

Sleep Disorders in Neurology

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ABSTRACT

Sleep has a complex structure and consists of four stages that repeat in cycles during the night. During certain phases and periods of the sleep cycle, a whole series of hormones and other substances are secreted that help regulate metabolism and other factors that affect health. Altered sleep patterns can lead to feelings of fatigue and sleepiness, and even increase the risk of a whole host of serious medical conditions. Differentiate between sleep problems, primary sleep disorders, and sleep disorders caused by a medical condition. Sleep problems are often caused by poor sleep hygiene or bad habits. It is about habits and environmental factors that can be influenced and controlled. These include smoking, drinking alcohol or caffeine, exercising intensely, or eating large meals before sleeping. There is also fatigue caused by changing time zones when traveling and psychological stresses that lead to difficulty falling asleep or staying asleep, such as deadlines at work, exams, marital conflicts or business crises.

Keywords: Sleep; Sleep Disorders; Neurology; Patients; Health

Abbreviations: EDS: Immoderate Daylight Sleepiness; EEG: Electroencephalogram; EOG: Electro-Oculography; NREM: Nonrapid Eye Motion; VLPO: Ventrolateral Preoptic Nucleus; PSG: Polysomnography; TMN: Tubero-mammillary-Histaminergic Neurons; LC: Locus Ceruleus; DR: Dorsal Raphe; SN: Substantia Nigra; PCS: Postconcussive Syndrome; OSA: Obstructive Sleep Apnea; ICSD: International Classification of Sleep Disorders

Introduction

Sleep disorders usually arise in sufferers who present to neurologists [1]. At times, signs are obvious, consisting of insomnia or immoderate daylight sleepiness (EDS). However, a few sufferers have severe sleep disorders, consisting of sleep apnea, which are frequently now no longer without problems obvious to the affected person or health practitioner and may exacerbate a neurologic ailment. Established hyperlinks exist among sleep apnea and stroke, epilepsy, and migraine, among sure sleep conduct issues and neurodegenerative diseases, and among circadian rhythm disorders and dementia. In mild of those hyperlinks, it's far vital that neurologists turn out to be acquainted with sleep issues and include sleep analysis and remedy into each day practice, and that sleep professionals and internists benefit wider appreciation of the effect of sleep disorders on neurologic function and disease. Sleep disturbances are not unusualplace in primary care and neurology [2]. It is expected that 50–70 million

Americans are laid low with persistent sleep disorders and intermittent sleep problems. Additionally, about one in 3 adults do now no longer get the endorsed quantity of sleep. Sleep issues frequently bring about impaired daylight functioning, affecting paintings overall performance and growing the probability of motor car accidents. These issues may also growth the threat for or exacerbate scientific and psychiatric issues. Most notably, there's mounting proof of a bidirectional dating among sleep deficiency and circadian disorder with cardiovascular and metabolic disease and neurologic disorders. Therefore, analysis and remedy of sleep and circadian rhythm issues are exceedingly vital for preferred medicine, in addition to neurology.

Sleep

Sleep is taken into consideration to be a restorative function, wherein power is restored and tissues are regenerated [3]. Sleep happens in a cyclical manner, alternating with intervals of wakefulness and elevated power use. Biologic rhythms play an vital position in

model to pressure, improvement of illness, and reaction to scientific remedy. Many rhythms consisting of relaxation and pastime, paintings and leisure, and consuming and ingesting oscillate with a frequency just like that of the 24-hour mild-darkish sun day. The time period circadian, from the Latin *circa* ("about") and *dies* ("day"), is used to explain those 24-hour diurnal rhythms. Sleep disorders and changes within the sleep-wake cycle had been proven to adjust immune feature, the ordinary circadian sample of hormone secretion, and bodily and mental functioning. The maximum not unusualplace manifestations of an alteration within the sleep-wake cycle are insomnia and sleep deprivation or elevated somnolence. In a few persons, pressure may also produce sleep disorders; in others, sleep disorders may also result in pressure. Acute pressure and environmental disturbances, lack of a cherished one, restoration from surgery, and ache are not unusualplace reasons of temporary and short-time period insomnia. Air journey and jet lag represent extra reasons of altered sleep-wake cycles, as does shift paintings.

Evaluation of sleep disorders calls for attention of ordinary sleep architecture [4]. A ordinary night time's sleep usually includes 3 to 5 sleep cycles of about 90 mins duration. A ordinary sleep cycle includes development from wakefulness thru a couple of minutes of stage 1 sleep, from which human beings can be without problems aroused, to stage 2, which constitutes about half of ordinary sleep. The ordinary person then passes into ranges three and four gradual wave sleep, which collectively account for 20% to 25% of sleep time. After a latency of about 90 mins following sleep onset (the REM latency) the person passes into REM sleep, at some point of which muscle mass are paralyzed and people document dream pastime, if aroused. REM is terminated both with the aid of using quick arousal or with the aid of using passage into stage 2 sleep to start any other cycle. The ranges of sleep are outstanding with the aid of using electroencephalogram (EEG) styles and physiologic modifications. The quantity of time spent in every sleep stage varies thru the night time such that greater time is spent in gradual wave sleep within the first a part of the night time and greater time is spent in REM sleep over the last a part of the night time. Infants spend 50% of sleep time in REM. The sleep sample of the aged is usually characterised with the aid of using fragmentation with reduced gradual wave sleep. Total sleep time decreases with age.

Physiology

Sleep is described with the aid of using behavioral and physiologic modifications that encompass postural recumbence, behavioral quiescence, eye closure, and unique physiologic parameters primarily based totally on electroencephalography (EEG), electro-oculography (EOG), and electromyography (EMG) [1]. Sleep is similarly subdivided into nonrapid eye motion (NREM) and fast eye motion (REM) sleep. The ordinary person mind enters sleep first thru NREM ranges accompanied with the aid of using REM sleep about 90 mins later. NREM

and REM sleep then change thru 4 to 6 cycles lasting ninety to one hundred ten mins every. The first third of sleep is ruled with the aid of using NREM sleep and the remaining third of the night time is ruled with the aid of using REM sleep. NREM sleep is similarly divided into 3 stages (N1, N2, N3). The staging of sleep is primarily based totally at the recordings of the EEG, chin EMG, and EOG made at some point of polysomnography (PSG). The PSG is scored with the aid of using assigning a sleep stage to every 30-second epoch recorded. Stage wake can arise whilst the concern is alert with eyes open or comfortable with eyes closed. When the eyes are open, the EEG indicates low-amplitude, speedy mixedfrequency pastime. The EOG tracing includes eye moves and eye blinks, and the EMG chin pastime is elevated. Once the eyes are closed, alpha rhythms (8 to 13 Hz) predominate at the EEG and are maximum distinguished within the occipital leads. This alpha pastime attenuates with attention or with eye opening. Stage W is scored whilst 50 percentage of the epoch indicates alpha pastime within the occipital region. The ordinary person spends much less than five percentage of the night time on this stage.

Neuroanatomy

Changes among wake, NREM, and REM sleep are produced thru modulation of neurotransmitters and neuromodulators interconnecting the neuronal machine that regulates sleep [1]. The ascending arousal machine is vital in keeping wakefulness. It consists of a cholinergic department and a monoaminergic department. The cholinergic department consists of the pedunculopontine and laterodorsal tegmental nuclei, which challenge to the thalamic reticular nucleus which will set off the cerebral cortex. Acetylcholine excites the thalamic and cortical neurons maximally at some point of wake and REM sleep. The monoaminergic department consists of the locus coeruleus, dorsal and median raphe nuclei, tuberomammillary nuclei, and ventral periaqueductal grey matter. Histamine (H3), norepinephrine, and serotonin are launched from those diverse nuclei, that are additionally maximally lively at some point of wakefulness which will set off the cerebral cortex. The monoaminergic machine is quiet in NREM sleep and became off in REM sleep. Hypocretin neurons within the lateral hypothalamus increase this activation of the cortex at some point of wakefulness. Dopamine is expanded at some point of intervals of wakefulness, and dopaminergic neurons modulate cortical activation not directly thru regulatory pastime of the globus pallidus and the thalamus. Sleep onset is related to a fast deactivation of each the monoaminergic and cholinergic branches of the arousal machine. GABAergic neurons within the preoptic hypothalamus sell sleep onset.

The ventrolateral preoptic nucleus sends descending inhibitory projections to more than one arousal structures at some point of sleep. The homeostatic system and the circadian clock decide the pastime of the ventrolateral preoptic nucleus. In NREM sleep, this nucleus inhibits each the cholinergic and monoaminergic branches

of the ascending arousal machine to result in sleep. In REM sleep, simplest the monoaminergic nuclei are inhibited, however the cholinergic nuclei are lively. REM sleep is pushed with the aid of using cholinergic neurons withinside the pons. Descending cholinergic projections produce muscle atonia with the aid of using activating neurons withinside the pontine reticular formation and ventral reticular formation that then challenge to the spinal cord. Glycine is the crucial neurotransmitter in those pathways. The monoaminergic nuclei additionally inhibit the ascending arousal machine at some point of wakefulness, ensuing in a machine of reciprocal inhibition. This has been termed the “sleep switch.” Both sides of the transfer strongly inhibit every different, ensuing in a remarks loop with simplest viable states: sleep and wakefulness. Hypocretin is the stabilizer of this transfer. In wakefulness, hypocretin reinforces the arousal machine to preclude undesirable switches into sleep. Narcolepsy with cataplexy is a ailment of low ranges of hypocretin, inflicting a loss of balance withinside the “sleep transfer,” ensuing in common and undesirable transitions among sleep and wakefulness.

Structure

Disturbed sleep has plagued humankind for ages, and the elusive feature of sleep has interested physicians and the general public alike [5]. Unfortunately, a look for a single “sleep center” withinside the mind has now no longer been successful. Instead, lesion and stimulation research have validated the complexity of the sleep system, the multiplicity of systems worried in sleep, and the reciprocal interactions vital for the initiation and protection of dozing conduct. Structures which have been observed to facilitate sleep encompass the basal forebrain (i.e., preoptic location of the hypothalamus, specially the ventrolateral preoptic nucleus [VLPO], selling sleep via -amino-butyric acid [GABA/galanin] pastime), the location surrounding the solitary tract withinside the medulla, the dorsal raphe nuclei, and the midline thalamus. The sleep-promoting position of the anterior hypothalamus outcomes from its inhibitory impact at the posterior hypothalamic awakening neurons (especially tuberomammillary-histaminergic neurons [TMN]) projecting broadly to the cortex. Structures which have been observed to facilitate waking are the newly observed hypocretin (orexin) neurons withinside the dorsolateral hypothalamus, the ascending reticular activating system of the pons and midbrain, and the posterior hypothalamus. Although no direct interplay among the VLPO and hypocretin system has been reported, each innervate the primary additives of the ascending arousal structures (the adrenergic locus ceruleus [LC], serotonergic dorsal raphe [DR], dopaminergic ventro tegmental location [VTA], and histaminergic TMN).

The VLPO [GABA/galanin] system inhibits, whilst the dorsolateral hypothalamic (hypocretin/ orexin) activates, those “arousal” structures. Destruction of the VLPO machine outcomes in insomnia, while destruction of the hypocretin system outcomes in narcolepsy

(hypersomnolence/sleep assaults and cataplexy). Integrity of the preoptic location of the anterior hypothalamus isn’t always required for sleep onset, as sleep may be restored with the aid of using inhibition of the posterior hypothalamus in cats made insomniac with the aid of using preoptic lesions. The manipulate of alternating principal sleep ranges (nonrapid eye motion [NREM]/REM cycling) is attributed to a reciprocal interplay among hostile structures: aminergic and cholinergic. Noradrenergic, histaminergic, and serotonergic neurons, that are lively at some point of the waking nation, are certainly silent at some point of REM sleep, while maximum different neurons are exceedingly lively. It has been customary that the activation of forebrain systems at some point of REM sleep is generated and transferred rostrally with the aid of using brainstem cholinergic nuclei. The shut-off of dorsal raphe serotonergic neurons is one of the fundamental elements underlying the pastime of those cholinergic nuclei (disinhibition). Both structures, aminergic and cholinergic, also are worried withinside the system of cortical activation with arousal. The dopaminergic system (particularly the ventral tegmental location) is specially worried withinside the manipulate of alertness.

Dopaminergic neurons of the VTA, however now no longer of substantia nigra (SN), are excited with the aid of using hypocretins, and there’s a more hypocretin innervation of the VTA than the SN. Dopaminergic neurons withinside the ventral periaqueductal grey (PAG) also are activated at some point of wakefulness. A descending dopaminergic projection may also have an vital position in sleep issues followed with the aid of using anomalies of sleep-associated motor manipulate (cataplexy, periodic limb motion ailment [PLMD], etc.). Circadian sleep/wake rhythm is modulated with the aid of using the hypothalamic suprachiasmatic nucleus (SCN). The SCN units the frame clock length to about 25 hours, with mild and time table cues (“time givers”) entraining it to 24 hours. The retinohypothalamic tract conveys mild stimuli to the SCN. This represents direct affect of mild at the pastime of the SCN. Melatonin has been implicated as a modulator of mild entrainment, considering it’s far secreted maximally at some point of the night time with the aid of using the pineal gland (“hormone of darkness”). Thus, the anterior hypothalamus (VLPO) appears to function a middle for “sleep switch” below the affect of the circadian clock (SCN). Increasing information of the neurochemistry of sleep has raised the desire for greater unique remedies of sleep disorders (e.g., hypocretin agonists and/or GABA/galanin antagonists for remedy of immoderate daylight sleepiness or hypocretin antagonists/GABA/galanin agonists for remedy of insomnia). Rational layout of latest instructions of stimulants/hypnotics will necessarily parallel higher information of the intimate mechanisms of sleep body structure.

Head Trauma

A concussion is described as nonpenetrating head trauma ensuing in a quick lack of attention [6]. There isn’t any definition for the

duration of a “quick” length, however a few professionals permit up to six hours earlier than attention returns. Most vital, sufferers with a concussion will regain ordinary attention and feature a ordinary neurological exam findings and a ordinary CT test of the brain. In as many as 30% of sufferers who revel in a concussion, postconcussive syndrome (PCS) will expand. Patients with PCS may also have headache, nausea, emesis, reminiscence loss, dizziness, diplopia, blurred vision, emotional lability, or sleep disturbances after a minor head harm. Fixed neurological deficits aren’t a part of PCS, and any patient with a set deficit calls for cautious evaluation. PCS commonly lasts 2-4 months. Typically, the signs height four–6 weeks after the harm. It is vital to constantly search for a contrecoup harm to the brain with any head trauma. Contrecoup accidents arise whilst a pressure moves one aspect of the pinnacle difficult sufficient to shift the mind withinside the contrary course of the harm, and inertia then forces the mind to strike the other aspect of the intracranial cavity, therefore inflicting an harm to the other aspect of the mind from the unique trauma. Both direct trauma and contrecoup accidents can motive intracerebral and extracerebral bleeding, or each. Intracerebral bleeding, consisting of cerebral contusion, is because of the disruption of microvasculature usually withinside the parenchyma. That disruption can motive the arteries below the arachnoid and above the pia to bleed, known as a subarachnoid hemorrhage. Nearly half of all sufferers with minor head harm can have a cerebral contusion seen on CT test.

Patients

Complaints associated with sleep and wakefulness are pervasive withinside the preferred population [1]. Approximately 30 percentage of adults document one or greater signs of insomnia along with issue falling asleep, staying asleep, awakening too early, or nonrestorative sleep. It is expected that 4 to 21 percentage revel in EDS as a minimum three days in keeping with week. Only 6 percentage of sufferers with sleep proceedings see a health practitioner specially for a snooze problem, and lots of others lodge to over the counter medicines or self-remedies. Sleep disorders are related to sizeable morbidity and mortality. Insomnia, for example, is related to impairment of all factors of best of existence along with bodily functioning, physical ache, social functioning, and mental health. Obstructive sleep apnea (OSA) will increase the threat of cardiovascular and cerebrovascular disorder in addition to inflicting motor car accidents. Individuals with sleep disturbances gift with any of 4 principal proceedings. The first is insomnia, which can be defined as difficulty in falling asleep or staying asleep, having an inadequate quantity of sleep, or poor quality of sleep. The second is EDS, which may also show up as emotions of loss of power or tiredness related to naps, falling asleep at irrelevant times, or issue with attention or reminiscence. The maximum not unusualplace motive of EDS is inadequate time for sleep. The third grievance is of bizarre sleep conduct, commonly defined with the aid of using a mattress partner. The fourth is of an lack of ability to sleep

on the favored time. A single sleep problem can be related to more than one proceedings.

It is vital to recognize the inducement of sufferers in in search of remedy. For example, insomnia may also effect task overall performance and motive a difficulty for lack of employment. A grievance of loud night breathing may also gift simplest after someone is compelled to sleep in a separate room to save you traumatic a mattress partner. The International Classification of Sleep Disorders (ICSD) has helped unify the technique to sleep proceedings with the aid of using classifying over 60 sleep disorders. Patients ought to fill out a snooze questionnaire and a 1- to 2-week sleep diary. The questionnaire ought to deal with the sufferers’ ordinary sleep hours, nocturnal awakenings, daylight napping, paintings hours, loud night breathing, daylight functioning, sleep environment, moves in sleep (e.g., leg moves), bizarre behaviors in sleep (e.g., sleepwalking), way of life elements (e.g., caffeine intake), weight modifications, beyond scientific records, social records, medicines, own circle of relatives records of sleep issues, and different sleep symptoms (e.g., cataplexy or sleep paralysis). A sleep diary ought to file the time of having inside and outside of mattress, sleep onset time, awakenings, naps, exercise, sleep medication, and caffeine intake. There are numerous scales used to evaluate the degree of daylight sleepiness in someone, consisting of the Epworth Sleepiness Scale, that may assist with analysis. In addition to preferred scientific and neurologic examinations, the bodily exam ought to encompass the sufferers’ weight, height, frame mass index (BMI), blood pressure, and neck circumference. The top airway ought to be inspected for pharyngeal narrowing, tonsillar growth, uvula growth or edema, a huge tongue, low-mendacity palate, and micrognathia, all of that are threat elements for sleep apnea.

In comparing and dealing with sufferers with sleep disorders, 3 questions are fundamental [7]:

1. Does the affected person have problem staying wide conscious at some point of the day?
2. Does the affected person have problem falling asleep or staying asleep at night time?
3. Does the affected person have bizarre sensations or conduct at some point of sleep?

These signs frequently cross collectively. For example, people who’ve problem staying wide conscious withinside the daylight may also nap excessively at some point of the day after which have problem falling asleep at night time. Some human beings who’ve problem falling asleep at bedtime aren’t completely rested the subsequent day, in order that they have problem staying wide conscious. People who’ve bizarre conduct at some point of sleep — or, greater frequently, their mattress partners — may also fail to get the desired quantity of ordinary sleep and feature problem staying wide conscious the subsequent day.

Age

With age, the desired variety of hours of sleep does not change; however, older adults have a growth in degree 1 and a pair of sleep (mild sleep) and a lower in stages three and four sleep (deep sleep) [8]. Sleep quality and sleep performance additionally lower with age. Therefore, many older adults have sleep-associated proceedings, along with waking up earlier, disturbed sleep, elevated midnight wakefulness, reduced overall time asleep, and immoderate daylight sleepiness. In addition, sleep disorders (e.g., stressed legs syndrome, sleep apnea), discomfort (e.g., ache, anxiety), and sleep-impairing medications (e.g., cold medications, steroids) are greater not unusualplace amongst older adults. Hospitalized older adults are particularly liable to disrupted sleep, and sleep disturbance is not unusualplace. Environmental noise, disrupted mild/darkish cycle, caregiver interruptions, ache, and pressure all make a contribution to a much less than restful environment. Sleep medications, consisting of sedative-hypnotics, ought to be averted in older adults due to the fact they impair sleep best, motive residual sedation, growth threat of falls, and impair reminiscence and feature. Instead, nonpharmacologic sleep-selling measures have validated sizeable benefit. To expand individualized sleep-promoting strategies, health care companies ought to start with an evaluation of the affected person's sleep records and traditional sleep sample, along with traditional bedtime and upward thrust time, bedtime routines, medications, and subjective evaluation of sleep. An interdisciplinary evaluation can be required to perceive and deal with sleep disorders or different bodily situations that intrude with sleep. Interventions to sell rest encompass massage, tune remedy, guided imagery, and innovative muscle relaxation. Environmental adjustments encompass noise reduction, mild adjustment, reduced midnight interruptions, and elevated significant daylight pastime

Psychology

Psychosocial reasons are particularly not unusualplace [9]. They are usually both psychosocial or medical in origin. Anxiety can motive issue in keeping sleep and issue in starting up sleep; melancholy usually reasons early morning awakening with an lack of ability to fall returned asleep. Treating those situations can enhance sleep and consequently enhance best of existence. Shift paintings also can be a motive for extended sleep onset. Adjustment to existence modifications consisting of the beginning of a baby or marriage changes also can have an effect on someone's sleep. Many people unknowingly have an effect on their sleep best thru caffeine or alcohol use. Caffeine has a half-existence of 4 hours; so, each the timing of the substance and the amount can have an effect on the cappotential to sleep. Diet pills-which frequently include caffeine—may have a comparable impact. Alcohol will to begin with result in sleep however produces activation because it wears off, frequently inflicting the affected person to awaken withinside the center of the night time. People with per-

sistent scientific ailments are at risk of a number of sleep problems, frequently from changes of their herbal sleep cycle. Frequent nocturia or persistent ache can result in complete awakening and issue falling returned asleep. Medications with sedating or activating homes can intrude with sleep additionally. There is a huge variety of medicines that can motive sleep problems. Any of those elements may also make a contribution to impairment in each day functioning and in the end result in a reduced best of existence.

Disorder

Disordered sleep is one of the nearly inevitable effects of having older [10]. Several situations are conventional on this age group. Even sufferers of their past due nineties can have a lot the identical length of sleep in a 24-hour-length as their more youthful colleagues would, despite the fact that the content material and timing can have changed. The quantity of deep gradual wave sleep (SWS) (Stage 3-4) falls, however this will be because of the recording amplitude modifications attributable to cell loss instead of real modifications withinside the sample of sleep. The quantity of fast eye motion (REM) sleep, at approximately 20%, is likewise preserved. However, modifications withinside the amplitude of the circadian and ultradian rhythms arise with ageing. The principal varieties of sleep-slow wave and REM-have markedly specific underlying physiological procedures. SWS is an basically solid nation, with brainstem manipulate of all simple physiological procedures consisting of respiration pushed with the aid of using arterial carbon dioxide concentrations. There are 4 'stages' of growing depth, and at some point of the latter (SWS stage 3 + 4), some of the restorative cellular procedures are believed to arise. Certainly, at some point of those ranges, the anabolic hormones are in large part launched. REM sleep is an lively nation just like being wide conscious. Physiological procedures react to mentation with the exception that maximum humans hyperpolarize their spinal motor tracts to motive paralysis at some point of REM. This can fail and result in sleep behavioural pastime or now no longer reply to wakening and therefore result in sleep paralysis. Whatever the dream mentation consists of, physiology matches, dreams of running motive tachypnoea, tachycardia, and hypertension; while swimming underwater results in imperative apnoea. During each sleep styles, there's a innovative lack of motor power, and this impacts the top airway as well.

Conclusion

The regular schedule of sleep and wakefulness in the body, their division and change in the day coordinated with the change of day and night determines the circadian rhythm. Sleep plays an extremely important role for the health of the organism, because during sleep the organism is renewed, and if a person does not sleep well for a long period of time, serious physical and mental illnesses can occur. During sleep, body temperature decreases, blood pressure, breathing and digestion slow down, which helps the body recover from work

during wakefulness. At the same time, the growth of cells is accelerated, thus the recovery of all tissues, the production of white blood cells is increased and the immune system is activated. During sleep, the brain is very active, the memory process is established, creative ideas are developed and, most importantly, harmful products created by the brain's work during the day are removed. The part of the brain that we call the hypothalamus participates in the regulation of breathing, heart rate, normal blood pressure and body temperature, and the 24-hour circadian rhythm is also managed here. It divides wakefulness and sleep, the period of dreaming and deep sleep, the rhythm of body temperature changes, the secretion of some hormones such as growth hormone and cortisol, and the secretion of neurotransmitters.

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