Sleep Disorders in Chronic Pain

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Introduction

Normal sleep is divided into two phases- Rapid eye movement sleep (REM) and Non Rapid eye movement sleep (NREM). Sleep architecture is measured via a Polysomnogram which records- Electroencephalogram (EEG) for cerebral activity, Electromyogram (EMG) for muscle activity at chin / limb, Electro-oculo-gram (EOG) for eye movements and vital signs.

Stages of Sleep with Features [1–3]

Wakefulness-Predominantly Alpha (8–13 Hz)-with eyes closed and Beta (>13 Hz)-with eyes open on EEG .

NREM- (75% of sleep time)-Has 4 progressive stages-

Dreamless sleep

Generalized decrease in Autonomic nervous system activity

Intact muscle tone, involuntary repositioning movements of body happen

No penile erections for men

Blood flow including cerebral flow decreases

Important neuroendocrine activity such as growth hormone, prolactin and cortisol secretion

- Stage 1/ N1-(5%) lightest sleep, transition between wakefulness and sleep,
  - Theta waves 3–7 hz.
  - lasts 5–10 min.
  - Slow rolling eye movements, Heart rate decreases.
- Stage 2/ N2-(45%)-Background theta waves, 20% delta waves, sleep spindles and K complexes, eye movements disappear, muscles relax.
- Stage 3/ N3-(12%) + Stage 4/ N4-(13%)-Deep sleep-Slow wave sleep (SWS) -high amplitude, low frequency Delta waves (1–3hz). This is most restorative sleep.

REM sleep-(25%) also called activated or paradoxical sleep because of associated intense autonomic activity

- Intense Autonomic activity.
- High level of brain activity similar to wakefulness, high brain oxygen use.
- Poikilothermic thermoregulation.
- Penile erection in men.
- Atonic, areflexic paralysis.
- Dreaming accompanied by rapid eye movements.

First REM period happens about 90–120 min after sleep onset (REM latency). NREM-REM cycle repeats itself throughout the night, roughly every 90 min. In latter half of night, REM periods lengthen and occur more frequently, eventually ending in arousal.

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© Springer Nature Switzerland AG 2019
A. Abd-Elsayed (ed.), *Pain*, https://doi.org/10.1007/978-3-319-99124-5_94

REM sleep is associated with increased acetylcholine activity whereas NREM is associated with decreased adrenergic and cholinergic activity.

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Relationship Between Sleep and Pain

There is a bidirectional relationship between Sleep and Pain with a stronger causal influence of sleep on pain than pain on sleep [1]. Research shows that 50% of people with persistent insomnia suffer from chronic pain [4]. Also, chronic pain sufferers very commonly report sleep disturbance (60–88%) which also correlates with increased pain, dysfunction, mood disturbance, impaired cognition and fatigue [5]. Sleep deprivation studies consistently show that disturbance of sleep continuity induces increased pain perception and hyperalgesia. Both REM and slow wave sleep disruption decrease pain thresholds [6].

Polysomnography Findings in Chronic Pain Conditions [4]

1. No consistent pattern of objective sleep disturbance.
2. Sleep continuity disruption, i.e. sleep fragmentation is the most common finding.
3. Sleep architecture is overall preserved with decreased sleep efficiency, increased sleep onset latency, decreased total sleep time, decreased slow wave sleep.
4. Some Fibromyalgia studies show alpha wave disruption in NREM sleep but specificity of this anomaly to Fibromyalgia is controversial [7].

Effect of Medications and Comorbid Illness

Sleep architecture in chronic pain patients can also be influenced by comorbid medical conditions and by medications used to treat pain conditions as follows-

Depression- Reduced stage III and IV sleep, short REM latency

SSRIs, Benzodiazepines -REM suppression

Opiates- Reduce Slow Wave sleep, Dose-dependent REM suppression

Tricyclics-Increase Slow Wave sleep

Gabapention- Increases slow wave sleep

Pregabalin- Increases slow wave sleep

Treatment Implications: Given the bidirectional relationship between Sleep and Pain, its very important to ensure adequate, restorative sleep in chronic pain conditions.

High Yield Points

- Normal sleep is divided into NREM and REM sleep. NREM makes up 75% of sleep time, consists of 4 stages, characterized by low autonomic activity, intact muscle tone and dreamless sleep. REM sleep in contrast makes up 25% sleep time, marked by muscle paralysis, active dreaming with rapid eye movement and intense autonomic activity. Normal REM latency is 90 min.
- Most consistent sleep finding in chronic pain patients is sleep fragmentation.
- Various medications used to treat Pain conditions can affect sleep architecture and sleep disruption can lead to enhanced Pain.

Questions

1. Which of the following signifies REM sleep
   A. EEG-awake, EMG-no activity, EOG –REMs
   B. EEG-3-7 hz, EMG-low voltage activity, EOG-slow rolling
   C. EEG-delta waves, EMG-inactive, EOG-REMs
   D. EEG-alpha or beta waves, EMG-high tonic activity, EOG-eye movements and blinks
   Answer: A
2. Most common polysomnographic finding in chronic pain patients is
   A. abnormal sleep architecture
   B. sleep fragmentation
   C. REM suppression
   D. Increased slow wave sleep
   Answer: B
3. Normal REM latency is
   A. 25 minutes
   B. unknown
   C. 200 minutes
   D. 90 minutes
   Answer: D

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