APPRAOCH TO THE CHILD WITH SLEEP PROBLEMS

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A MORE RECENT CASE

- CC: snoring
- HPI: 5 year old HF presents with complaints of snoring & recurrent URIs since infancy
- Review of sleep:
  - Bedtime: 8:15 pm, sleep latency 15-20 minutes
  - Awakenings: 1-2 times per night, usually to use restroom
  - Nightmares occur 1-2 times per month, usually between 2-4 am

- Birth Hx: Born at 29 3/7 weeks gestation, Twin B, BW 1375 grams, C-section due to twin-twin transfusion. Pt is the recipient twin. No intubation, 6 week NICU stay, on apnea monitor until 7 months of age
- Review of Systems: Negative except for 5 day hx of cough
- PMHx: History of motor & speech delays
- PSHx: PDA ligation
- FHX: Father with OSA and hx of childhood epilepsy. Twin sister with mild obstructive & central apnea
- SHx: Attends kindergarten

PHYSICAL EXAM

- VS: T 98.4 F BP 86/57 Wt 19.2 kg Ht 104.5 cm BMI 17.58
- General: NAD, well developed
- Head: No dysmorphology
- External nose: No deformity
- Oropharynx: Tonsils grade III
- Chest: CTAB
- Heart: RRR, without murmurs
- Abdomen: Soft and non-tender
- Skin: No rash
- CNS: EOMI, normal tone, normal gait, without ataxia

POLYSONMNOGRAPHY

- Sleep study done at age 4 years and 9 months, for complaints of sleep-disordered breathing associated with enlarged tonsils, showed severe central apnea and moderate obstructive sleep apnea
  - 80.6 respiratory events/hr (12.2 obstructive events/hr and 68.4 central events/hr)
  - Central apneic events were more prominent during REM sleep.
SLEEP STUDY #2

- Patient had an adenotonsillectomy and a split night sleep study performed at age 6.
  - PSG showed mild obstructive sleep apnea (2.6 obstructive events/hr) and severe central sleep apnea (81 central apneic events/hr)
  - Lowest O2 sat of 92%
  - End tidal pCO2 elevated to as high as 56 mm Hg
  - BiPAP at a pressure setting of 10/5 cm H2O with back-up rate of 8 resulted in 0 respiratory events/hr

HISTORY OF SLEEP MEDICINE AS A DISCIPLINE

- 1930: First sleep recording by Hans Berger. He noted that the alpha rhythm disappeared with sleep onset.
- 1937: First continuous overnight EEG sleep recording in humans by Loomis et al.
- 1952: Aserinsky and Kleitman discovered rapid eye movements every 90-120 minutes and subsequently revealed dreaming during this stage of sleep.
- 1950s: Jouvet electromyographically demonstrated muscle atonia accompanying REM sleep in normal animals.
- 1986: The Association of Professional Sleep Societies (APSS) was organized.
- 1988: AASM (American Academy of Sleep Medicine) formed the Sleep Medicine Fellowship Training Committee.

DEFINITION OF SLEEP

- A normal reversible, recurring behavioral state of disengagement and unresponsiveness to the environment that is characterized by typical changes in the electroencephalogram (EEG)

CIRCUITRY OF NONREM SLEEP

- GABAergic neurons in ventrolateral preoptic area of anterior hypothalamus send inhibitory projections to histaminergic neurons in posterior hypothalamus
- This causes inhibition of histaminergic activating systems that project to forebrain
- Acetylcholine causes further reduction of arousal by inhibition of histaminergic excitatory input to brainstem activating systems

REM SLEEP

- GABAergic REM-on cells inhibit norepinephrine release (NE) from locus ceruleus and lateral tegmental area, and inhibits serotonin (5-HT) release from the raphe nuclei
- Noradrenergic & serotonergic REM-off cells show progressively reduced firing during stages 1-3 with virtual silence during REM sleep
SLEEP-WAKE NEUROTRANSMITTERS

• Acetylcholine → REM sleep
• Adenosine → homeostatic sleep drive
• Glutamate → main excitatory neurotransmitter
• GABA → main inhibitory & primary NREM neurotransmitter
• Glycine → main inhibitory neurotransmitter in spinal cord and responsible for REM sleep-related muscle atonia/hypotonia
• Hypocretin → narcolepsy

HISTAMINERGIC PROJECTION PATHWAYS

SLEEP-WAKE REGULATION

• Two components interacting to regulate the timing & consolidation of sleep and wakefulness:
  • Sleep Homeostasis
    • Defined as increasing pressure related the duration of previous wakefulness
  • Circadian Rhythm
    • Biological rhythms that are ubiquitous and genetically determined

OVERVIEW OF SLEEP STAGES

• NREM (non-rapid eye movement) sleep.
  • Divided into N1, N2, and N3 based on specific EEG findings.
• REM (rapid eye movement sleep)
WHAT HAPPENS DURING SLEEP

- Sympathetic activity, HR, CO, BP, swallowing rate, salivary production, esophageal & intestinal motility, GFR, core body temperature, muscle tone, metabolic rate
- Parasympathetic activity, renal water absorption, hormone secretion

SLEEP DEPRIVATION CONSEQUENCES

- Decreased seizure threshold, cognition, attention, pain tolerance, & resistance to infection.
- Increased metabolic rate, insulin resistance, and sympathetic activity.
- Increased motor vehicle accidents & medical errors.

SLEEP THROUGH THE YEARS

- Newborn sleep is polyphasic (i.e., occurs repetitively & randomly throughout a 24 hour day).
- Monophasic sleep (i.e., occurs once, generally at night) develops during early childhood (ages 3-5 years), when napping ceases.
- Daily duration of sleep decreases from newborn infants (70% of 24 hour day) to adults (25-35% of a 24-hour day).

SLEEP ARCHITECTURE

- In the first 6 months of life, sleep is classified as:
  - active sleep (REM sleep equivalent)
  - quiet sleep (NREM sleep equivalent)
  - indeterminate sleep or transitional sleep.
- Classification of sleep in infants older than 6 months of age is similar to that of adults.

DEVELOPMENTAL MILESTONES IN SLEEP ARCHITECTURE

- Sleep spindles: 1 month
- Delta waves: 3 months
- K complexes: 6 months

DEVELOPMENTAL MILESTONES IN SLEEP PATTERNS

- A greater frequency of awakenings occur among breast-fed compared to bottle-fed infants.
- Ability to put themselves to sleep: 2-4 months.
- Ability to sleep through the night: 6-9 months.
- Cessation of daytime napping: 3-5 years.
AGGREGATE HOURS OF SLEEP PER DAY

- Total sleep time gradually decreases throughout childhood.
- Birth to 2 months: 16-19 hours
- Infants (2-12 months): 12-16 hours
- Toddlers (1-3 years): 11-12 hours
- Preschool (3-5 years): 10-12 hours
- Pre-adolescence (5-14 years): 8-11 hours
- Adolescence (14-18 years): 7-9 hours
- Adults: 7-9 hours

CIRCADIAN RHYTHMS AND SLEEP HOMEOSTASIS

- The suprachiasmatic nucleus is functional in utero.
- Irregular sleep-wake rhythms are present immediately after birth. Regular sleep-wake rhythms develop by 2-4 months of age.
- Endogenous circadian sleep phase preference first develop between 6-12 years of age.
- Development of sleep phase delay is between 12-18 years.

ASSESSMENT OF SLEEP DISORDERS IN CHILDREN

- Detection of sleep problems is important in children because sleep disorders have been linked with physical, cognitive, and social development.
- Special needs children are at a higher risk for sleep problems as compared with developmentally normal children.

CLASSIFICATION OF SLEEP DISORDERS

- Insomnia
- Sleep-related breathing disorders
- Hypersomnias of central origin
- Circadian rhythm sleep disorders
- Parasomnias
- Sleep-related movement disorders
- Isolated symptoms and normal variants
- Other sleep disorders

PUTTING THIS INTO PRACTICAL USE...

- What are your patients (or more likely parents) complaining of?
  - Difficulty initiating or maintaining sleep
  - Excessive daytime sleepiness
  - Snoring or other breathing problems during sleep
  - Abnormal movements or behaviors during sleep

MY KID DOESN'T SLEEP!!!

- What are your patients (or more likely parents) complaining of?
**PEDIATRIC INSOMNIA**

- Behavioral insomnia of childhood
  - Sleep onset association subtype
  - Limit setting subtype
- Primary (psychophysiologic) insomnia
  - Primarily in older children, consist of conditioned anxiety around difficulty falling or staying asleep
- Transient forms
  - Self limited period of night time awakings that can be the result of a stressful life event

**PREVALENCE & ETIOLOGY**

- Estimated prevalence ranges from 20-30%
- Multifactorial etiology with intrinsic, extrinsic, and environmental factors

**EVALUATION**

- Medical history
- Developmental history
- Family history
- Behavioral assessment

**TREATMENT**

- The mainstay of treatment for behavioral insomnia of childhood are behavioral interventions:
  - Bedtime routines
  - Systematic ignoring or “extinction” and its variants
  - Bedtime fading
  - Positive reinforcement
  - Parental education and prevention
  - Sleep hygiene principles
  - Stimulus control
  - Sleep restriction
  - Relaxation techniques and cognitive-behavioral strategies to reduce anxiety

**PHARMACOLOGIC INTERVENTIONS**

- In children, the vast majority of sleep problems can be managed adequately with only behavior therapy
- In certain populations, such as children with ADHD, autism spectrum disorders, and developmental delays; a combination of behavioral and pharmacological therapy may be beneficial

**MY KID SNORES AND/OR STOPS BREATHING WHEN THEY SLEEP!!!**
SLEEP RELATED BREATHING DISORDER

- Central sleep apnea syndromes
- Obstructive sleep apnea syndromes
- Sleep-related hypoventilation/hypoxemia syndromes

OBSTRUCTIVE SLEEP APNEA (OSA)

- Characterized by episodes of complete or partial upper airway obstruction during sleep, often resulting in gas exchange abnormalities and disrupted sleep
- Condition exists in 2-5% of children
- Most common between the ages of two and six years
- Major risk factors include adenotonsillar hypertrophy and obesity

OSA DISEASE SPECTRUM

- Mild: AHI between 1-4
- Moderate: AHI between 5-15
- Severe: AHI >15

OSA PATHOPHYSIOLOGY

- AHI: apneas and hypopneas per hour of sleep
- SaO2, end-tidal CO2, percent of total sleep time with level of end-tidal CO2, are also factored into severity of OSA

EVALUATION

- History & physical exam
- Polysomnography (PSG)

TREATMENT

- First line: Adenotonsillectomy
- Positive pressure ventilation:
  - Continuous positive pressure ventilation (CPAP)
  - Bilevel positive pressure ventilation (BPAP)
SYMPTOMATIC TREATMENT

- Weight reduction
- Medication - Intranasal steroids or leukotriene modifiers
- Positioning – Side lying sleeping position, elevate head of bed
- Orthodontics – Rapid maxillary expansion technique involving insertion of a plastic dental device
- Nasal expiratory resistor device - One way valve attached to each nostril with adhesive tape
- Supplemental oxygen – Bridging therapy, rarely used

OTHER SURGERIES

- Uvulopalatopharyngoplasty (UPPP)
- Tracheostomy
- Maxillary advancement
- Tongue reduction

MY KID IS FALLING ASLEEP IN SCHOOL AND ACTING OUT!!!

- Common causes:
  - Insufficient nocturnal sleep, inadequate sleep hygiene, and medication side effects
- Less common causes:
  - Narcolepsy, idiopathic hypersomnia, periodic limb movement disorder, and a variety of toxic, endocrine, and metabolic problems
  - Obstructive sleep apnea can present with complaints of daytime sleepiness or associated behavioral problems; complaints of excessive snoring or abnormal breathing during sleep are usually, but not always present

UNDERLYING MEDICAL CONDITIONS PRESENTING WITH EXCESSIVE DAYTIME SLEEPINESS

- Anemia
- Malignancy
- Metabolic derangements
- Post-traumatic hypersomnia
- Recurrent hypersomnia (Kisse-Levin syndrome)
- Menstruation-associated hypersomnia
- Pregnancy-associated hypersomnia
- Circadian rhythm disorders
- Toxic exposure: carbon monoxide, heavy metals
- Meningitis/encephalitis
- Increased intracranial pressure
- Intracranial mass, particularly craniopharyngioma

HYPERSOMNIA OF CENTRAL ORIGIN

- Primary complaint is daytime sleepiness that is not due to disturbed sleep or misaligned circadian rhythms
  - Narcolepsy (with or without cataplexy)
  - Idiopathic hypersomnia (with or without long sleep time)
  - Behaviorally induced insufficient sleep

NARCOLEPSY

- Clinical syndrome of chronic sleepiness and:
  - Cataplexy
  - Hypnogogic hallucinations
  - Sleep paralysis
ETIOLOGY

• Loss of orexin signaling
• Genetic factors – DQB1*0602 haplotype
• Rare brain lesions

DIAGNOSTIC CRITERIA FOR NARCOLEPSY

• Patient has complaints of excessive daytime sleepiness almost daily for at least 3 months
• Mean sleep latency on multiple sleep latency test (MSLT) is less than or equal to 8 minutes or 2 or more sleep onset REM periods (SOREMPs) are observed following sufficient nocturnal sleep (min 6 hours) during the night prior to the test
• Hypersomnia is not better explained by another sleep disorder, medical or neurological disorder, mental disorder, medication use, or substance use disorder

AND THOSE WITH ABNORMAL MOVEMENTS OR BEHAVIORS DURING SLEEP...

• Abnormal movements or behaviors may be observed in a variety of sleep disorders, including respiratory disturbance, parasomnias, and nocturnal seizures
• Other types of sleep related movements disorders: Periodic limb movement disorder, restless legs disorder, and rhythmic movement disorder

PARASOMNIAS

• NREM related parasomnias are disorders of arousal
  • Confusional arousal
  • Sleepwalking
  • Night terrors
• REM related parasomnias involve the intrusion of the features of REM sleep into wakefulness or failure to manifest one of the core features of REM sleep
  • Sleep paralysis
  • Nightmares
  • REM sleep behavior disorder
• Miscellaneous parasomnias bear no specific relationship to sleep stage
  • Nocturnal enuresis
  • Sleep related hallucinations

SLEEP RELATED MOVEMENT DISORDERS

• Simple, stereotopic movements that disturb sleep
• Restless legs syndrome
• Periodic limb movement disorder
• Sleep related bruxism
• Sleep related rhythmic movement disorder

RESTLESS LEGS SYNDROME (RLS)

• Marked discomfort in legs that occur only at rest and are immediately relieved by movement
• It is hypothesized that RLS arises from dysfunction of hypothalamic dopaminergic cells that are the source of spinal cord dopamine
• RLS can be associated with iron deficiency, pregnancy, uremia, diabetes mellitus, rheumatic disease and venous insufficiency
DIAGNOSTIC CRITERIA FOR RLS

- Urge to move legs
- Urge to move begins or worsens during periods of rest or inactivity
- The urge to move legs is totally or partially relieved by movement
- The urge to move legs is worse in the evening or night

TREATMENT OF RLS

- Non-pharmacologic therapy (stretching exercises, avoidance of aggravating factors such as caffeine, nicotine, and alcohol).
- Iron therapy
- Levodopa
- Dopamine agonists
- Low potency opioids
- Benzodiazepines and benzodiazepine agonists

PERIODIC LIMB MOVEMENT DISORDER

- Sudden jerking leg movements that commonly accompany RLS
- Repetitive, stereotyped movements that involve extension of big toe with partial flexion of the ankle, knee and sometimes the hip
- Diagnosis is by PSG:
  - Repetitive movements that are 0.5 to 5 seconds in duration, typically separated by an interval of 20 to 40 seconds (range 5 to 90 seconds)
  - More than 5 periodic limb movements per hour of sleep

ISOLATED SYMPTOMS AND NORMAL VARIANTS

- Hypnic jerks (sleep starts)
- Sleep talking

RHYTHMIC MOVEMENT DISORDER

- Consist of stereotyped repetitive movements involving large muscle groups, usually of the head and neck
- Movements begin immediately prior to sleep onset and are sustained into light sleep
- Include head banging, head rolling, and body rocking or rolling
- Typically occur in the toddler years, and resolve gradually by the school years
- Distinctive character of rhythmic movement disorder allows a clinical diagnosis
- In rare cases, may need to differentiate from seizure activity

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I WISH Y'ALL A SOUND SLEEP!