

Pediatric Sleep Disorders: Evaluation and Management

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Introduction to Pediatric Sleep



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Outline

- Pediatric Sleep 101
 - Why we sleep
 - Basics of sleep medicine
 - Developmental sleep
 - Circadian Rhythm
- Evaluation of Sleep Problems
 - History and the “sleepy” child
 - Physical Exam
 - Parent questionnaires
 - Actigraphy
 - Polysomnography
 - Multiple Sleep Latency Test
- Common Pediatric Sleep Problems

Sleep 101



Sleep 101: why we sleep

- Everybody (including mammals and birds) sleeps!
- Nobody knows why we need sleep
 - Contrary to everybody's mother, sleep has never been proven to "cure" anything
 - But we all know that people and other mammals that are sleep deprived, even partially, do poorly in several arenas, including earlier death
 - Perception
 - Cognition
 - Psychomotor
 - Performance

Sleep 101: why we sleep

- Restoration/Growth Theory
 - REM sleep restores mind
 - Slow wave sleep restores body
- Evolutionary/Adaptive Theories
 - Similar sleep patterns in cats, dogs, rabbits, humans
 - More complex mammals, i.e. dolphins – no REM – hemispheric sleep only, have complete control
- Energy Conservation Theory
 - (minimally) decreased metabolic rates when sleeping
- Learning/memory Theory
- Unlearning Theory
 - “detoxification”

Sleep 101: Sleep Stages

Children > 6 months of age

- Rapid Eye Movement (REM) Sleep
- Non-REM Sleep
 - 4 stages
- Wake

Infants < 6 months of age

- Active
- Quiet
- Indeterminate
- Wake

Sleep 101: non-REM sleep

- Stage 1
 - Light, transitional sleep ~6%
 - Slow rolling eye movements
 - Still incorporate some cues from the environment
- Stage 2
 - “filler” sleep ~40-50%
- Stage 3 & 4
 - slow wave, delta sleep ~30%
 - “deep” sleep
 - Minimal cues from the environment incorporated
- Infants = quiet or indeterminate = 50%

Sleep 101: REM sleep

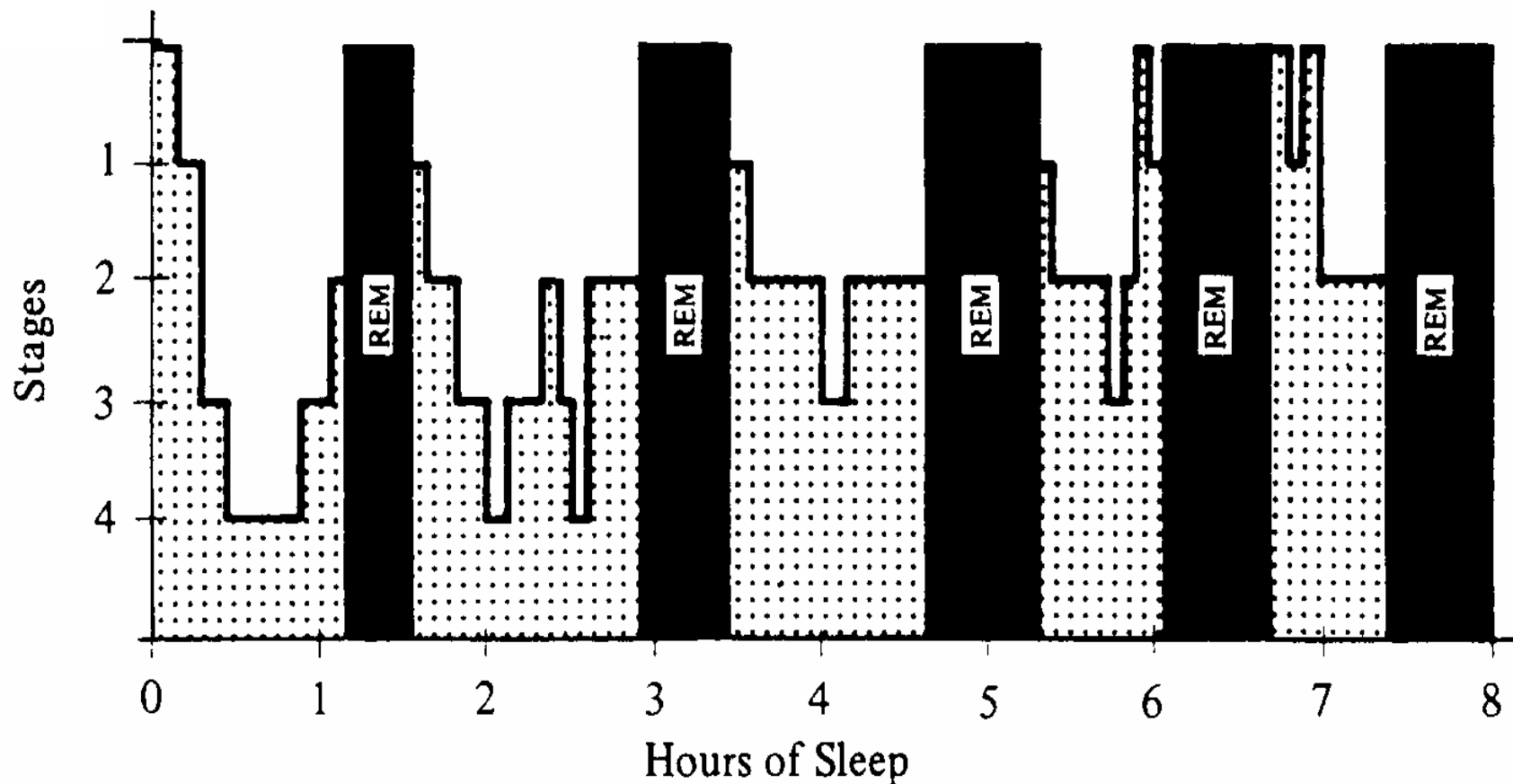
- ~20% of total sleep; 3-5 cycles/night
- more common later in the night/morning
- Rapid Eye Movements (eye twitching)
- active mind → DREAMS, incorporates environmental input
- quiet body → low tone, little movement
- Breathing more irregular during this stage
- Infants: 50%

Sleep 101: WASO

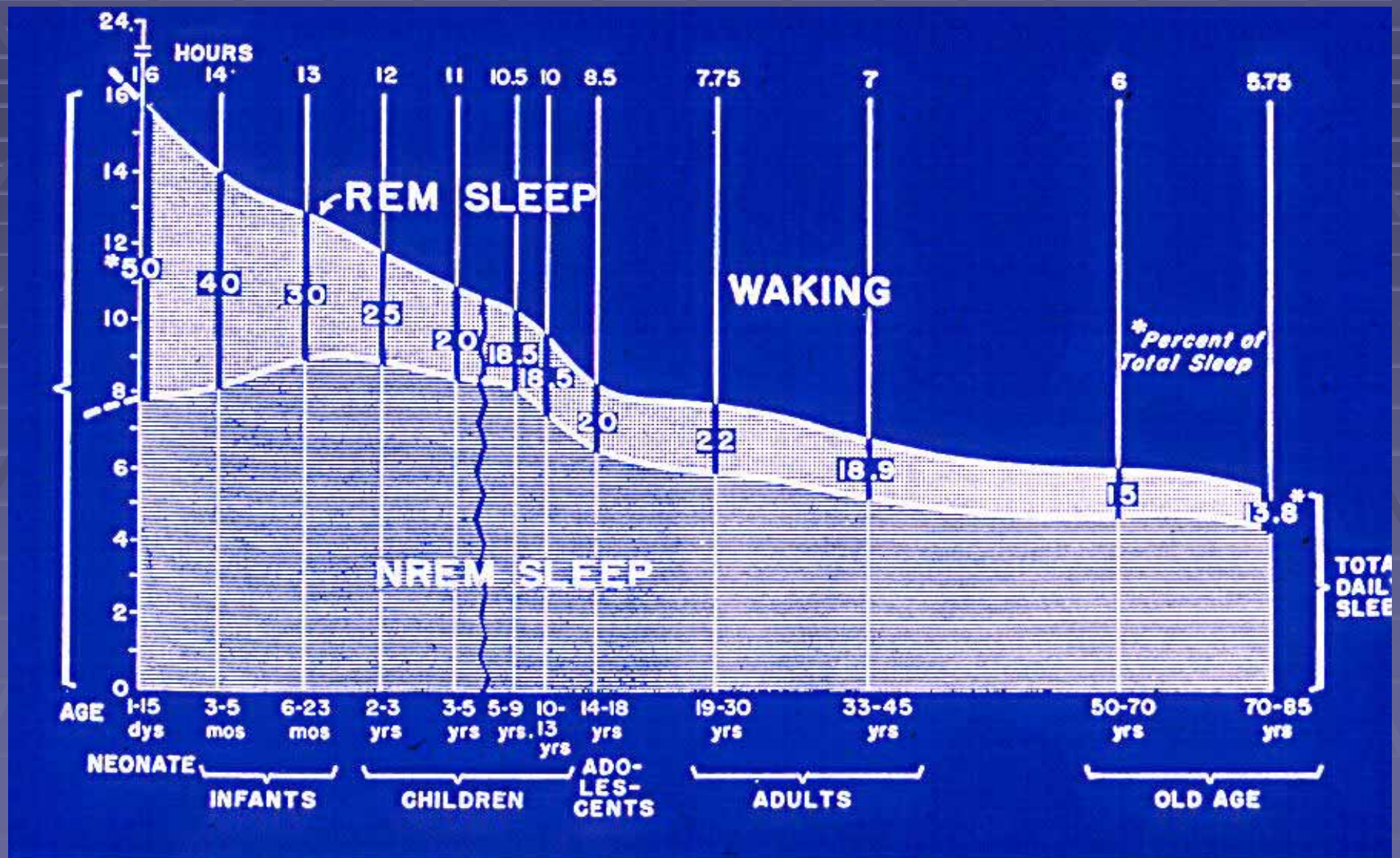
- Wake after sleep onset (WASO)
 - Up to 6% of total sleep time!!
 - Normal to have 3-5 full awakenings per night, more in infancy
 - Oftentimes will wake up between sleep stages
 - Can have up to 11 arousals on brain waves PER HOUR.
 - And this is all normal!!!

Sleep 101: Sleep Stages

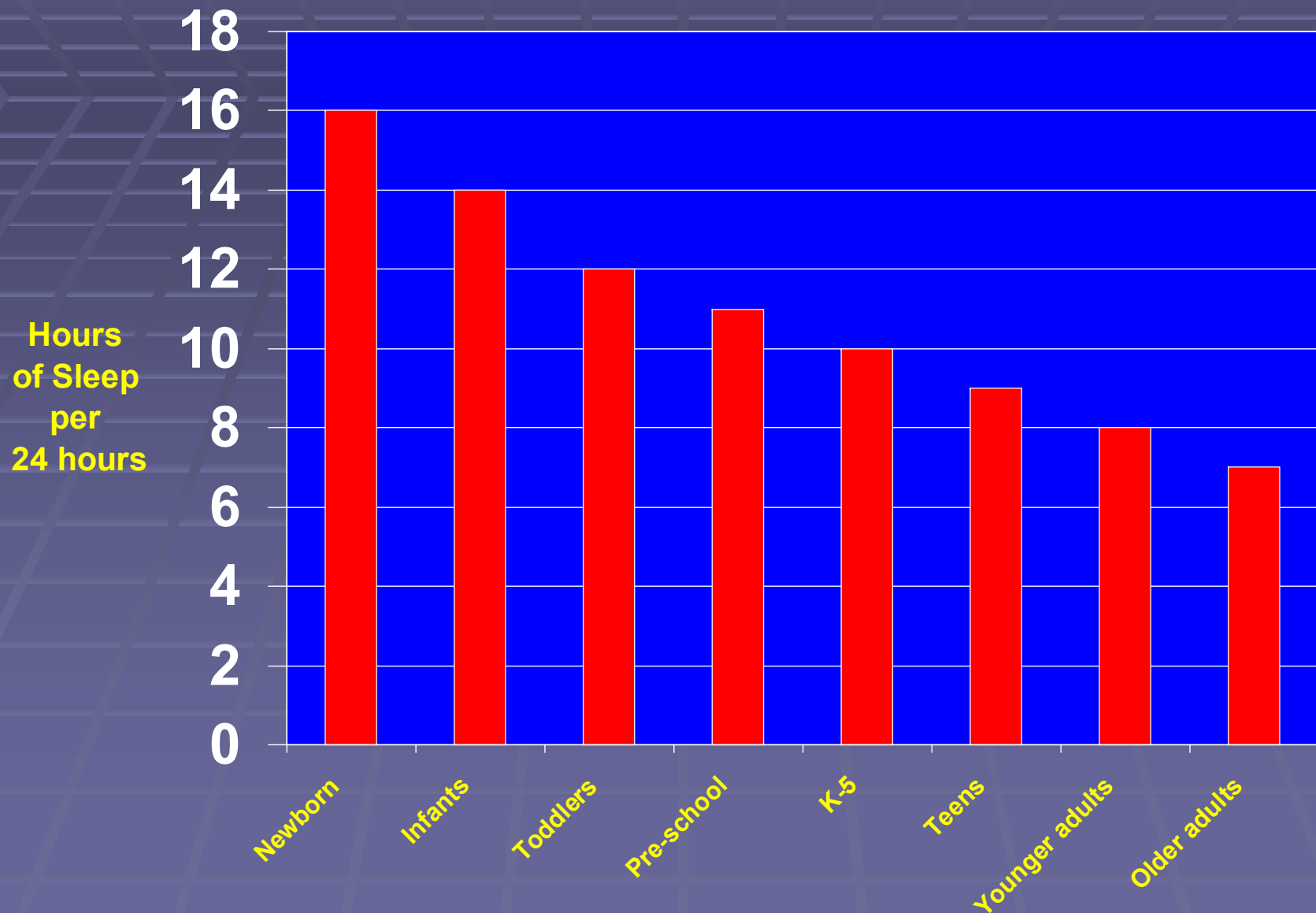
SEQUENCES OF STATES AND STAGES OF SLEEP ON A TYPICAL NIGHT



Sleep 101: Developmental Changes



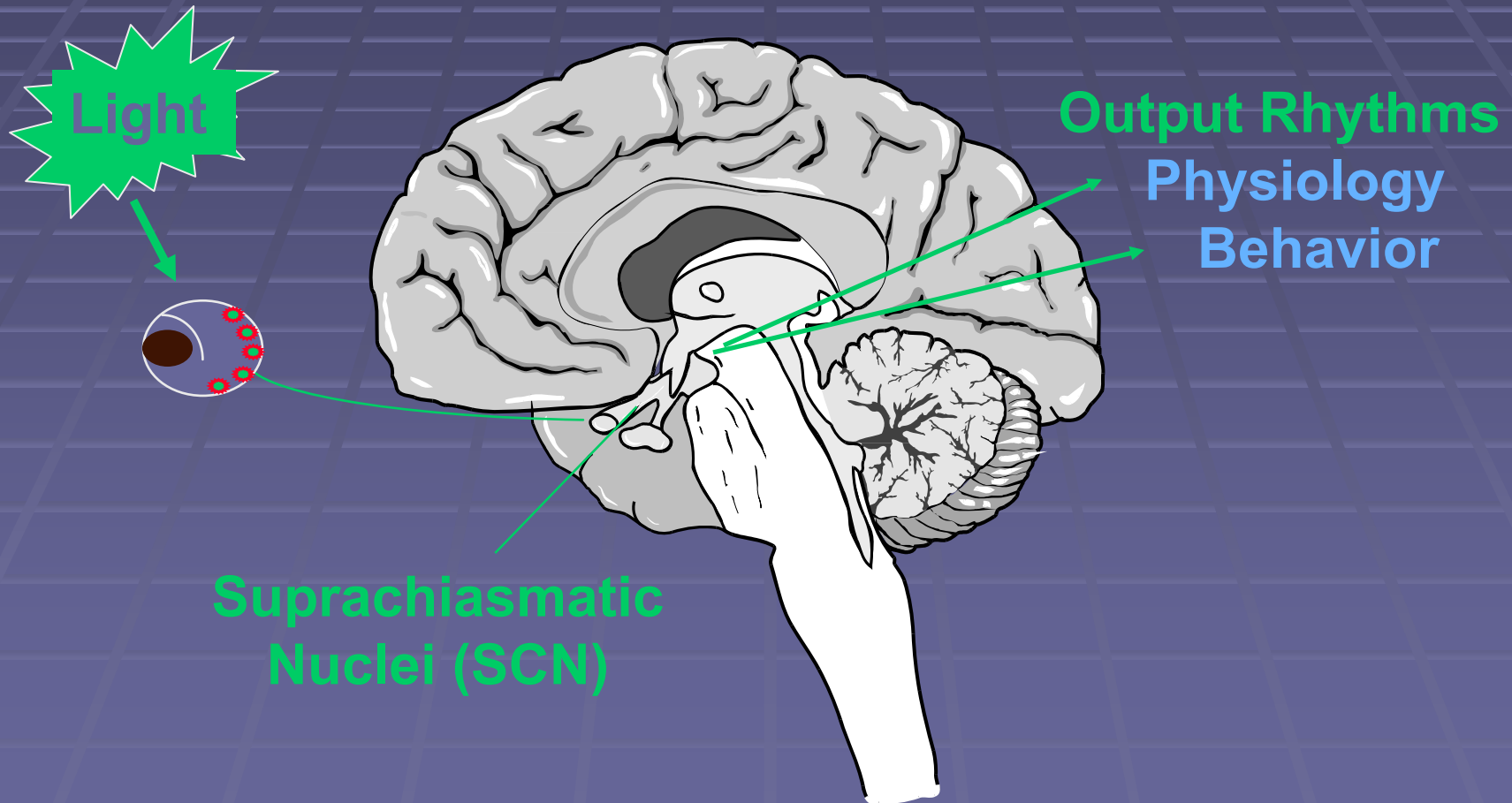
Sleep 101: Developmental Changes



Sleep 101: Circadian Rhythm

- Intrinsic biologic rhythm with a periodicity of about 24 hours
 - Sleep-Wake cycles
 - Melatonin (peaks at bedtime)
 - Temperature (cold and sleepy...at night)
 - Cortisol (ready to go in the morning)
 - Performance
 - Cognition
 - Mood/Emotion
 - Metabolism

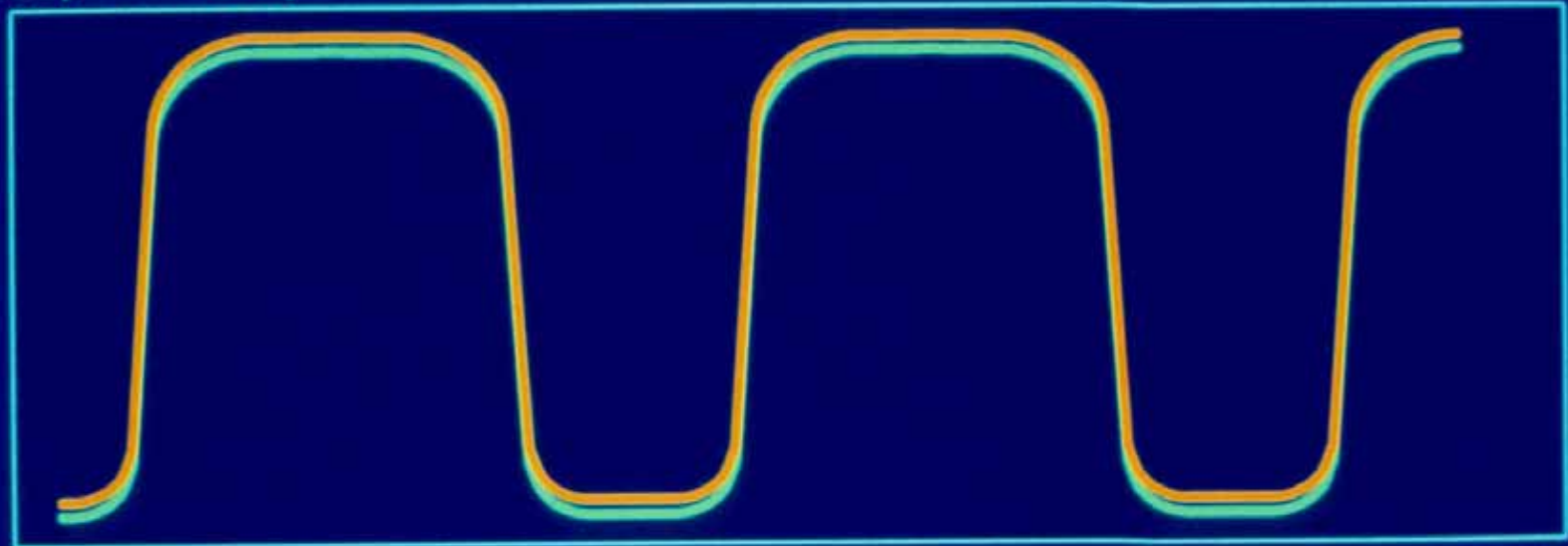
Sleep 101: Circadian Rhythm



Sleep 101: Circadian Rhythm

Adequate Sleep and Synchrony of Circadian Sleep Rhythm and Daily Schedule

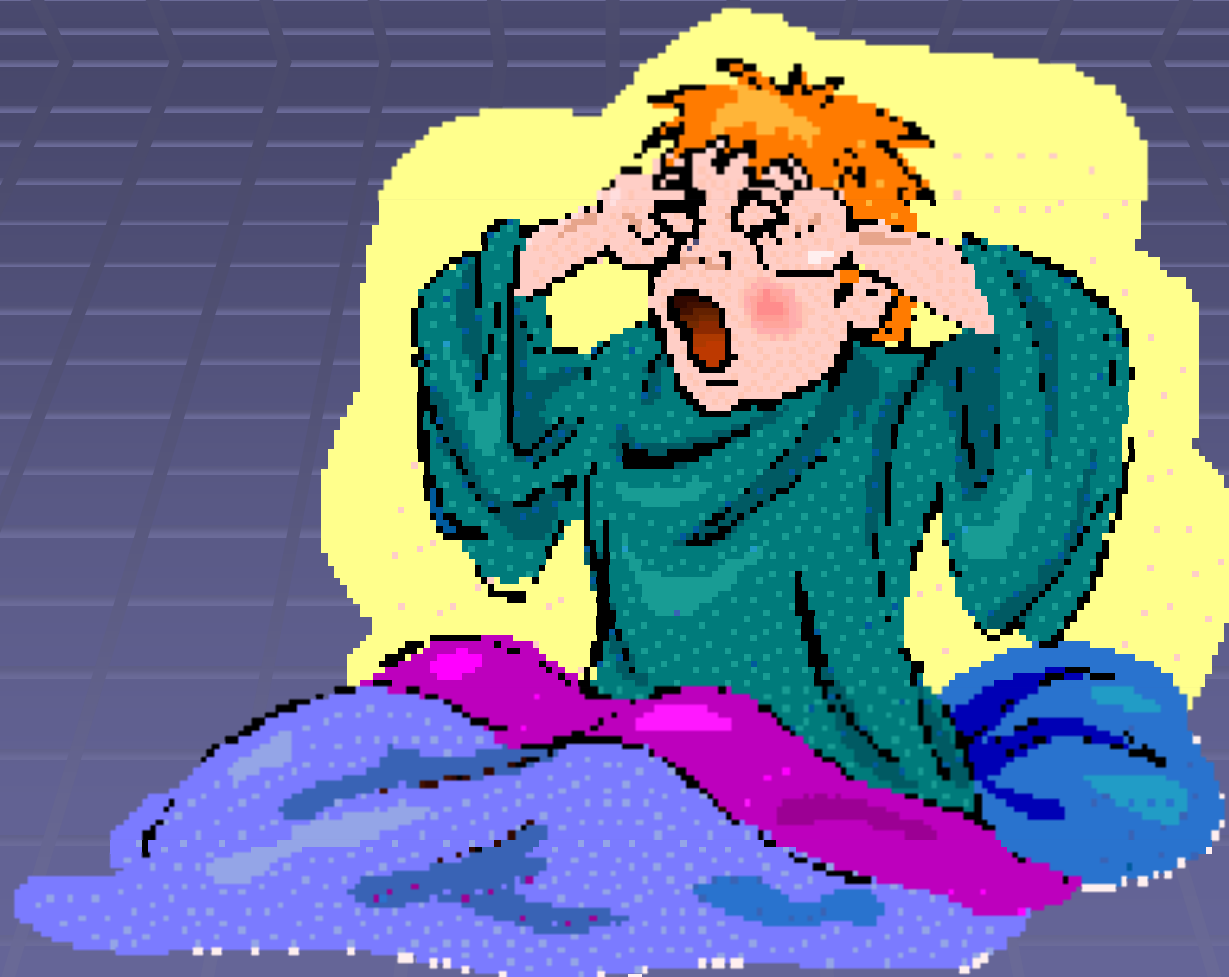
Sleep Tendency



Time (days-nights)

- Scheduled Bedtime Hours
- Circadian Sleep Tendency
- Desired Schedule

Approaches to Pediatric Sleep Problems



Approaches to Pediatric Sleep Problems

- GOOD HISTORY

- B Bedtime routines

- E excessive daytime sleepiness/
dysfunction

- A awake after sleep onset? Parasomnias?

- R routines (schedules)

- S snoring/ sleep-disordered breathing

- Other medical, family, social,
environmental history

Approaches to Pediatric Sleep Problems

- Sleep Hygiene questions
 - Bedtime routine
 - Bedroom description: bed, computers, TV's, phones, stereos, noise/light from outside, roommates/bedmates (including non-human)
 - What else done in bed? Homework, reading, playing games, watching TV
 - Food/beverages, especially caffeine, in afternoon and evening
 - Exercise patterns → “running them ragged” before bed?

Approaches to Pediatric Sleep Problems

- (actual) Sleep questions
 - Snoring? Mouth breathing? “Darth Vader” breathing? Gasping? Pauses?
 - Movements: leg kicking, tossing/turning, sleep walking?
 - Talking? Screaming?
 - Sweating?
 - Teeth grinding?
 - Wet the bed?
 - Arousals/awakenings? Actually getting out of bed?

Approaches to Pediatric Sleep Problems

- If abnormalities during asleep:
 - How often does it occur?
 - 6 times/night, once a year, etc.
 - What time of night does it happen
 - 1st third, middle, early morning
 - Any correlative stressors?
 - i.e., snoring worse if sick or on stomach
 - i.e., nightmares before tests
 - What makes it go away?
 - If aroused, falls asleep again how, where, and how long does it take?
 - Does the child remember the problem?

Approaches to Pediatric Sleep Problems

- Morning after questions:
 - Difficult to arouse? Self, parent, clock?
 - Tired during day? Yawning?
 - Sleepy during day? Actual naps or falling asleep in school, cars, buses...
 - Daytime behavior? Cranky, hyper, angelic, etc.
 - What is “best” time of day?

The “Sleepy” Child

Insufficient Sleep
(Sleep Deprivation)

Fragmented Sleep
(Sleep Disruption)

**EXCESSIVE DAYTIME
SLEEPINESS**

Primary Disorders of
Excessive Daytime Sleepiness

Mood

Neurobehavioral
Deficits

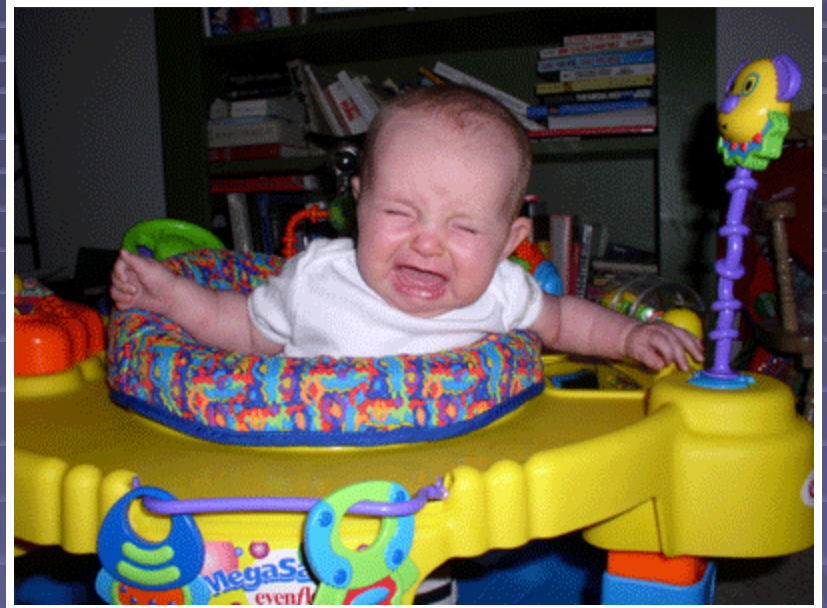
A note about daytime function....

- Excessive daytime sleepiness in adults is as simple as that – they are inappropriately sleepy
- In children, hypoarousal is often manifest by hyperactivity, distractibility, including the inability to nap/sleep
 - Think of puppies chasing their tails when trying to go to sleep
 - Too tired to do anything successfully, including going to sleep

Too tired to go to sleep



well



A note about daytime function....

- Children who are deprived of quality sleep
 - Have poorer academic performance
 - Have more inattention
 - Have more behavior problems
- This is not necessarily the same as
 - ADHD
 - PDD/autism spectrum disorders

Approaches to Pediatric Sleep Problems

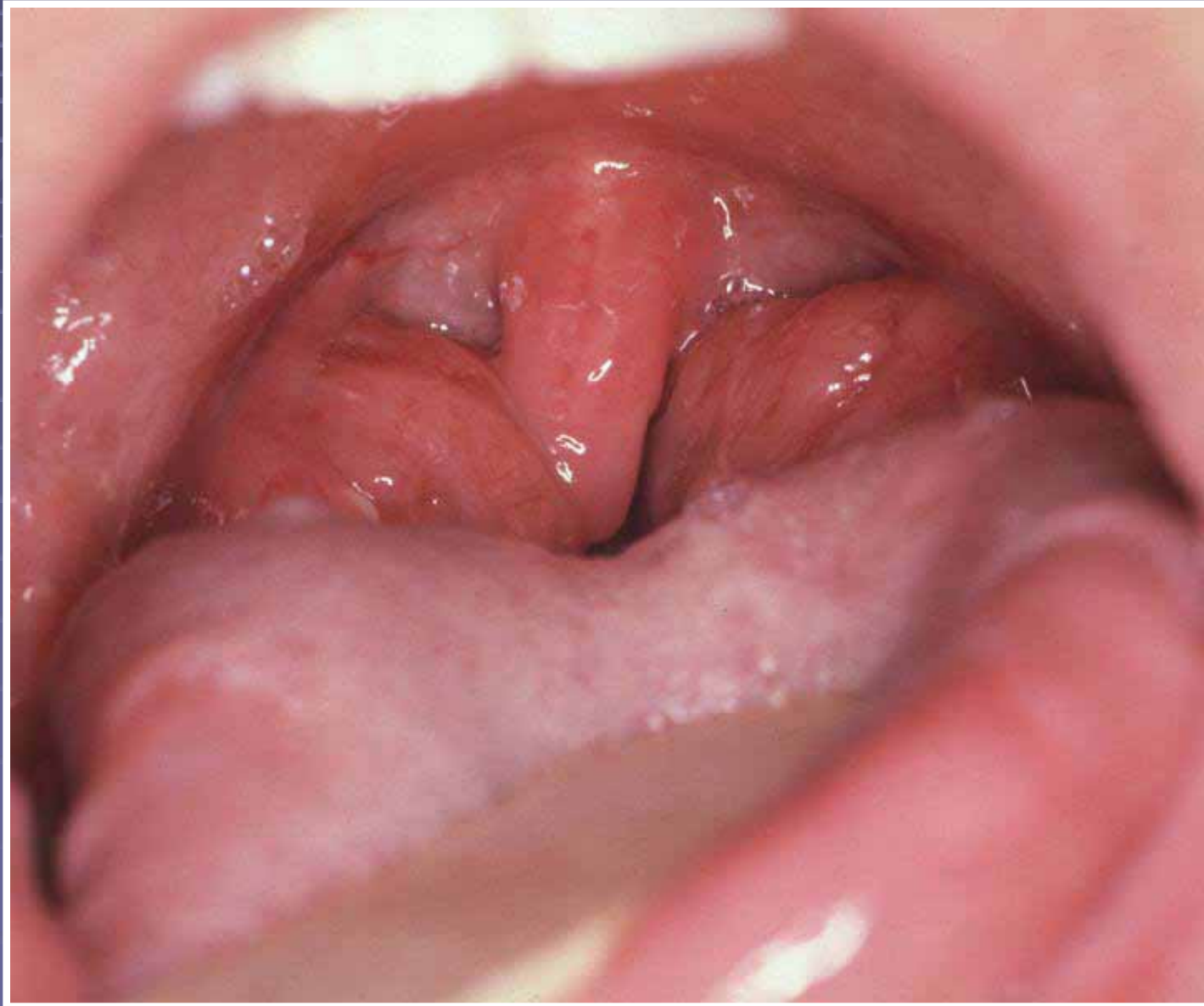
- GOOD EXAM

- Any craniofacial malformation
- Upper airway (including nose)
- Obesity
- Neurologic (overall tone)
- Psychiatric (demeanor, affect)
- Primary cardiac or pulmonary disease
- Allergic disease

Approach to Reading Group Problems: EXAM



Approaches to Pediatric Sleep Problems: EXAM



Approaches to Pediatric Sleep Problems: EXAM



Approaches to Pediatric Sleep Problems: EXAM



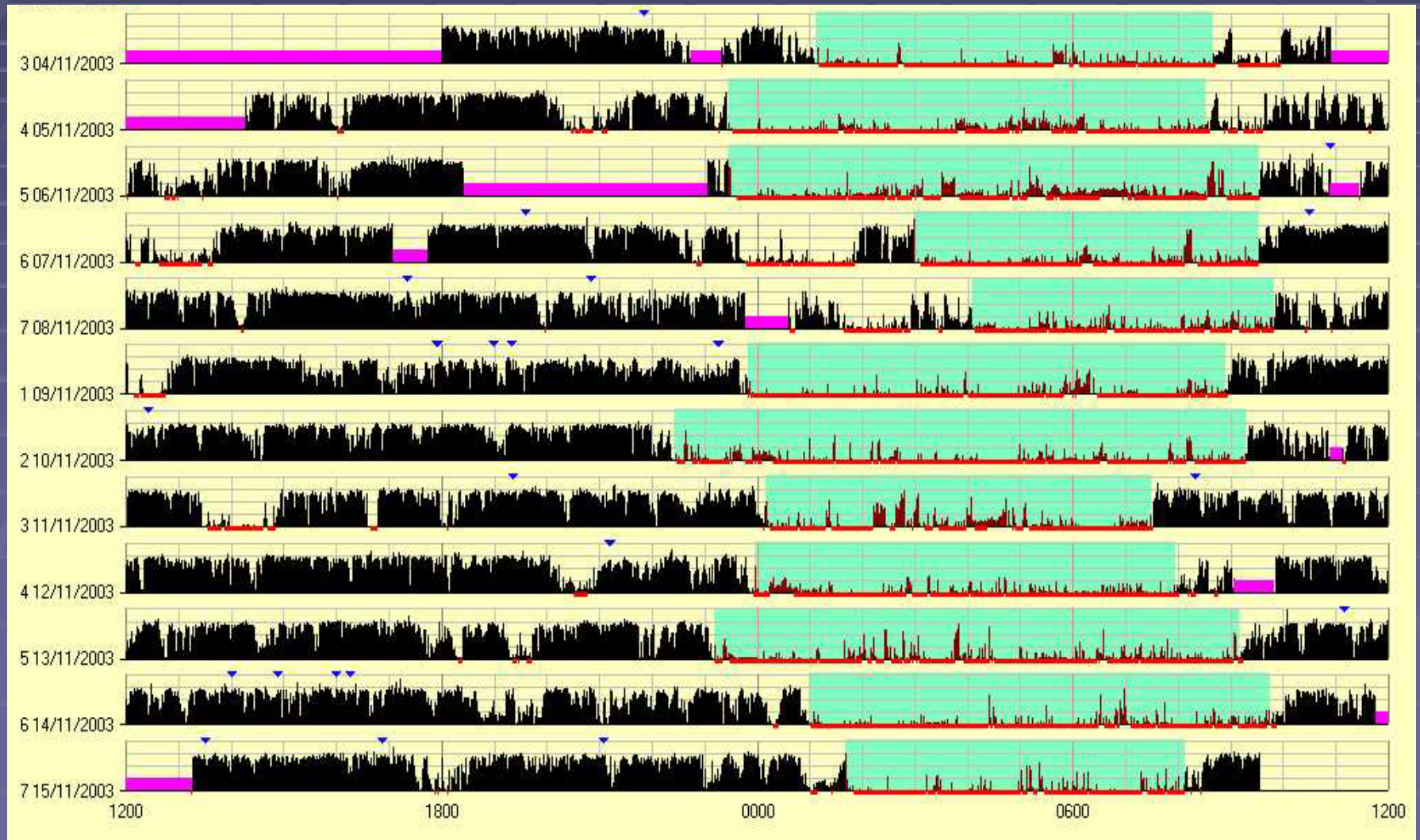
Approaches to Pediatric Sleep Problems

- Standardized parental reports
 - Actigraphy Monitoring
 - Screening Studies (naps, oximetry)
 - Polysomnography (overnight sleep study)
 - Multiple Sleep Latency Test
- HISTORY by parents/child NOT ENOUGH to diagnose all disorders

Parental Subjective Reports: Scales/Surveys

- Child Sleep Habits Questionnaire (CHSQ) by Owens et al, 2000.
- Pediatric Sleep Questionnaire (PSQ) by Chervin et al, 1998
 - Both are used for research purposes
 - Have not been used in large scale general pediatric populations as a substitute for a sleep specialist

Actigraphy

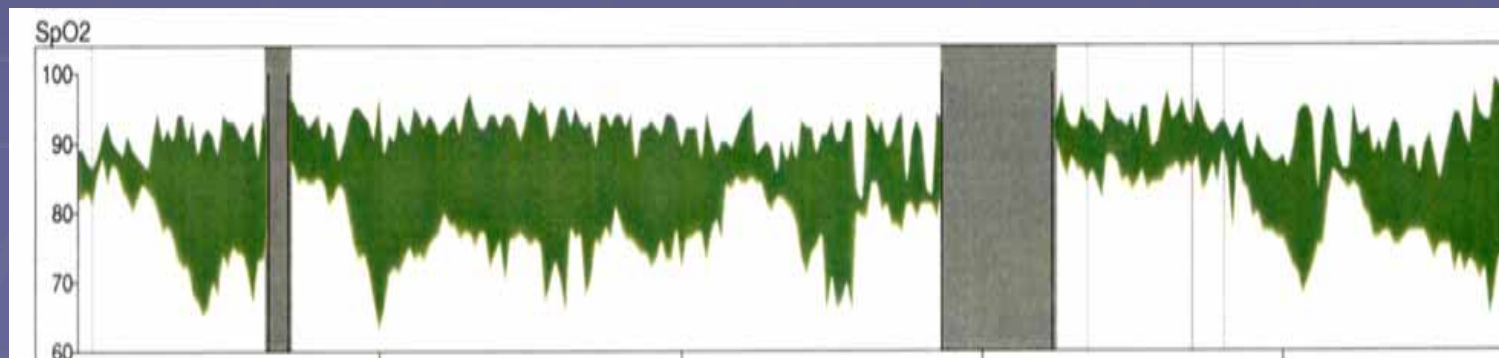
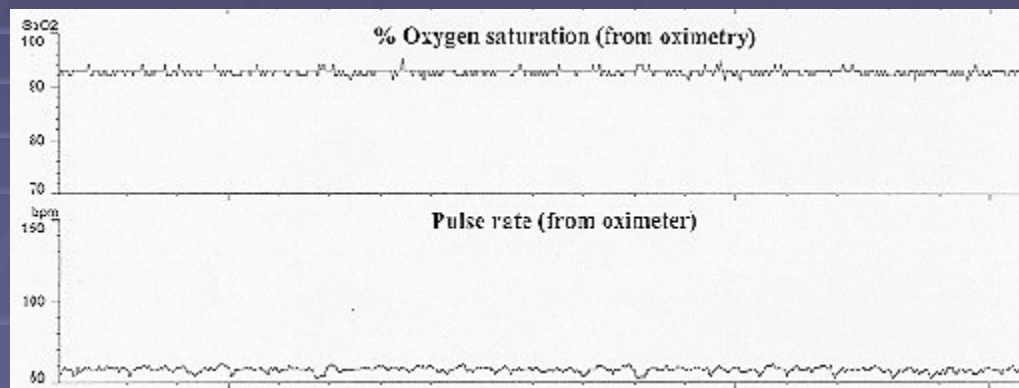


Overnight Oximetry

- Child wears a portable, non-invasive pulse oximetry probe overnight while sleeping – continuously measures oxygen levels
- It does not distinguish between artifact and real, i.e. with motion
- Parent keeps detailed log as to what they are doing (i.e., asleep, in swing, in bed, crying, etc.)
- Information is downloaded and print out given to provider to analyze.

Overnight Oximetry

- If abnormal, helpful
- If normal, need further screens



Polysomnography

- An overnight “sleep study” that is at least 6 hours
- Tries to mimic usual routine at nighttime
- We are the only accredited Pediatric facility in Washington, and probably WAMI
- Located at Bellevue’s Overlake Hospital
- Insurance usually covers it (part of it)

Polysomnogram



Polysomnogram

- What we actually do:
 - EEG: brain activity used to determine sleep stage and arousals
 - EOG: eye movements to determine REM sleep
 - EMG (chin, leg): to determine REM sleep and evaluate leg movements
 - ECG: heart rate responses
 - Oral and nasal airflow: to evaluate breathing
 - Snore microphone: to evaluate for snoring
 - Pulse oximetry, end-tidal CO₂: for breathing
 - Thoracic and Abdominal Movements: for breathing
 - Video recording: for everything!

Polysomnogram

- What we actually measure:
 - Sleep architecture
 - Total Sleep Time
 - Sleep Latency
 - Latency to REM
 - % in each sleep stage
 - Arousals (spontaneous, respiratory related, movements related) == necessitates a 3 second EEG change
 - Normal less than 11 arousals/hr
 - Normal to have 3-5 full awakenings

Polysomnogram



Polysomnogram



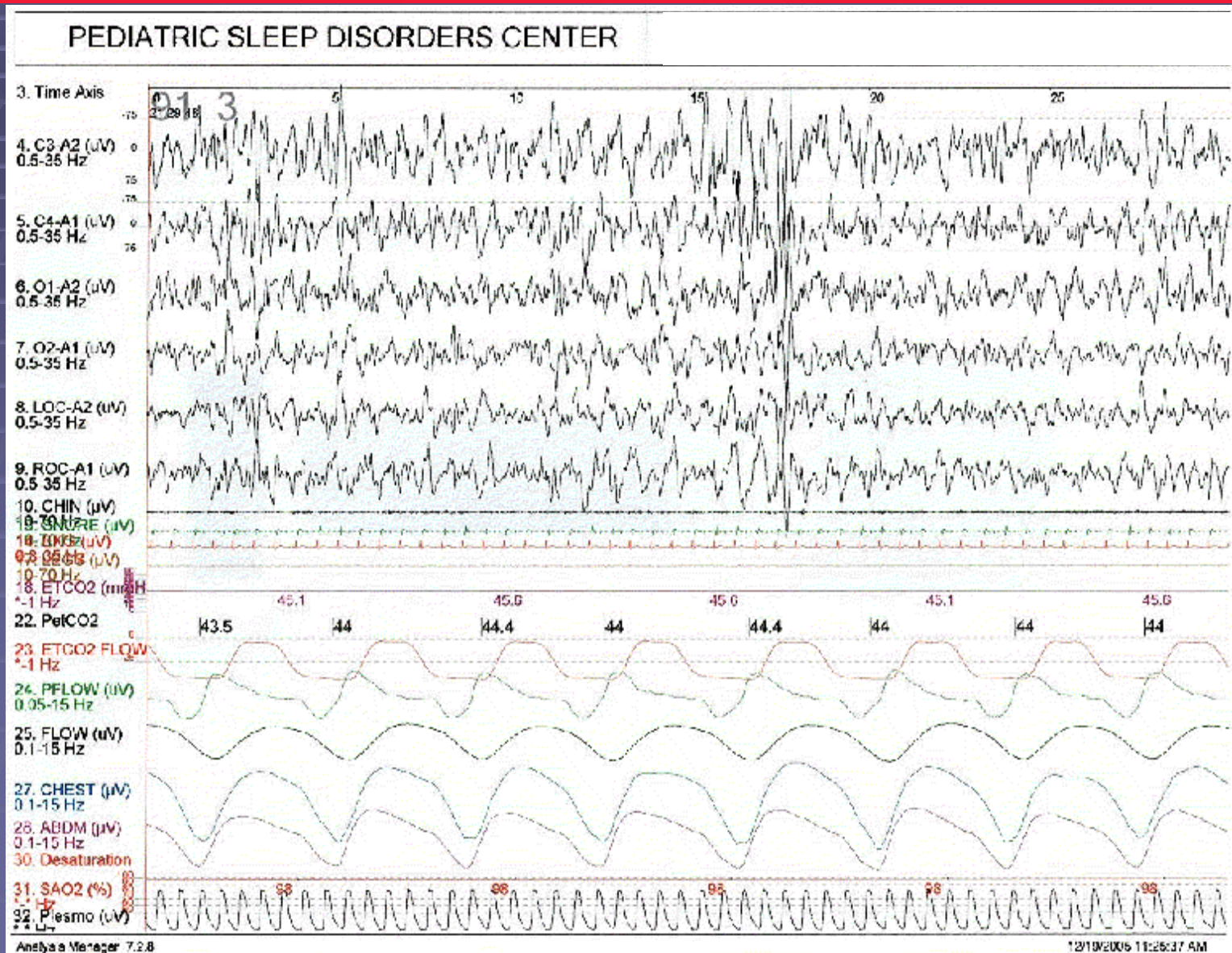
Polysomnogram

- What we actually measure, cont'd:
 - Respiratory Summary
 - Respiratory rate
 - Oxygen levels
 - Carbon dioxide levels
 - Apneas: cessation of airflow
 - Hypopneas: decrease but not full cessation of airflow
 - Periodic breathing: fast shallow breaths followed by a pause, common in infants
 - Snoring and severity
 - Respiratory Disturbance Index: number of total abnormal respiratory events/ hours asleep

Polysomnogram

- What we actually measure:
 - Limb Movements
 - Isolated
 - Periodic → Restless Legs Syndrome
 - Respiratory Related
 - Cardiac Summary
 - Heart rate
 - Presence of noted arrhythmias

Polysomnogram



Polysomnogram

- What it doesn't do:
 - Identify certain types of seizures
 - Frontal Lobe
 - Tell us what level an airway obstruction is occurring (i.e., nose, tonsils, etc.)
 - Tell us if somebody is having reflux
 - Predict sudden death for anything, including:
 - Prader-Willi
 - SIDS/ALTE
 - Neuro/muscular disease (i.e., DMD)
 - Cardiac disease

Multiple Sleep Latency Test (MSLT)

- Objectively assess severity of sleepiness.
- Series of 4-5 naps at 2 hour intervals after being awake for 2 hrs.
- Performed after an overnight polysomnogram to ensure adequate sleep.
- Dark, quiet room and patient laying down.
- Asked to close eyes and relax.
- Abnormal if sleep onset < 10 minutes.

Common Pediatric Sleep Problems



Common Pediatric Sleep Problems

- Sleep Deprivation
 - By far THE most common reason for a child (particularly a teen) to be sleepy
 - Can occur in the context of normal or abnormal sleep
 - The average adolescent still needs 8.5-9 hours a sleep/night → this rarely happens in our society

Common Pediatric Sleep Problems

- Sleep Fragmentation
 - Sleep Disordered Breathing
 - Disorders of Initiating and Maintaining Sleep (DIMS) – the insomnias
 - Primary
 - Secondary
 - “organic” vs. “learned” or behavioral
 - Usually combination of above
 - Periodic Limb Movements
 - Parasomnias

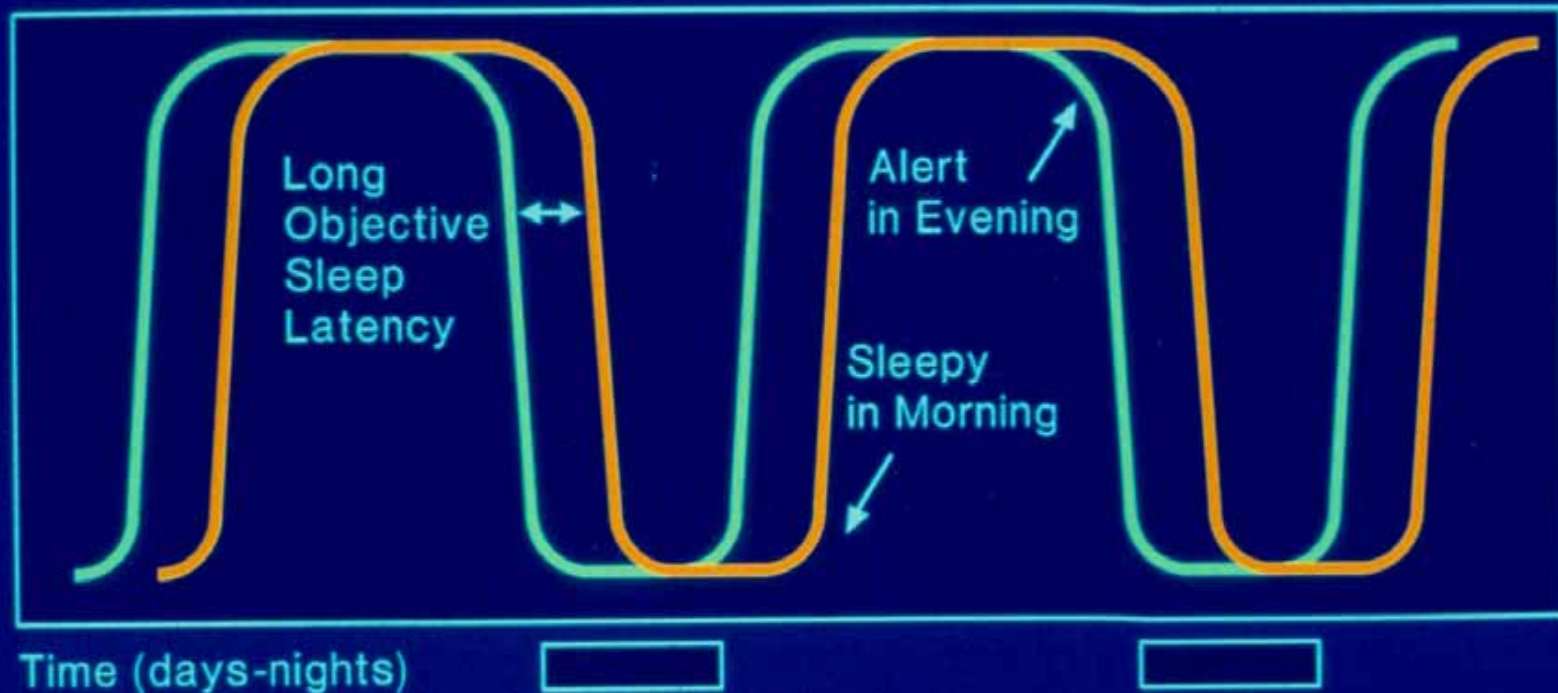
Circadian Rhythm

- Disruptions result in:
 - “morning lark” vs. “night owl”
 - Inability to maintain a socially acceptable day-night pattern
 - Have persistent problems with insomnia
 - Frequent nighttime awakenings (because body thinks it's day)
 - Inappropriate daytime fatigue (in kids manifest by hyperactivity) (because body thinks it's night)

Delayed Sleep Phase

Delayed Sleep Phase Bedtime Ahead - Sleepiness Behind

Sleep Tendency



- Symptoms**
- Can't fall asleep at night
 - Can't get up in morning
 - Tired all day except evening

- Scheduled Bedtime Hours
- Circadian Sleep Tendency
- Desired Schedule

Sleep Disordered Breathing

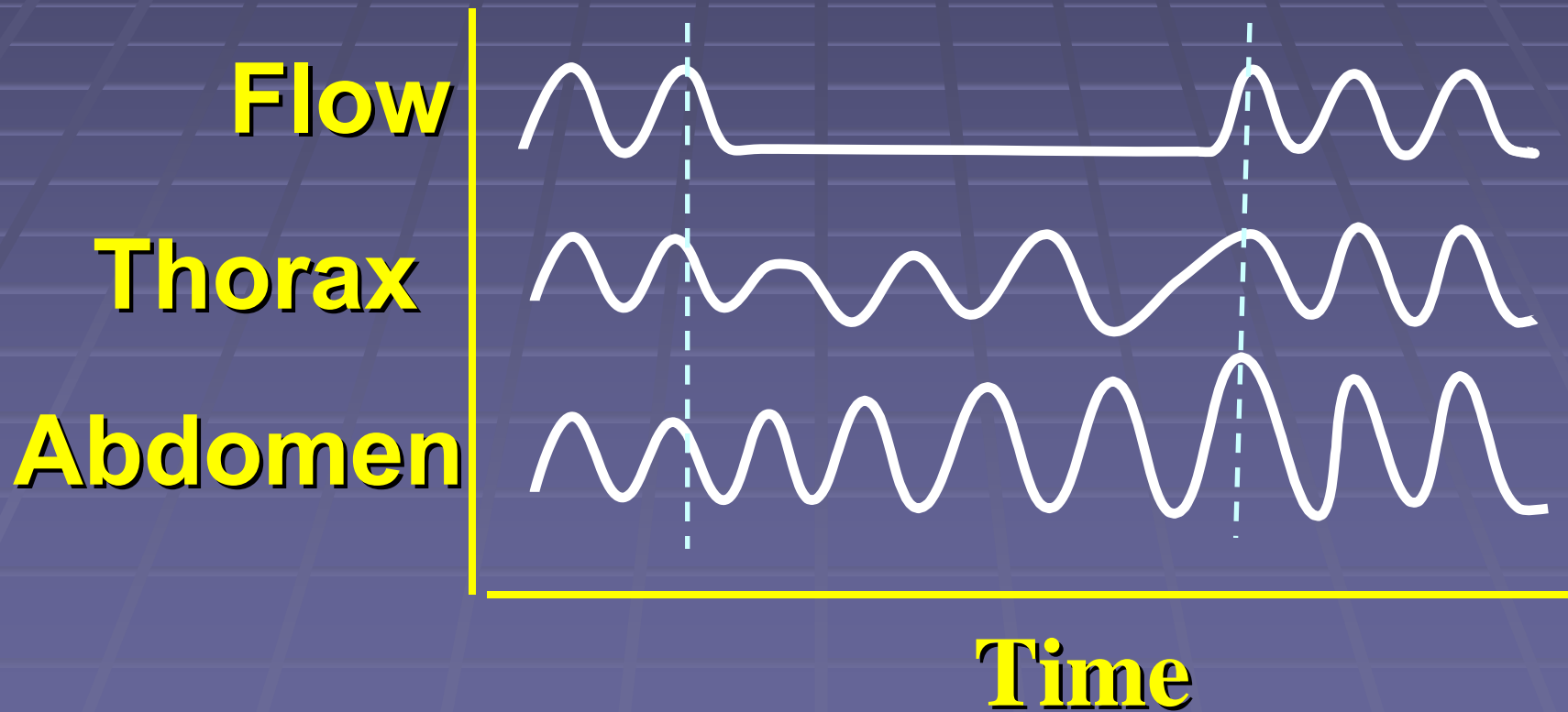
Why is breathing a big deal in sleep?

- Breathing worse in sleep, especially REM
 - Less cortical input overall
 - Smaller lung volumes
 - Low muscle tone → upper airway collapse, decreased amount of air exchange
 - Relative immaturity of the respiratory system particularly in infants
- Smallest airway to pharyngeal structure ratio is during childhood (3-6 years of age)
- Craniofacial abnormalities also predispose to airway narrowing and other malformations

Sleep Disordered Breathing

- SDB is prevalent in children, up to 5%
- Ranges from Primary Snoring to full Obstructive Sleep Apnea Syndrome
 - OSAS characterized by episodic hypoventilation with repeated arousals
 - Cessation of airflow in the presence of effort (i.e., trying to breathe but can't...something's blocking)
 - Daytime sequelae (behavioral, cardiovascular) suspected but not well studied
 - Higher Blood Pressures, Heart Dysfunction
 - Poorer School Performance
 - Increased Inattention and hyperactivity scores

Obstructive Apnea



PEDIATRIC SLEEP DISORDERS CENTER

2. Body Position

2. Body Position

9. THE FUND

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10. CHIN (cm)

12. Spring

18. LEGS (11)

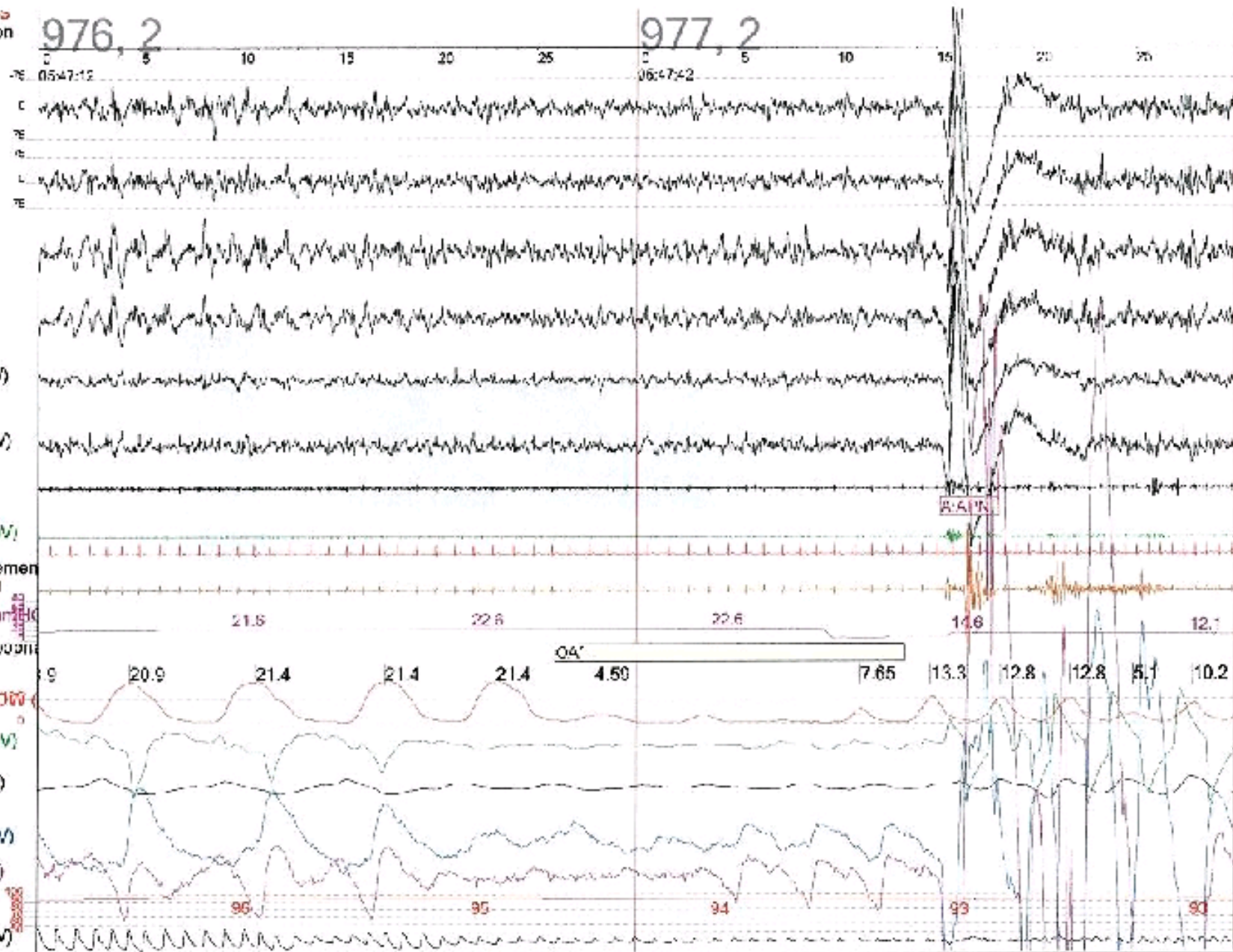
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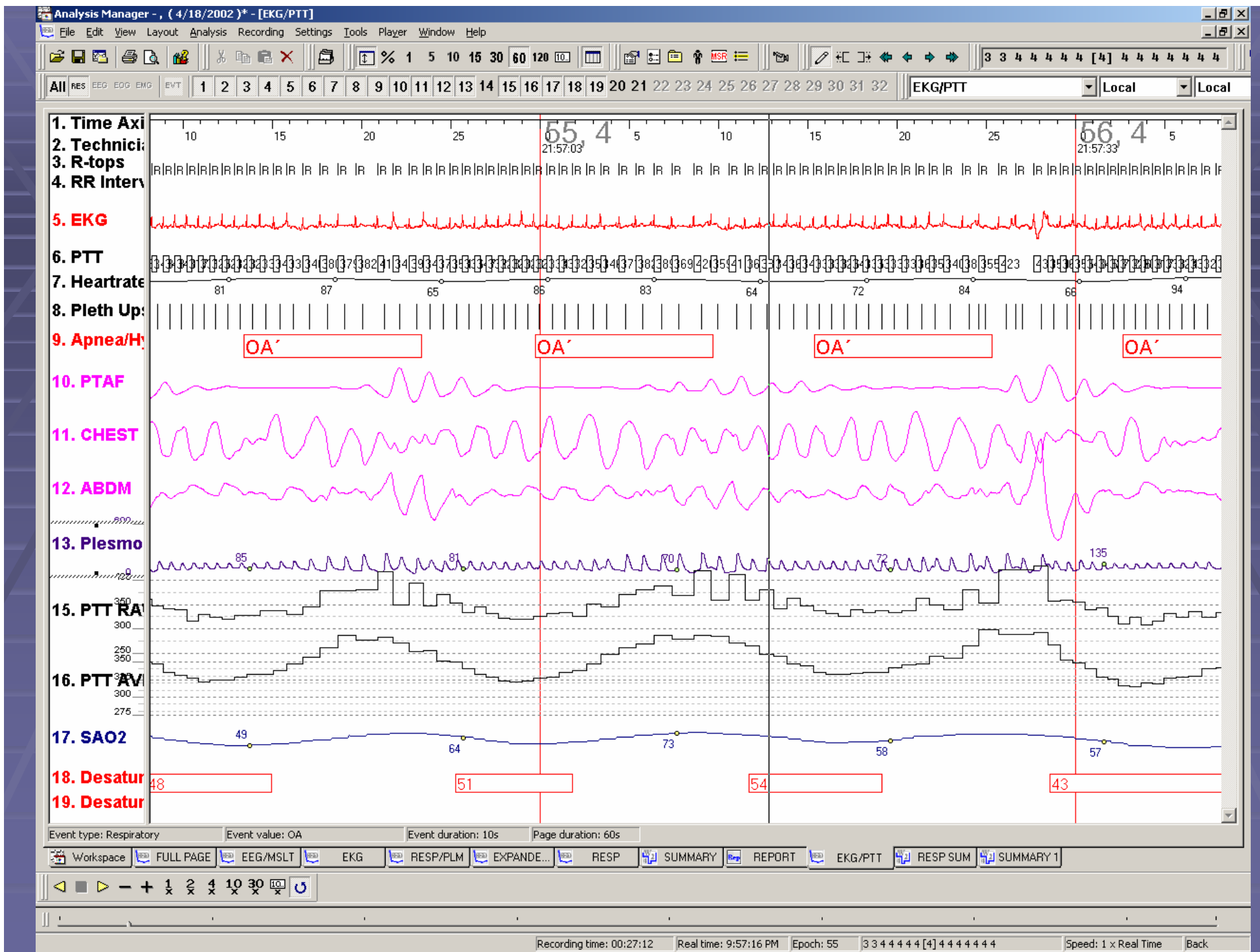
28 CHEST 61

0.1-15 Hz

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* 1 Hz





Parasomnias

- Nightmares: REM
- Sleep walking (Somnambulism): Delta
- Sleep talking (Somniloquy): any stage
- Night terrors: Delta
- Bruxism: REM
- Sleep Stage Transition Disorders
 - Body Rocking
 - Head Banging

Somnambulism (Sleepwalking)

- Ranges from sitting up in bed to eating, unlocking doors, may have unusual verbalizations, enuresis
- Keep in mind – while complex things can happen, it is rare that kids do things like drive, end up in somebody else's locked house, end up in boyfriend's car....

Periodic Limb Movement Disorder

- Interrupts sleep frequently due to rhythmic movement of legs
- Can be associated with Restless Legs Syndrome
 - Insatiable urge to move legs most prominently before sleep
 - Iron deficiency, uremia
 - Treated with Dopamine agonists
 - Increased in hyperactivity???

Disorders of Initiating and Maintaining Sleep (DIMS): “Organic”

- Psychiatric Disorders
 - Depression
 - Generalized anxiety disorders
 - Mania
- Chronic/Acute Illness (i.e., JRA)
- Neurodevelopmental Disorders (i.e., autism)
- Seizure disorders
- Due to medications!

DIMS: Acquired behaviors

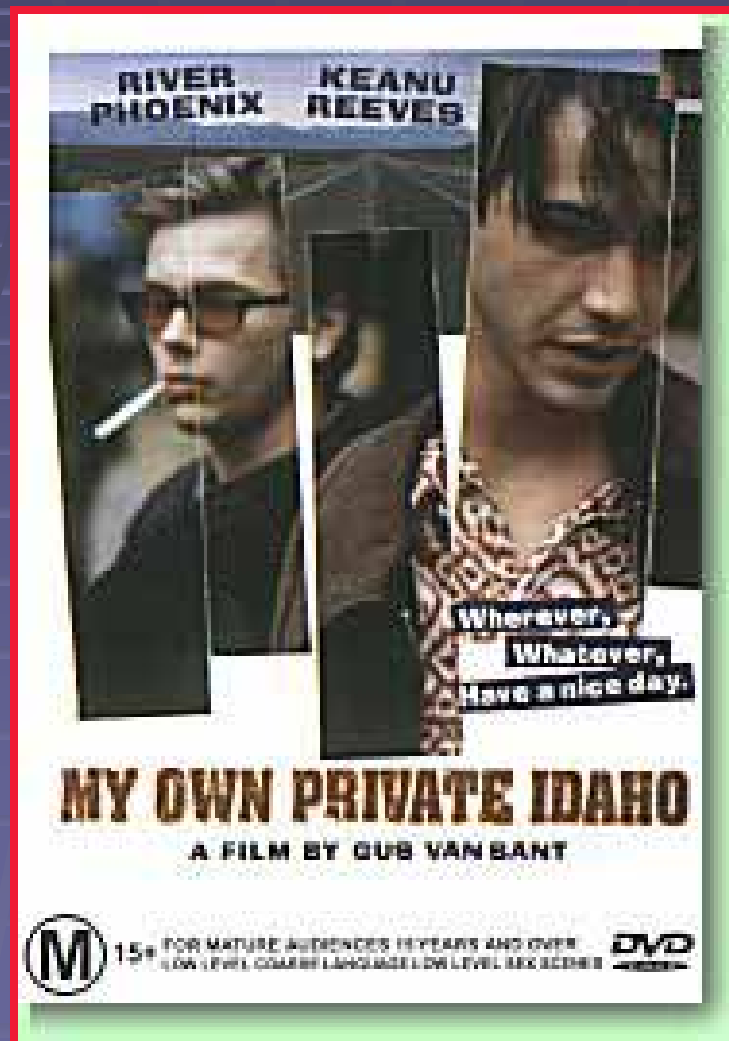
- Sleep onset association disorder
- Limit Setting disorder (bedtime resistance)
- Adjustment Sleep Disorder (includes phobias)
- Psychophysiological Insomnia

Wait 'til Amber's talk....

Common Pediatric Sleep Problems

- Hypersomnias
 - TRULY SLEEPING as opposed to chronic fatigue
 - Narcolepsy
 - Klein-Levin
 - Idiopathic
 - Post-traumatic

Narcolepsy



Narcolepsy

- Can present in adolescence, or earlier.
- Presenting symptoms:
 - Excessive daytime sleepiness
 - Cataplexy (if present, diagnostic)
 - Sleep paralysis
 - Hypnagogic hallucinations
 - night time sleep disruption, naps refreshing.
- Abnormality of neurotransmitter (hypocretin).
HLA linked.
- Diagnosis: history, sleep study and MSLT.

Example MSLT

	Sleep latency	REM latency
Nap # 1	1.5 minutes	5 minutes
Nap # 2	2 minutes	2 minutes
Nap # 3	0.5 minutes	2.5 minutes
Nap # 4	0.5 minutes	2.5 minutes
Means	1.1 minutes	3 minutes

Sleep Onset < 5 minutes = pathological sleepiness
> 2 sleep onset REM = narcolepsy

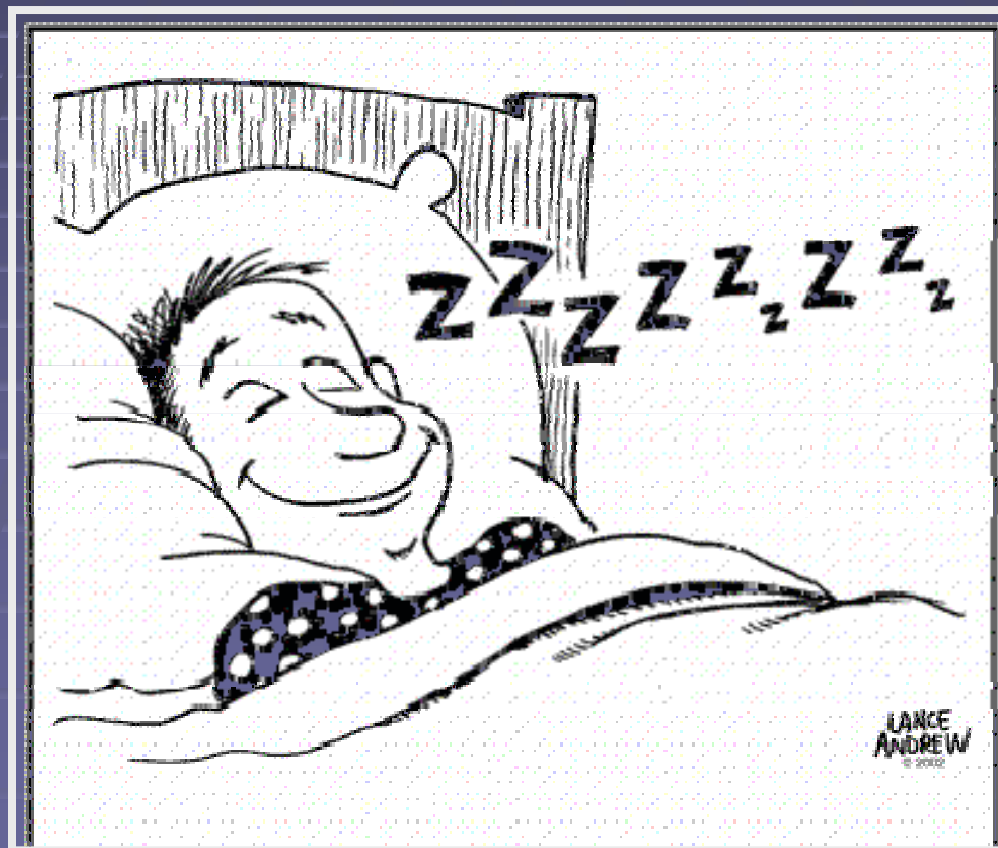
Narcolepsy

- Treatment:
 - Education
 - Safety issues (driving, etc.)
 - Scheduled naps necessary
 - CNS stimulants (modafinil) for sleepiness
 - Cataplexy needs other treatment as stimulants are not effective (SSRIs, TCAs or sodium oxybate)
 - Psychosocial support
- Timely diagnosis and treatment important!

In Summary

- Sleep is a phenomenon that is tightly regulated by developmental patterns and circadian rhythms, but not hard to disrupt.
- A good sleep history (BEARS) and physical are important to any comprehensive sleep evaluation.
- Polysomnography (Sleep Study) as well as actigraphy, oximetry studies, and MSLT's can be vital to diagnosing a sleep disorder. In some disorders, only sleep studies can definitively diagnose the condition.
- Children can manifest “sleepiness” in different ways, such as inattention and hyperactivity.
- Sleep disorders are relatively common, but underestimated, and can cause serious sequelae if untreated.

Thank you.





Behavioral Sleep Disorders: Diagnosis and Management

Amber McAfee ARNP
Sleep Disorders Center
Children's Hospital and Regional
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Discussion

- Common sleep concerns
 - Sleep-Onset Association Disorder
 - Bedtime refusal/ Inadequate Limit Setting
 - Delayed Sleep Phase Syndrome
 - Insomnia
 - Sleep Talking/Sleep Walking
 - Night terrors

Objectives

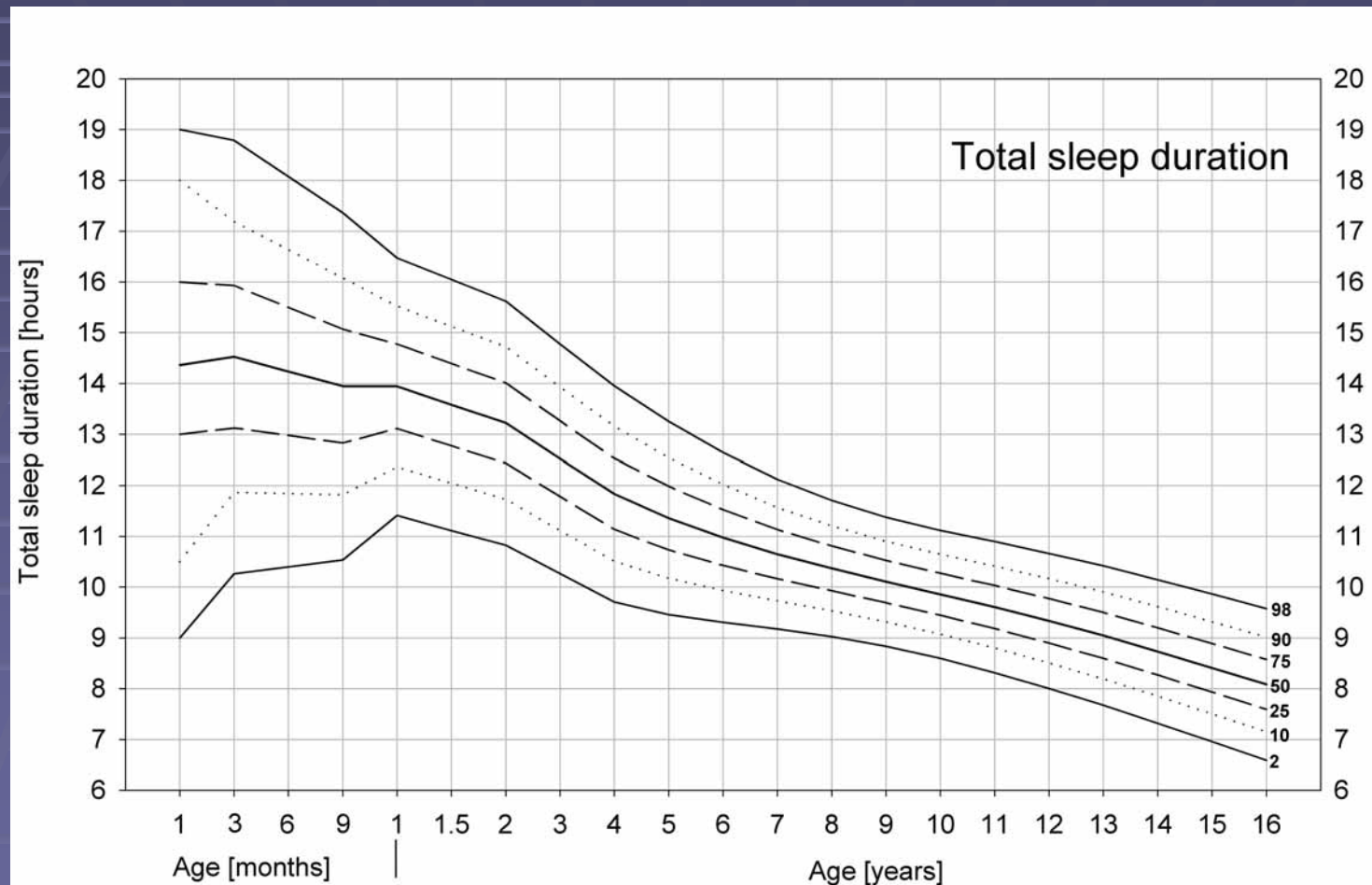
- Discuss Common Behavioral Sleep Disorders
- Diagnosis and Management
- Provide interventions for caregivers and professionals
- Discuss importance of bedtime routine and sleep hygiene
- When to refer to sleep center

Occurrence of Behavioral Sleep Disorders

- Difficulties initiating, maintaining sleep are common in infants, children and adolescents
 - 20 to 30% toddlers
 - 15-30% in preschoolers
 - 15 to 27% school-aged
 - night wakings in 15-20% toddlers

Children Need Sleep

- Infants 16 hours
- Toddlers 13 hours
- Pre-school 12 hours
- School age 11 hours
- Teens 10 hours
- Adults 8 hours



Sleep Deprivation

- Daytime sleepiness
- Moodiness
- Behavioral problems
- Learning problems
- Health effects: various metabolic systems, endocrine function, cardiovascular and immune response.
- Effects caregiver performance and mood
- Safety risk: Driving, operating machines

Sleep-Onset Association Disorder

- When sleep onset is impaired by the absence of a certain object or set of circumstances

Sleep-Onset Association Disorder

- 6 months-3 years
- Self-soothers vs. signalers
- Need parent or object to sleep
 - Pacifier, bottle, rocking, the car

Treatment

Sleep-Onset Association Disorder

- Good sleep habits (see next slide) along with:
- Extinction
 - Take the association completely awayOR
- Graduated Extinction/Checking method
 - Slower
 - Preferred and greater acceptance by caregivers

Good Sleep Habits

- Consistent sleep schedule (weekends and naps too)
- Consistent awake time-key to setting sleep/wake cycle
- Sleep Environment
- Sleep Routine
- Sleep Hygiene
- Consistent responses to undesirable behaviors
- Transitional object
- Drowsy but awake

Checking Method/Graduated Extinction

- Take association away
- Frequent or infrequent checks
- Consistent every night
- Second night worse than first
- Teach child to self soothe
- Bedtime will carry over to night awakenings

Sleep Hygiene

- Bedtime routine
- Set bedtime/awake time
- Consistent awake time
- Set nap time
- Dark, quiet, cool and safe
- Daily exercise
- Healthy Diet
- Education and sleep priority





TIPS

Association Disorder

- Slowly take away the association
 - Decreasing amount of bottle (no falling asleep with bottle)
 - Caregiver in room, then into hallway, then into other room
 - Give small rewards frequently (don't expect too much)
 - Everyone arouses at night-normal



Bedtime Refusal

Inadequate Limit Setting

- May happen at any age
- Difficult for child to settle at night
- Frequent requests
- Gets out of bed repeatedly
- Hard to differentiate sometimes from Delayed Sleep Phase Syndrome

Treatment

Bedtime Refusal/Inadequate Limit Setting

- Good Sleep Habits
- Concentrate on sleep routine
- May use pictures of bedtime routine
- Timer set 5 minutes prior to bedtime routine
- Blame it on the timer or the pictures
- Pleasant activity right before bed (in bedroom)
- Remember: The child is doing their job, it is the caregivers job to enforce the rules!

Treatment

Nighttime Arousals

- Redirect to own bed
- Use calm soft voice
- Same interaction with each arousal
- Doesn't need food or drink/ may have at bedside
- Always exceptions (illness)
- Refer back to good sleep habits
- Once child falling asleep on their own the night time awakenings should follow

Delayed Sleep Phase Syndrome

- “I’m not tired”
- “Just one more email”
- “I can only fall asleep watching TV”
- “None of my friends go to sleep early”



Delayed Sleep Phase Syndrome

- Circadian rhythm disorder
- Preferred sleep time is delayed
- Prevalence is 7% or more in adolescence

Treatment

Delayed Sleep Phase Syndrome

- Sleep deprivation may be necessary
- Shift sleep cycle slowly
 - Phase advance 15min earlier every few days
 - Phase delay chronotherapy delay 2-3hours
- Sleep Hygiene (must change sleep habits!)
- Must **maintain awakening time**
- Relaxation techniques
- Bright light exposure in morning
- Melatonin to assist in shifting biological clock
- Parent or guardian support
- Child motivated



Sleep Hygiene

- Bedtime routine
- Set bedtime/awake time
- Consistent awake time
- Set nap time
- Dark, quiet, cool and safe
- Daily exercise
- Healthy Diet
- Education and sleep priority



Insomnia



Insomnia

- Difficulty falling asleep *and/or*
- Frequent night waking *and/or*
- Early morning awakening *and/or*
- Non-restorative sleep *and*
- Significant daytime sleepiness
- Transient, acute, chronic
- Viewed as a problem by parent or child

Treatment Insomnia

NONPHARMACOLOGICAL

- Sleep Hygiene (no napping, same routine and bedtime/awake time)
- Exercise/30min of daylight
- Bed only for sleep (out of bed if not sleeping)
- Calm, cool, quiet environment
- Sleep Diary and Sleep Log
- Clock out of room
- Relaxation
- Cognitive restructuring
- Rule out primary sleep disorder

Insomnia/Pharmacological

Not FDA approved in children

PHARMACOLOGICAL

- Melatonin-shows promise/variable effects
- Anti-histamine (Benedryl)-most commonly tried
 - Daytime grogginess
 - Impact School performance
 - Increases OSA
- Benzo/hypnotics/anti-depressants
 - Clonidine
 - Clonazepam
- Non-benzo hypnotic
 - Zolpidem (Ambien)
 - Zaleplon (Sonata)
 - Lunesta (eszopiclone)

(Focus on reason for insomnia)

Sleep Hygiene

- Bedtime routine
- Set bedtime/awake time
- Consistent awake time
- Set nap time
- Dark, quiet, cool and safe
- Daily exercise
- Healthy Diet
- Education and sleep priority



Parasomnias

- Dysfunctions of sleep, sleep stages or **partial arousals from sleep**
 - Sleep walking/sleep talking
 - Head-banging/body rocking
 - Teeth grinding
 - Night terrors
 - Nightmares

Sleep Walking (Somnambulism)

- Occur out of slow wave sleep
- Arousals are usually calm with some ambulation
- Clumsy, uncoordinated, injuries may occur
- Greatest frequency in childhood (4-8years)
- Eyes may be open
- Urinate in unusual places

Treatment

Sleep Walking

- Do not attempt to awaken, just redirect
- Prevent injuries
 - Bells on door or pop cans on floor
 - High locks that child can't reach
 - Lock windows
- Usually self-limited and will improve with age
- Rule out underlying sleep disturbance

Sleep talking (Somniloquy)

- Normal
- May be seen with sleep walking, night terrors
- Do not awaken
- Child usually does not remember event
- Avoid laughing at child or giving attention to night time symptoms

Rhythmic Movement Disorder

Head Banging/Body Rocking

- Rhythmic, repetitive movements
- Usually seen during sleep onset, or with arousals from sleep
- Seen in 2/3 of normal children by 9 months of age
- 1/2 of 18 month-olds
- Less than 10% of 4 year-olds

Treatment

Rhythmic Movement Disorder

- Protect child from injury
- Avoid sleep deprivation
- Medications may be used in extreme cases
- Refer to sleep center
- Think about neurodevelopmental evaluation if daytime symptoms present

Teeth Grinding (Bruxism)

- Rhythmic clenching, or movements of the jaw or forceful grinding of the teeth during sleep.
- 5-20% of children may exhibit
- May run in families
- Morning headaches may occur, painful teeth

Treatment Bruxism

- Rule out underlying sleep disorder
- Mouth guard to prevent teeth damage
- Minimize stress, anxiety or precipitating factors

Night terrors

- Incidence
 - 1-3%
 - Peaks at age 5-7 years
 - Age onset: infancy - 12 years
 - Male > female
- Frequency
 - Often highest at onset
 - Often higher (> once a week) with younger onset
- Usual disappearance by adolescence

Night terrors

- Out of slow wave sleep
- Sudden and frightening
- Screaming, dilated eyes, fast breathing
- Parental efforts make it worse
- No recollection of episode in morning
- Stress, illness, extreme changes in activity or anxiety may worsen

Treatment Night Terrors

- Do not awaken child
- Console and prevent injury
- Avoid sleep deprivation
- Maintain sleep routine and sleep/awake times
- Refer to sleep center if they occur nightly, disrupting quality of life, injury

Nightmares

- Arousal from dream sleep (Rapid Eye Movement-REM)
- Occurs in last third of night
- Brief, although may be difficult to fall back asleep
- Child is oriented and has good recollection of dream

Treatment Nightmares

- Comfort and console
- May use dream catcher or magic dream spray
- Avoid prolonged arousal at night
- Avoid sleep-onset association
- Do not dwell, 'think happy thoughts'
- If nightly or interfere with daytime function refer to sleep center

It takes a village

Ask yourself: How has your child been sleeping?

- Primary care provider
- Social work
- Child life specialist
- Dietician
- Behavioral health team
- Teachers/educators
- Parent/Caregivers and Family
- Sleep specialist, accredited sleep centers, sleep lab staff, CPAP coordinator, MD's, ARNP's, RN's



References

- Sleeping Through the Night: How Infants, Toddlers, and Their Parents Can Get a Good Night's Sleep by Jodi Mindell PhD (Harper-Collins, 2005).
- The All-in-One Resource for Solving Sleep Problems in Kids and Teens by Jodi Mindell and Judi Owens, 2005
- Clinical guide to Pediatric Sleep: Diagnosis and management of sleep problems Jodi Mindell and Judith Owens 2003
- www.kidzzzzsleep.org for parents and providers
- www.sleepfoundation.org

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PEDIATRIC SLEEP DISORDERS

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PEDIATRIC SLEEP DISORDERS

Sudden Infant Death Syndrome

Obstructive Sleep Apnea

Periodic Leg Movements

Attention Deficit Disorder

Narcolepsy

Circadian Rhythm Sleep Disorders

Childhood Sleeplessness

Sleep-onset Association Disorder

Limit-setting Sleep Disorder



OBJECTIVES

- ❖ Understand the prevalence of OSAS
- ❖ Consequences of OSA
- ❖ Diagnosis
- ❖ Management

PREVALENCE

❖ Children: 1-3%

Ali, *Arch Dis Child* 1993

Gisalsen, *Chest* 1995

Redline, *AJRCCM* 1999

❖ Adult: 2-4%

Young, *NEJM* 1993

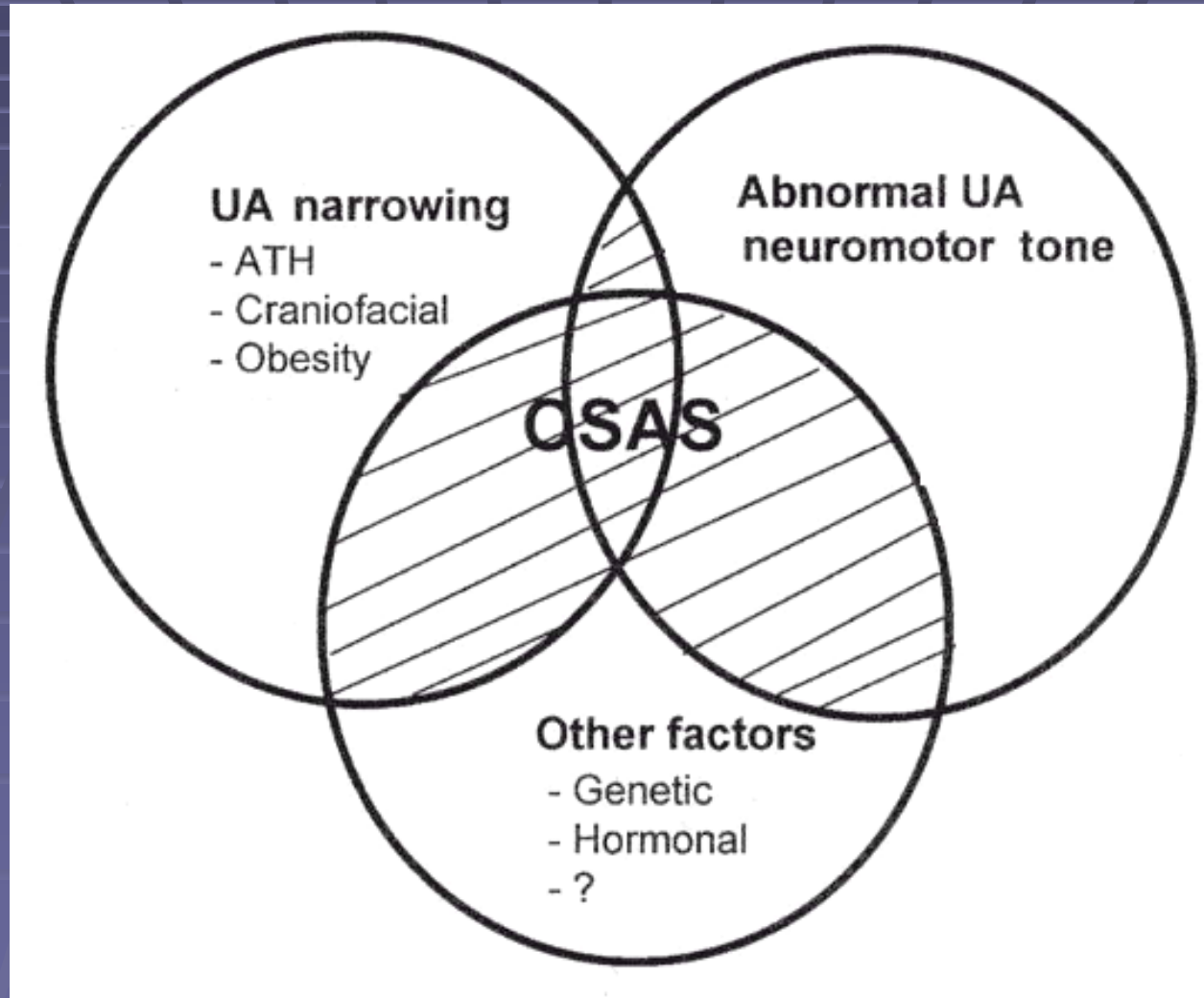
EPIDEMIOLOGY

- ❖ 7-20% of children snore(primary snoring)
- ❖ 1-3% of preschool children have OSAS
- ❖ Peak age 2-5 years (coincides with lymphoid hyperplasia)
- ❖ Natural history of OSAS in children is unknown
- ❖ More common in African American, in obese children and with family history of OSAS
- ❖ Male to female ratio is equal

ETIOLOGY OF SLEEP APNEA

- ❖ Multifactorial
- ❖ Genetic predisposition
- ❖ Upper airway size (craniofacial anomalies)
- ❖ Low muscle tone (cerebral palsy)

PATHOPHYSIOLOGY OF OSAS



PATHOPHYSIOLOGY OF PEDIATRIC OSAS

- Obesity
- Adeno-tonsillar hypertrophy
- Craniofacial malformation

Apnea/Hypopnea

Hypoxia
Hypercapnia
Pressure changes

Arousals

Fragmented Sleep

Autonomic
(Sympathetic)
Activation
↑ HR, BP surge

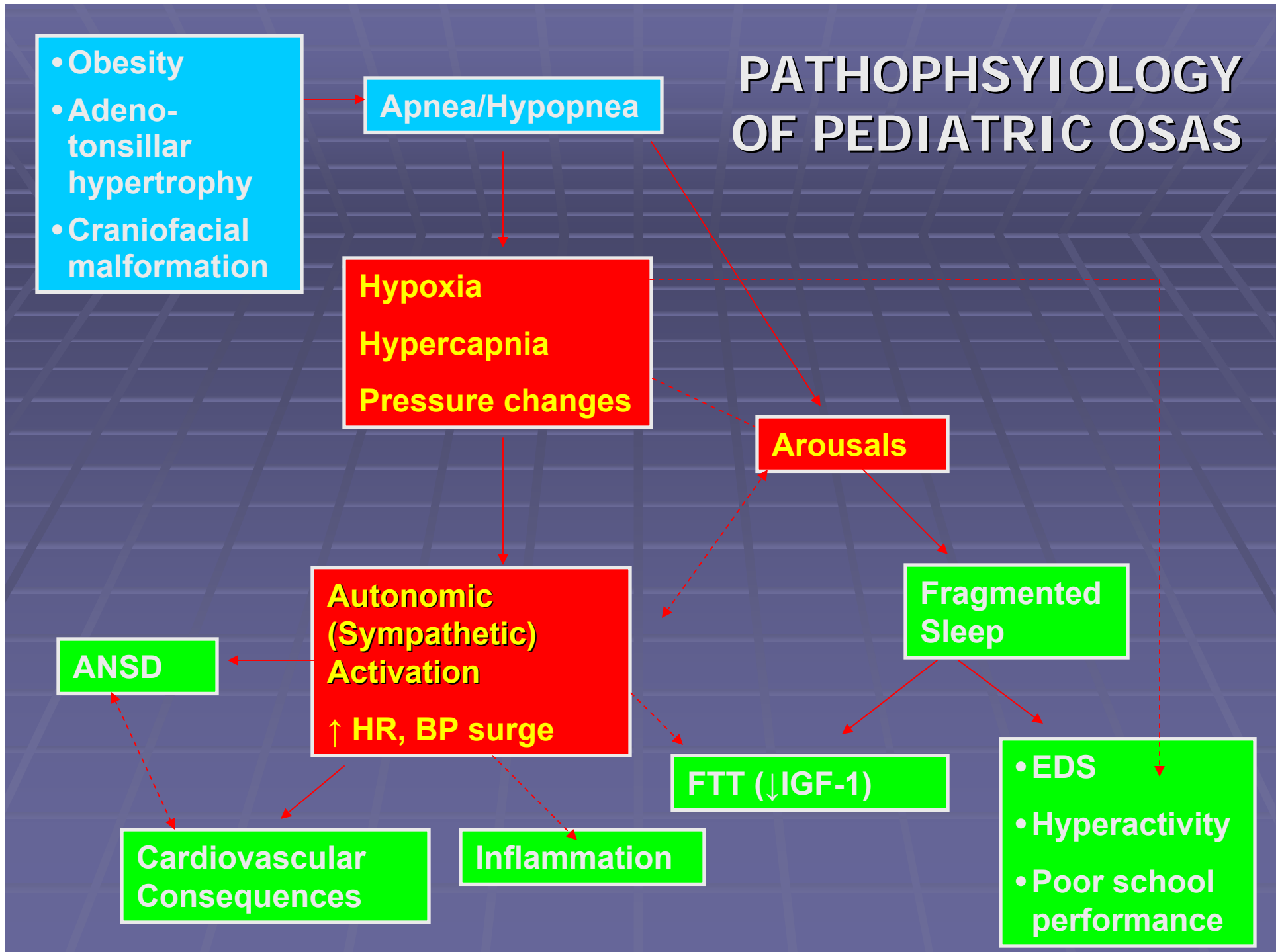
ANS

FTT (↓ IGF-1)

Cardiovascular
Consequences

Inflammation

- EDS
- Hyperactivity
- Poor school performance



DIAGNOSIS

- ❖ History
- ❖ Physical examination
- ❖ Laboratory

NIGHTTIME OBSERVATIONS

- ❖ Labored breathing/snoring/apneas/gasping
- ❖ Diaphoresis/mouth breathing
- ❖ Restless sleeper
- ❖ Unusual position (neck hyperextension)
- ❖ Enuresis

DAYTIME OBSERVATIONS

- ❖ Daytime sleepiness
- ❖ Mouth breathing
- ❖ Swallowing difficulty (large tonsils)
- ❖ Poor school performance
- ❖ Behavioral problems including ADHD, aggressive behavior or mood disturbance

EXCESSIVE DAYTIME SLEEPINESS

- ❖ Difficulty waking up in the morning
- ❖ Falling asleep in unusual circumstances, the classroom, church, TV
- ❖ Increased nap/mood changes



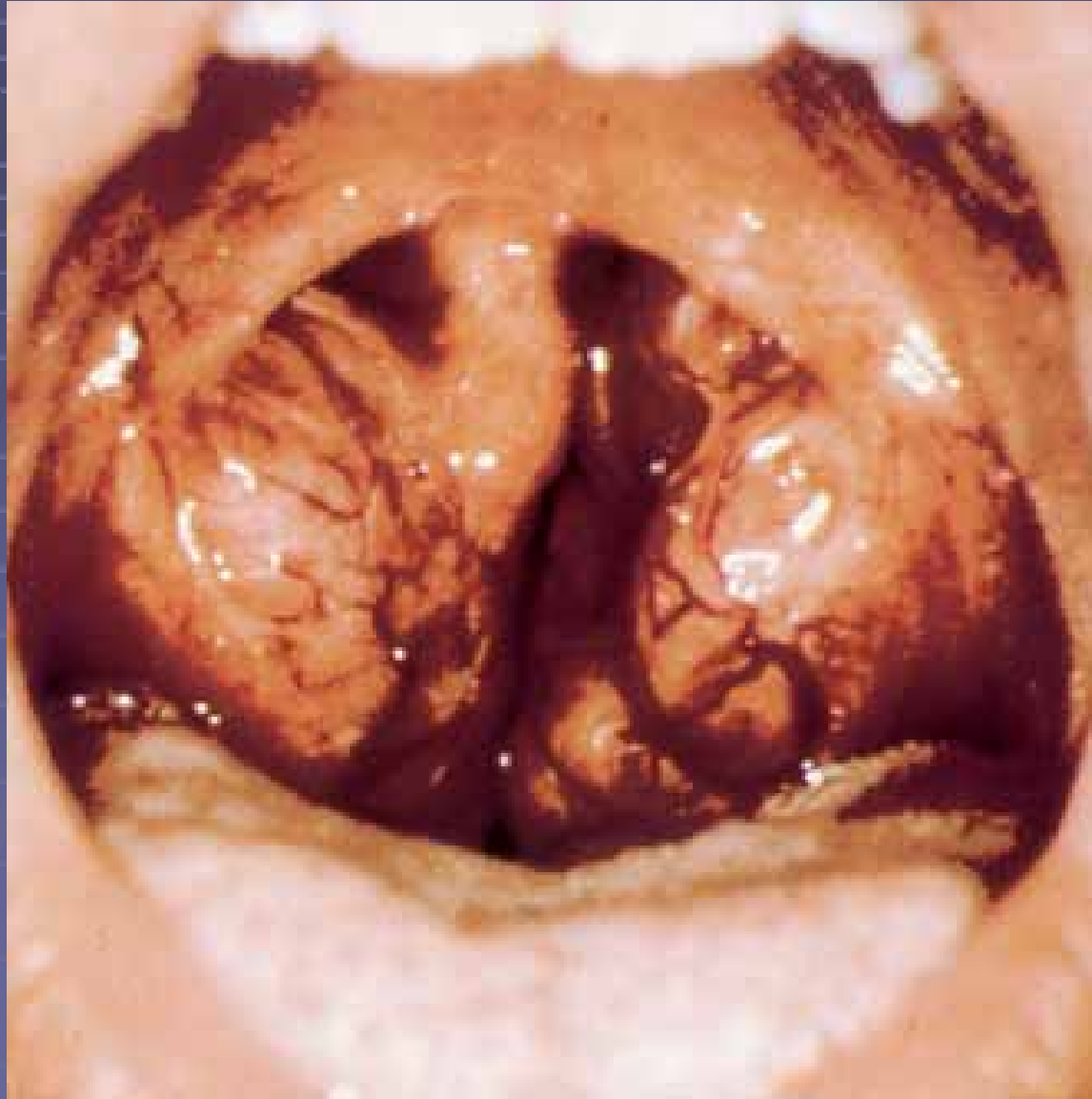
ASSOCIATED FEATURES

- ❖ Growth failure (increase in caloric expenditure, growth hormone)
- ❖ Increase in partial arousal parasomnia
- ❖ Increase in seizure frequency
- ❖ Behavioral sleep problems, such as bedtime resistance and night-wakings
- ❖ ADHD, aggressive behaviors
- ❖ Poor school performance, excessive daytime sleepiness (rare)

PHYSICAL EXAMINATION

- ❖ Failure to thrive
- ❖ Obesity (prevalence is increasing)
- ❖ Nasal obstruction
- ❖ Mouth breathing
- ❖ Enlarged tonsils
- ❖ Increased second heart sound
- ❖ May be entirely normal

TONSILLAR HYPERTROPHY



STANDARDS AND INDICATIONS FOR CARDIOPULMONARY SLEEP STUDIES IN CHILDREN

Polysomnography is recommended to differentiate benign snoring from snoring associated with airway obstruction, hypoxemia, and sleep disruption.

The absence of hypoxemia during sleep does not preclude clinically significant obstructive sleep apnea syndrome.



American Thoracic Society, 1996

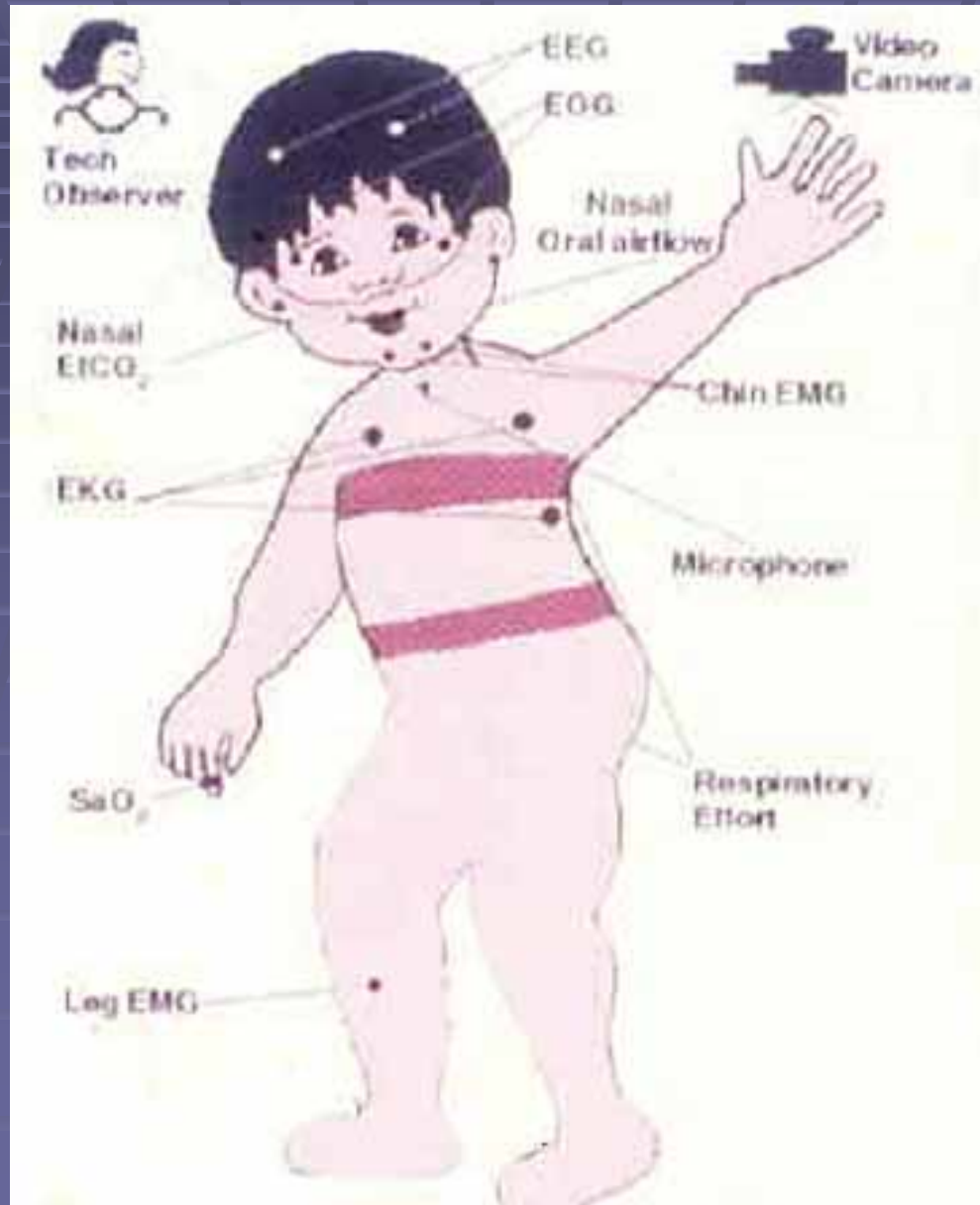
DIAGNOSTIC TECHNIQUES

- ❖ Nocturnal polysomnography (overnight sleep study)
- ❖ Pulse oximetry (false negative)
- ❖ Audiotaping/videotaping
- ❖ Nap polysomnography (out of favor)
- ❖ Unattended home polysomnography (research)

POLYSOMNOGRAPHY MONTAGE

- ❖ Sleep staging
- ❖ Respiratory measures
- ❖ Electrocardiography
- ❖ Oxygen saturation
- ❖ Limb movement activity
- ❖ Position monitoring
- ❖ Video monitoring
- ❖ End-tidal carbon dioxide

POLYSOMNOGRAPHIC EVALUATION

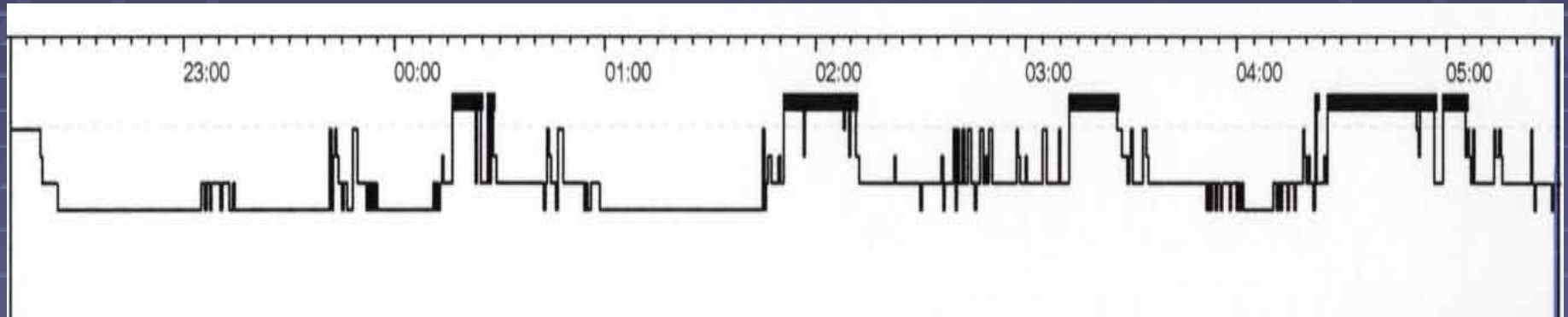


POLYSOMNOGRAPHY REPORT

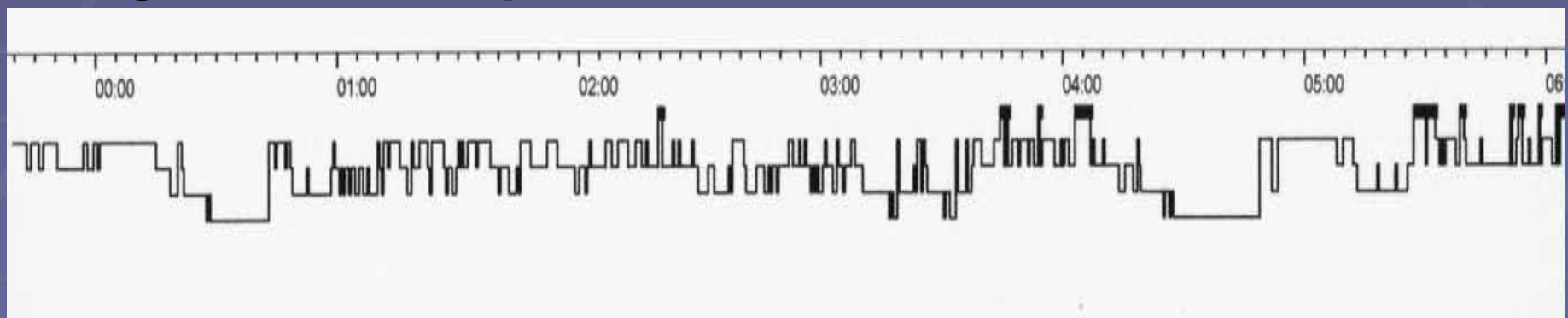
- ❖ AHI (apnea hypopnea index) or RDI (respiratory disturbance index) measures the number of apneas or hyponeas per hour of sleep
- ❖ RDI > 5/hour or AI >1/hour
- ❖ O2 desaturation below 90%
- ❖ Maximum end tidal CO2 > 53 or ETCO2 > 45 mmHg for > 60% of total sleep time
- ❖ Sleep architecture
- ❖ Arousal index (arousals/hr of sleep)

HYPNOGRAM OF POLYSOMNOGRAM

Normal

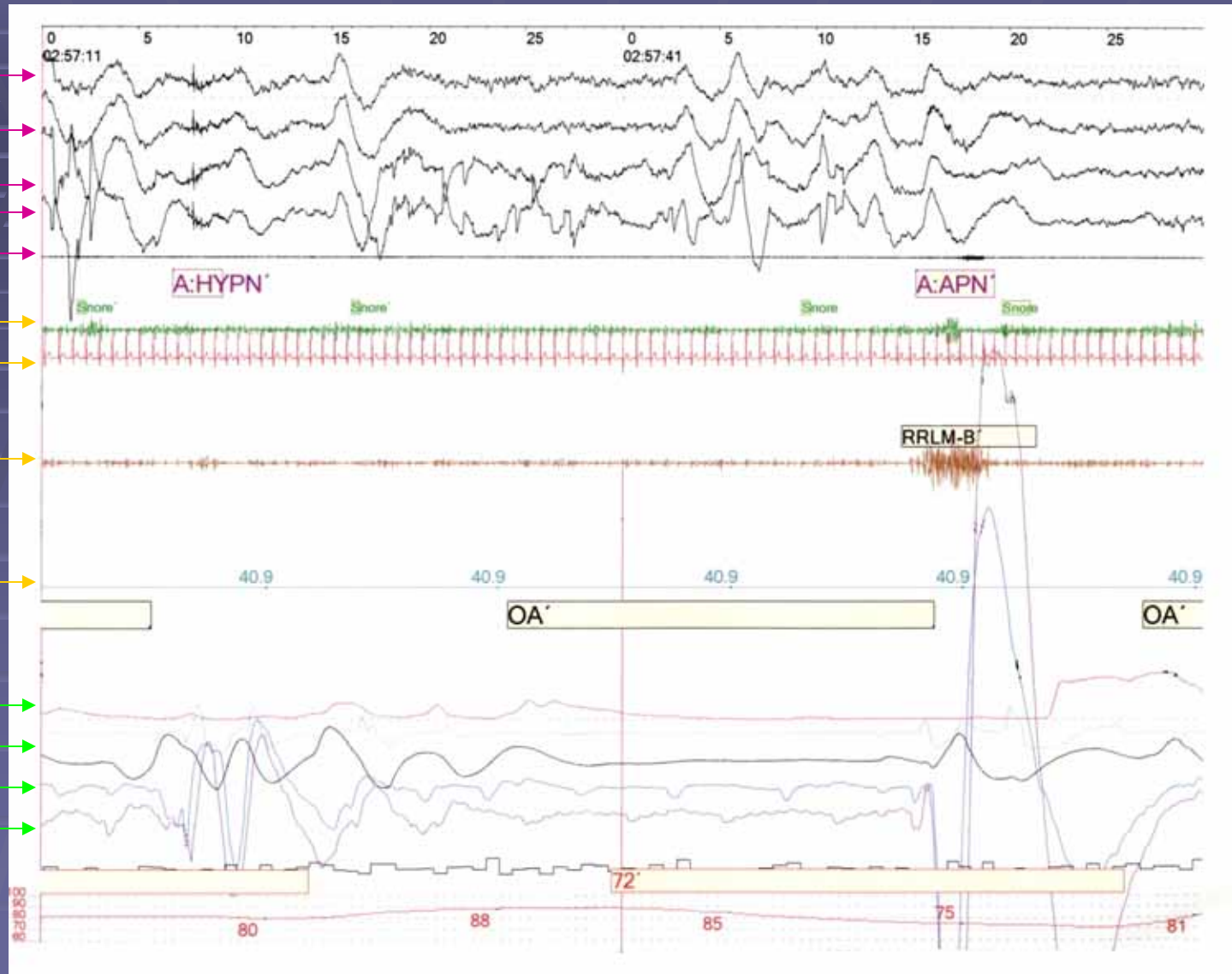


Fragmented Sleep



POLYSOMNOGRAM

C3-A2
O1-A2
LOC/ROC-A2
CHIN
SNORE
EKG
LIMB
TC-CO2
EtCO2
FLOW
CHEST
ABDOMEN



OBSTRUCTIVE SLEEP APNEA SYNDROME

Treatment:

Oxygen Therapy

Adeno-tonsillectomy

Continuous Positive Airway Pressure

UPPP, Mid face
distraction, Tracheostomy

ADENOTOMY

- ❖ Hypertrophy causing upper airway obstruction (OSA)
- ❖ OSA resolution in about 50-60%
- ❖ Healing time is about 2 weeks
- ❖ Complications include: bleeding (1-4%)
pulmonary edema (24 hours), dehydration,
infection, aspiration pneumonia

PARENTAL EXPECTATIONS

- ❖ Snoring resolves
- ❖ Sleep disturbance resolves
- ❖ Quality of speech improves
- ❖ Daytime energy levels improve
- ❖ Less frequent upper airway illnesses
- ❖ Able to breathe through nose

CONTINUOUS POSITIVE AIRWAY PRESSURE (CPAP)

- ❖ Positive airway pressure
- ❖ Via a nasal mask or full face mask
- ❖ Stents airway open
- ❖ Prevents intermittent airway collapse

CONTINUOUS POSITIVE AIRWAY PRESSURE (CPAP)



CHILDREN ON CPAP



CPAP/TRISOMY 21

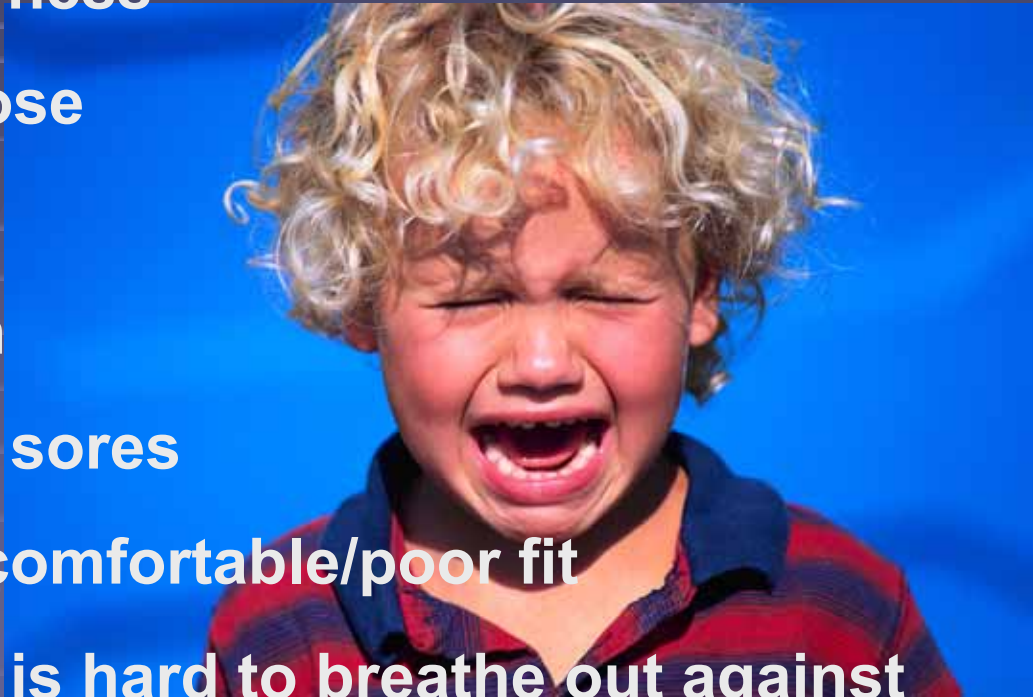


CPAP IN CHILDREN

- ❖ Mask size (style) nasal or full face mask
- ❖ Compliance
 - Empowerment
 - Positive reinforcement
 - Desensitization
 - Role modeling

COMMON COMPLAINTS CPAP

- Nasal dryness
- Runny nose
- Sweating
- Skin rash
- Pressure sores
- Mask uncomfortable/poor fit
- Pressure is hard to breathe out against
- Difficult to get used to
- Not attractive





Sleep Disturbance in Children with Special Needs

GENERAL CONSIDERATIONS/OBJECTIVES

- ❖ Sleep problem is common in children with intellectual disability/neuromuscular disorders
- ❖ Screening for sleep disordered breathing is important

SLEEP DISTURBANCES

- ❖ Sleep disordered breathing
- ❖ Sleep onset insomnia
- ❖ Sleep maintenance insomnia
- ❖ Frequent nocturnal arousals
- ❖ Circadian disorders
- ❖ Periodic limb movement disorder/Restless Leg Syndrome

CONSEQUENCES

- ❖ Poor quality sleep
- ❖ Impaired daytime function
(neurocognitive function)
- ❖ Poor school performance
- ❖ Excessive daytime sleepiness
- ❖ Behavioral problems/ADHD
- ❖ Cardiovascular consequences

RISK FACTORS FOR SLEEP DISORDERED BREATHING

- ❖ Down Syndrome
- ❖ Craniofacial syndromes
- ❖ Prader Willi Syndrome
- ❖ Cerebral Palsy
- ❖ Neuromuscular disorders
- ❖ Arnold Chiari malformations



DOWN SYNDROME AND SLEEP

- ❖ Prevalence of sleep related upper airway obstruction is common (40-60%)
- ❖ Midfacial and mandibular hypoplasia
- ❖ Macroglossia/glossoptosis
- ❖ Reduced pharyngeal tone
- ❖ Sleep apnea and hypoventilation

CRANIOFACIAL ABNORMALITIES AND SLEEP

- ❖ Sleep disorders common due to anatomy
 - Pierre Robin Sequence
 - Goldenhar syndrome
 - Treacher-Collins syndrome
 - Velocardiofacial syndrome
 - Cleft lip and palate

CROUZON SYNDROME



CEREBRAL PALSY

- ❖ Leading cause of childhood disability
- ❖ Prematurity increases the risk
- ❖ Spastic, dystonic, hypotonic
- ❖ Pneumonia, due to inadequate clearance of secretions (tone, scoliosis, aspiration)

CEREBRAL PALSY (cont.)

- ❖ Children with CP develop OSA at an increased rate (20-50%)
- ❖ Upper airway obstruction due to muscle tone
 - Manifest consequences of OSA

Kotagagl et al. Dev Med Child Neurol 1994;36; 304-11 Sleep abnormalities in children with severe cerebral palsy

SLEEP DISORDER IN CHILDREN WITH SEVERE INTELLECTUAL DISABILITY

- ❖ Sleep problem is common with prevalence rate ranging from 44-86%
- ❖ Majority persist over time (Owens ,1991)

PRADER WILLI SYNDROME

- ❖ Genetic syndrome; chromosome 15
- ❖ One in 10,000 to 15,000
- ❖ Facial features (almond shaped eyes)
- ❖ Developmental delay, feeding difficulties in newborn, rapid weight gain 1-6 years



PRADER WILLI SYNDROME

- ❖ Obstructive sleep apnea
- ❖ Hypoventilation (low tone and obesity)
- ❖ Daytime sleepiness (fragmented sleep)
- ❖ High prevalence of seizure
- ❖ Myopia and strabismus
- ❖ Behavioral problems/hypothalamic dysfunction

SLEEP DISORDERED BREATHING IN PWS

- ❖ 13 controls and 13 with PWS
- ❖ 69% had AHI > 10 per hour
- ❖ Increased BMI was associated with severe hypoxemia
- ❖ Severe OSA was associated with daytime sleepiness and impulsiveness

OSA AND SEIZURE

- ❖ Sleep disruption
- ❖ Exacerbates epilepsy
- ❖ Excessive daytime sleepiness
- ❖ Improvement of symptoms and seizure frequency with treatment of OSAS

SLEEP DISORDERS AND EPILEPSY

- ❖ Patients with refractory epilepsy have high prevalence of OSA
- ❖ Treatment of OSA led to improvement of seizure (reduction of sleep stage shifts)

Malow et al. OSA is common in refractory epilepsy patients Neurology (2000) 55 pp 1002

NEUROMUSCULAR DISEASE

- ❖ Duchenne's muscular dystrophy
- ❖ Spinal muscular atrophy
- ❖ Myasthenia gravis
- ❖ Mitochondrial disorders

NMD/SLEEP HYPOVENTILATION

- ❖ Weakness of chest wall/resp.muscles
- ❖ Increased work of breathing
- ❖ REM hypotonia
- ❖ Respiratory muscle fatigue
- ❖ Kyphoscoliosis

ARNOLD CHIARI MALFORMATIONS

- ❖ High prevalence of obstructive sleep apnea (75% had AHI > 10/hr)
- ❖ Central sleep apnea (50%)
 - Mixed
- ❖ Improvement with surgery

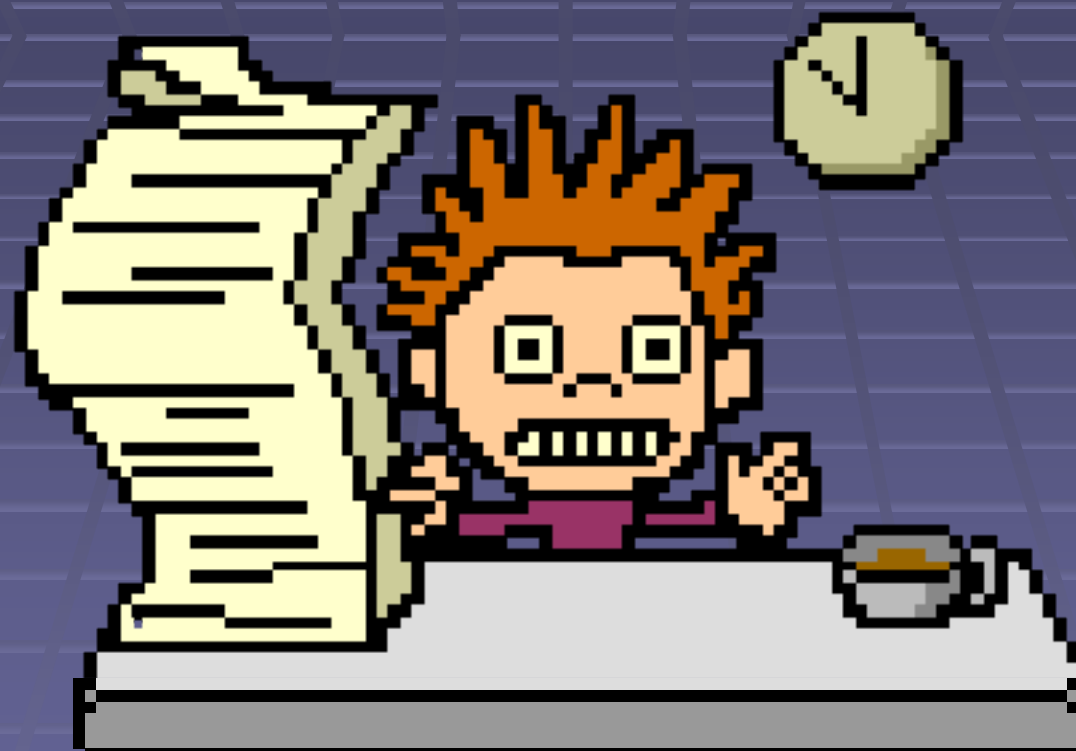
Gagnadoux et al. Neurol 2006;66; 136-138. Sleep Disordered Breathing in patients with Chiari malformation; Improvement after surgery

TREATMENTS

- ❖ Multidisciplinary
- ❖ Chest Clinic/Sleep Clinic
- ❖ BiPAP/oxygen
- ❖ Severe cases, tracheostomy with NIPPV or mechanical ventilation
- ❖ Optimize quality of life of the child (parent)

TREATMENT

- ❖ Adenotonsillectomy
- ❖ Weight loss
- ❖ If OSAS persists or hypoventilation, BiPAP
- ❖ Excessive daytime sleepiness persists, consider modafanil



SLEEPLESSNESS

- ❖ Sleep initiating, maintaining, early awakening
- ❖ Sleep onset association disorders
- ❖ Limit setting
- ❖ Underlying medical conditions
- ❖ Circadian rhythm disorder
- ❖ Medications

CIRCADIAN RHYTHM DISORDERS

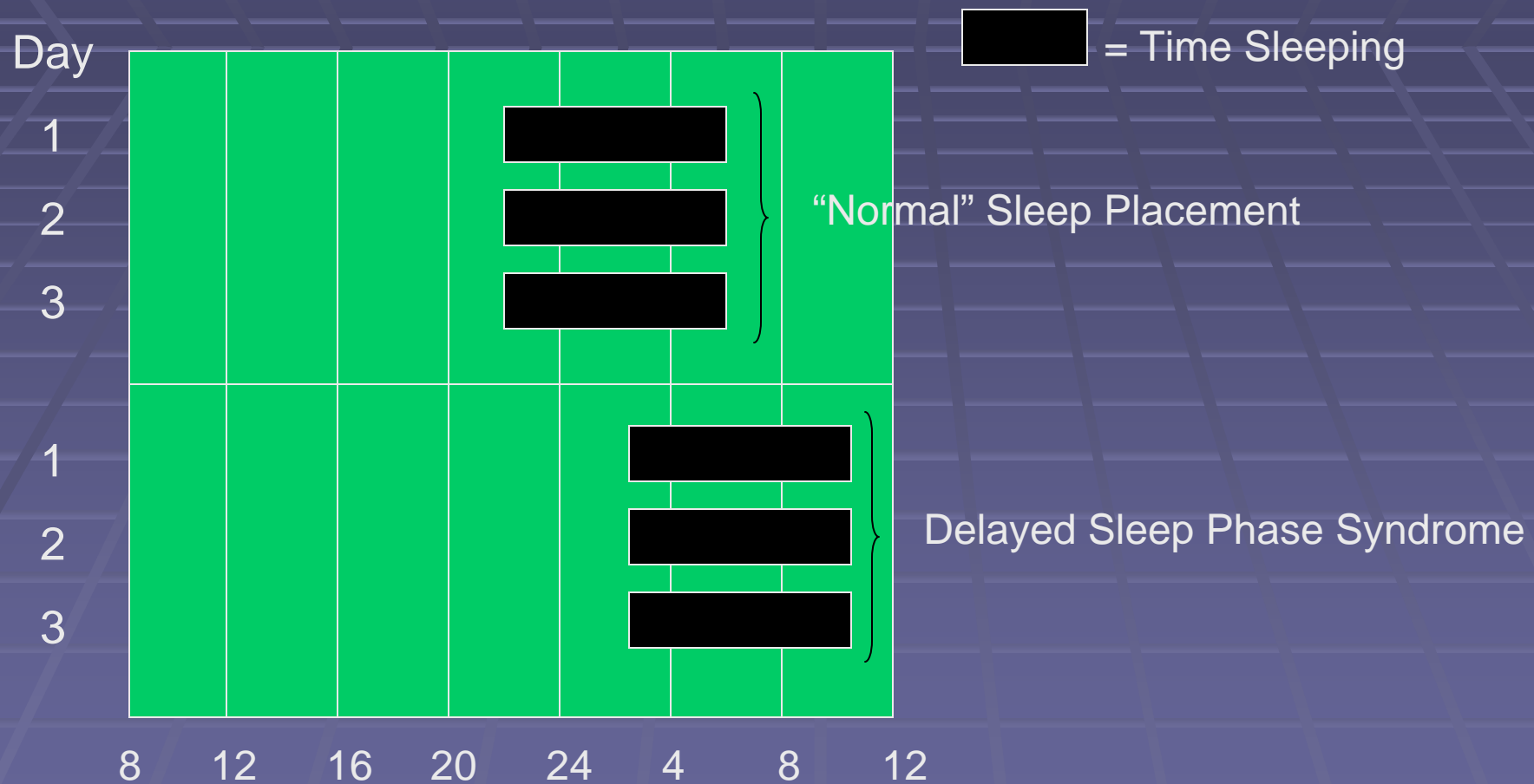
- ❖ Misalignment between own clock and societal norms
- ❖ **Intrinsic** (Delayed Sleep Phase Syndrome, Advanced Sleep Phase Syndrome)
- ❖ **Extrinsic** (jet lag, shift work)
- ❖ Leads to insufficient sleep and sleepiness



CIRCADIAN RHYTHM DISORDERS (cont.)

- ❖ Most common among severely delayed children
- ❖ Bedridden, do not track light
- ❖ Brain injured children do not entrain their biologic clock
- ❖ Lack of visual stimuli (blind)
- ❖ Inadequate social contact

DELAYED SLEEP PHASE SYNDROME



Adapted from Campbell et al. (1999), *Sleep Medicine Reviews*, 3(3), 179-200

CIRCADIAN RHYTHM DISORDERS/EVALUATION

- ❖ Detailed sleep pattern
- ❖ Sleep diary/actigraphy
- ❖ DSPS, sleep 3-6am, wake 10-2pm
- ❖ Prevalence < 1% in pediatric, 7% in adolescents, higher in developmentally delayed children
- ❖ Genetic evidence (HLA-DR1 & families)

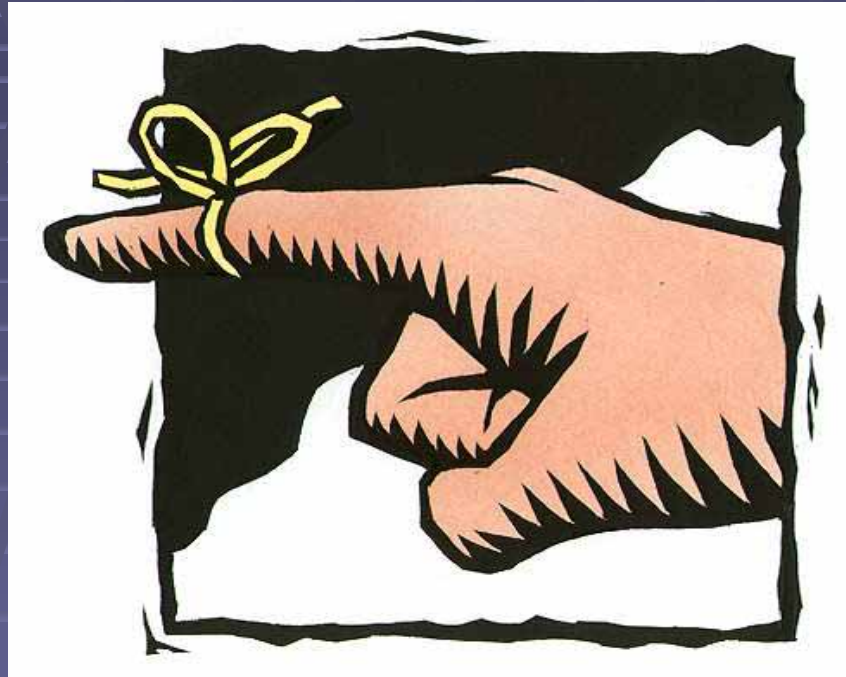
MEDICATIONS AND SLEEP (INSOMNIA)

- ❖ Steroids
- ❖ Beta agonists
- ❖ Caffeine/theophylline
- ❖ Antihypertensive
- ❖ Dopamine agonists
- ❖ SSRI
- ❖ Stimulants

MEDICATIONS AND SLEEP (SLEEPINESS)

- ❖ Benzodiazepines
- ❖ Anticonvulsant
- ❖ Antipsychotics
- ❖ Antidepressants
- ❖ Antihistamines

CHILDHOOD INSOMNIA



There are currently no sleep medications labeled for use in children by the FDA

MEDICATIONS

❖ Benzodiazepines

- Decrease sleep onset latency
- Suppress partial arousals/treat RLS/PLMD
- Mechanism: binds to GABA receptors
- Rapid onset of action, half life variable
- Sleep architecture: suppress SWS, variable REM, decrease arousals

BENZODIAZEPINES

- ❖ Daytime drowsiness
- ❖ Cognitive impairment (long acting; clonazepam)
- ❖ Anterograde amnesia (short acting; temazepam)
- ❖ Respiratory depression (OSAS)
- ❖ Abuse potential

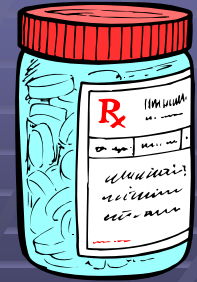
TRAZODONE (DESYREL)

- ❖ Insomnia
- ❖ 5HT agonist
- ❖ Short elimination half-life
- ❖ Decreases SOL, decreases REM, increases SWS
- ❖ Daytime somnolence; priapism in males
- ❖ Dose 25-50 mg QHS

NEWER ANTIDEPRESSANTS

- ❖ **SSRI's:** Citralopram (Celexa) sedating; may be useful in treatment depression associated with insomnia
- ❖ **Other antidepressants:** Nefazadone (Serzone) and mirtazapine (Remeron) sedating and less likely to cause insomnia

CLONIDINE



- ❖ **Possible clinical uses:** SOD in ADHD, special needs
- ❖ **Mechanism:** central alpha₂ agonist; NE
- ❖ **Pharmacokinetics:** rapid absorption, onset action w/in 1 hr, peak effects 2-4 hrs; half-life 6-24 hrs; narrow therapeutic index SOL, SWS, REM (discontinuation
↓
REM rebound)

CLONIDINE (cont.)

- ❖ **Side effects:** hypotension, bradycardia; anti-cholinergic; irritability, dysphoria; tolerance often develops; rebound BP on discontinuation
- ❖ **Drug interactions:** CNS depressants; stimulants (cardiovascular effects)
- ❖ **Formulations:** oral, patch; dose 25-300 ug
- ❖ **Comments:** increased use, reports of OD

MELATONIN

- ❖ **Possible clinical uses:** circadian rhythm disturbances in normal and special needs; jet lag; mild hypnotic properties
- ❖ **Mechanism:** mimics effects endogenous pineal hormone
- ❖ **Pharmacokinetics:** plasma levels peak 1 hr
- ❖ **Effects sleep architecture:** slight SOL

MELATONIN

- ❖ **Side effects:** ???; BP, bradycardia core body temp; ? seizure threshold; potential suppression hypothalamic-gonadal axis (trigger prec puberty)
- ❖ **Drug interactions:** ???; NSAIDs, caffeine, BZD may interfere normal production
- ❖ **Formulations:** variable strengths, reliability and purity; 1mg younger, 2.5-3mg older, 5 mg adol; up to 10 mg special needs reported
- ❖ **Comments:** often used for inappropriate indications

HERBALS



- ❖ **Chamomile:** mild sedating effects; related to ragweed
- ❖ **Valerian root:** BZD-like properties, less “hang-over”; effects may not be seen for several weeks; case reports and controlled trials support use; may have withdrawal
- ❖ **Kava:** subjective improvement sleep without negative performance effects; anxiolytic; may cause weight loss, rash, HDL

HERBALS



- ❖ **Lavender:** CNS depressant effect; aromatherapy reported to improve sleep; oil toxic if large amount ingested
- ❖ **Hops:** sedative and hypnotic effects; may be combined with valerian root, chamomile; pediatric open-label trial effective and well-tolerated; may cause hypersensitivity



CONCLUSION

- ✓ Sleep disorders are common in children with special needs
- ✓ Early screening is essential
- ✓ Appropriate diagnosis, and treatment improves the quality of life of the child and the parents

THANK YOU

