER

Sleep Physiology

Neurotransmitters

- **Serotonin** helps to initiate sleep. **Acetylcholine** (ACh) is higher during REM sleep (associated with erections in men). **Norepinephrine** (NE) is lower during REM sleep.
- Ratio of ACh and NE is biochemical trigger for REM sleep.
- NE pathway begins in the pons, which regulates REM sleep.

Dopamine produces arousal and wakefulness. Dopamine levels rise upon waking.

- Orexin (or hypocretin) is a neurotransmitter that regulates arousal, wakefulness, and appetite. Activation of orexin triggers wakefulness, while low levels of orexin at night serve to drive sleep. A deficiency of orexin results in sleep state instability, leading to sleep disorders like narcolepsy.

SLEEP AND SLEEP DISORDER

Sleep physiology

Melatonin is converted from serotonin in the pineal gland in the brain under directions from the body's internal circadian clock.

- Melatonin production is inhibited by activation of photoreceptors cells in the retina.
- Melatonin production increases in the evening, causing drowsiness.
- Melatonin secretion regulates the sleep-wake cycle by inhibiting the circadian alerting system in the suprachiasmatic nucleus.
- Bright environmental light, capable of suppressing human melatonin, reverses the winter depressive symptoms of patients with seasonal affective disorder (SAD).

SLEEP AND SLEEP DISORDER

Drugs That Alter Sleep

Dopamine increases wakefulness. Dopamine blockers (e.g., antipsychotics) increase sleep.

Benzodiazepines cause limited decrease in REM and Stage 4 sleep. If used chronically and then stopped, sleep latency will increase.

• Moderate alcohol consumption leads to early sleep onset and increased wakefulness during the second half of the night. Intoxication decreases REM; REM rebound (with nightmares) occurs during withdrawal.

• Barbiturates decrease REM; REM rebound, including nightmares, occurs in withdrawal.

• Major depression increases REM, decreases REM latency (45 rather than 90 minutes), and decreases Stages 3 and 4 sleep. It also leads to early morning waking and multiple awakenings during the night.

SLEEP AND SLEEP DISORDER

Narcolepsy

Narcolepsy is a neurological disorder that decreases the ability to control the sleep-wake cycle. It is a REM disorder; patients typically enter REM within 10 minutes. It is linked to a deficiency in hypocretin. Narcolepsy patients experience 4 main symptoms (narcoleptic tetrad):

- Sleep attacks and excessive daytime sleepiness (**most common** symptoms)
- Cataplexy (pathognomonic sign): sudden loss of consciousness and symptoms ranging from slurred speech to total body collapse (can be triggered by loud noise, emotions, etc.)
- Hypnopompic and hypnogogic hallucinations (common)
- Sleep paralysis: the inability to move or speak while falling asleep or waking up from sleep

Treatment is modafinil or psychostimulants to treat the sleepiness and an antidepressant to treat the cataplexy.

SLEEP AND SLEEP DISORDER

Sleep Apnea

With sleep apnoea, individuals have episodes of apnea during the night causing them to have difficulties breathing. It is characterized by a loud snore and Common in obese, middle-aged men.

- **Obstructive or upper airway sleep apnea**: airway collapses or becomes blocked during sleep
- **Central sleep apnea**: area of the brain that controls breathing does not send the correct signals to the breathing muscles; often associated with medical problems
- **Mixed sleep apnea**: patients experience both obstructive and central sleep apnea

Clinical presentation includes:

- High risk of sudden death during sleep
- Development of severe nocturnal hypoxemia
- Pulmonary and systemic hypertension (with elevated diastolic pressure)
- Nocturnal cardiac arrhythmias (potentially life-threatening)
- Bradycardia, then tachycardia

SLEEP AND SLEEP DISORDER

Symptoms commonly include dry mouth, headaches, and daytime tiredness.

Restlessness and loud snoring are typically reported by sleep partners.

To diagnose, patients are referred to nocturnal polysomnography or home sleep tests to monitor pulse, oxygen level, etc. Treatment may be limited to diet or smoking cessation (mild cases); CPAP (continued positive airway pressure) in moderate to severe cases; and surgery in cases due to obstructive reasons.

SLEEP AND SLEEP DISORDER

Insomnia

Insomnia is characterized by difficulty initiating and maintaining sleep (DIMS).

- **Primary insomnia**
- **Secondary insomnia** (most common) is caused by medical problems, psychiatric problems, medications, etc.

Symptoms of insomnia include sleepiness during the day, general tiredness, irritability, and problems with concentration or memory.

SLEEP AND SLEEP DISORDER

Treatment varies:

- Sleep hygiene
- Behavior modification: stimulus control
- Pharmacotherapy: zaleplon, zolpidem, eszopiclone (work on sleep receptors to help individual to fall and stay asleep)
- Ramelteon, a melatonin receptor-agonist, works on the sleep wake cycle and has less incidence of dependence

Diagnosis	Sleep Stage	Features	Treatment	Memory for Event
Night terror	3	• Common in young boys • Familial • Wake up in middle of night and scream	Benzodiazepines	No
Nightmares	REM	Common during stressful times	Antidepressants	Yes
Somnambulism (sleep-walking)	3	• Confused and disoriented if awakened • Common in children • May harm themselves	Benzodiazepines	N/A
Bruxism (teeth grinding)	2	Usually stress-related	Teeth guards	N/A

SLEEP AND SLEEP DISORDER

Parasomnias

SLEEP AND SLEEP DISORDER