Treating Sleep Apnea in Children

Glen T. Porter, MD

Physician, Intermountain Medical Group, Intermountain Healthcare;
Salt Lake City, Utah

Objectives:
• Define sleep disorders in children and how diagnostic criteria differ in children
• Explain treatment algorithms and options for children with sleep disorders
• Review benefits and limitations of surgical treatment of sleep apnea in children
Pediatric Sleep
Disordered Breathing
Glen T. Porter, MD
“Going with the flow”

- **The soft palate** is the tissue at the back of the roof of your mouth. It helps block off your nose when you swallow.
- **The uvula** is a long flap of tissue that hangs from your soft palate.
- **Tonsils** are balls of tissue in the throat. They may play a small role in helping your body defend itself against illness.
- **The tongue** helps you talk, chew, and swallow.

Normally, air flows freely past the structures in the throat.
Pediatric Sleep Disordered Breathing

- Primary Snoring
- UARS
- Sleep Apnea (obstr
Primary Snoring

- Snoring without obstructive sleep apnea, frequent arousals from sleep, or gas exchange abnormalities. \( \geq 3 \) days/week.
- Prevalence of habitual snoring ranges from 3.2% (Iceland) to 12.1% (England).
- Healthy children
- Rested in AM
- Active
- Normal growth
- Reasonable behavior.
UARS in children

- Abnormally high upper airway resistance leads to increased respiratory effort and disrupted sleep even in the absence of gas exchange abnormalities.
- Little reliable data (esophageal pressure manometer is gold standard)
- No good data as to prevalence. One study on healthy children who snore showed 59% with OSAS, 25% Primary Snoring, 6% UARS, 10% no snoring. Rosen CL: Clinical features of obstructive sleep apnea in otherwise healthy children. Pediatri Pulmonol 1999;27:403-409.
- “A child with normal PSG findings and abnormal symptoms may have UARS, and treatment should be considered.” McColley, SA: Primary Snoring in Children, Principles and Practice of Pediatric Sleep Medicine. Elsevier, 2005.
Pediatric OSAS

“Disorder of breathing during sleep characterized by prolonged partial upper airway obstruction and/or intermittent complete obstruction that disrupts normal ventilation during sleep and normal sleep patterns”. Pediatrics Vol 109 No.4 April 2002
Pediatric OSAS

“Like obstructive sleep apnea (OSA) in adults, childhood OSAS is characterized by recurrent episodes of partial or complete airway obstruction during sleep, often accompanied by oxyhemoglobin desaturation or hypercarbia. Unlike adults, however, children are more likely to exhibit periods of prolonged partial airway obstruction rather than discrete events such as apneas and hypopneas. Prolonged partial airway obstruction sometimes takes the form of obstructive hypoventilation, in which pulmonary ventilation falls below the level necessary to maintain normocapnea, even when normal oxygen saturation is maintained.”

Hoban, T: Sleep and Its Disorders in Children; Seminars in Neurology 2004:24(3)
Pediatric OSAS

- OSA prevalence appears to range between 0.7% and 2.9%.
- Up to 60% of children who snore have OSAS.
Challenging to define with the same precision as adults
- Normal variability of sleep patterns
- Lack of widely available and reproducible sleep lab measurements
- Brief apneas may be physiologic: infants/prematurity
- Brief cessation of oronasal air flow is normal with end of a breath cycle
- Apneas common but disconcerting to parents: gasping for air, waking up, “mini- arousals”
- What constitutes apnea/hypopnea unclear, not well defined, varies with age
Morbidity of SDB in children


  - ADD/ADHD
  - IQ 5 points or more points lower than normal control
  - Inattention, poor memory, poor learning performance

- Anxiety, depression
  - Family disruption
  - Decreased quality of life (similar to or worse than children with chronic diseases such as asthma or Juvenile rheumatoid arthritis) Baldassari C: Pediatric obstructive sleep apnea and quality of life: a meta-analysis. Otolaryngol Head Neck Surg. 2008; 138:265–273.

- Cardiovascular dysfunction (blood pressure, abnormal ECG, perturbations in autonomic function, pulmonary hypertension, elevated diastolic pressures, increased left ventricular wall thickness)


- Enuresis (50%)

- Failure to thrive
Diagnosis -- History

- Frequent snoring (≥3 night/week)
- Labored breathing during sleep
- Gasps/snorting/observed apneas
- Sleep enuresis
- Abnormal positioning during sleep (sitting, neck extended)
- Cyanosis
- AM headache
- Daytime sleepiness
- ADHD/ADD, behavior issues
- Learning problems
Risk Factors

- Boys
- African-American
- RAOM
- Asthma, wheezing
- RARS
- Tobacco smoke exposure, maternal smoking during pregnancy
- Prematurity
- ATH
- Obesity (4-fold increase in risk)
- Delayed motor milestones
Diagnosis-- Questionnaires

- Fail to take into account the entire clinical picture and cannot be relied upon to accurately identify which children need treatment.
- Pediatric Sleep Questionnaire has reasonable sensitivity (0.85) and specificity (0.87). A score greater than 0.33 predicts a 3-fold increased risk of SDB on PSG. (Chervin RD: Pediatric sleep questionnaire: validity and reliability of scales for sleep-disordered breathing, snoring, sleepiness, and behavioral problems. Sleep Med 2000;1:21-32)
Diagnosis -- Physical exam

- Adenotonsillar hypertrophy
- Palatal position (high arched)
- Maxilla (adenoid facies)
- Mandible (micrognathia, retrognathia)
- Posterior OP
- Obesity
- Growth delay/failure to thrive
- HTN
- Physical exam alone cannot reliably predict which patient will have SDB.
Imaging

- MRI
- CT
- Endoscopy
- Endoscopy under anesthesia (PPV 0.94, NPV 0.8)
- Acoustic pharyngometry (90.9% sensitive, 88.4% specific)
Yes, but,..

- No clinical relation between size of tonsils and adenoids and presence of OSAS
- Loudness of snoring does not correlate with degree of OSA
- Sleep questionnaires to date demonstrate minimal usefulness.
- Utility of unattended home studies in pediatric patients has not been well studied and is currently not recommended or approved by the American Academy of Sleep Medicine
Pediatric PSG – The Gold Standard

- Standardized, yet unvalidated, clinical diagnostic criteria for OSA
- Cumbersome, expensive, resource-intensive, inconvenient,…but all we have.
- AHI, Desat index, arousals do not reliably predict the degree of physical or psychological impairment.
- Findings on PSG do not always correlate with clinical symptoms and therefore diagnosis should consider both.
Pediatric PSG scoring

- Oxygen saturation
- Volume/frequency of oronasal air flow
- Spirometry volumes/flow rates
- Respiratory muscle (ie: chest) excursion
- End-Tidal pCO2
- ECG
- Cortical activity EEG

- Obstructive apneas/hypopneas = 2 breaths, even if <10 seconds
- Hypopneas = 50% reduction in airflow associated with airflow or >/=3% desaturation. There is controversy on whether this adequately diagnoses children.
- RERAs not always scored
- Central apneas are common (rare during sleep onset). Only scored if they are >/=20 sec or associated with either arousal or >/=3% desat.
- End-tidal pCO2 >50mm Hg for more than 25% TST (AASM) vs. >45mm Hg for more than 10% TST (Cardiothoracic literature)
## OSAS in Children vs. Adults

<table>
<thead>
<tr>
<th>Clinical correlation</th>
<th>Children</th>
<th>Adults</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex ratio</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Etiology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excessive daytime fatigue</td>
<td>Cyclic obstruction or prolonged obstructive hypoventilation Normal REM &lt;50% of apneas T&amp;A (majority of cases) CPAP occasionally</td>
<td>Cyclic obstruction Decreased delta and REM REM or non-REM At termination of apnea</td>
</tr>
<tr>
<td>Neurobehavioral</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PSG characteristics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Obstruction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sleep architecture</td>
<td></td>
<td></td>
</tr>
<tr>
<td>State with OSA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cortical arousal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Treatment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surgical Medical</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medical</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Differential Diagnosis

- Infants: Apnea of Prematurity
- Apnea Infancy: sporadic pauses 20 sec or more (central, obstructive, mixed)
- Periodic breathing: 3–6 sec pauses, gradual desaturation (Immature pattern)
- Syndromic children
- Neuro–developmental delay
- Central / cortical component
- Seizures
- Parasomnias: night terrors / sleep walking
AASM Practice Parameters for Respiratory Indications for PSG in Children

- PSG indicated when clinical assessment suggests the diagnosis of OSA
- Children with mild OSA preop should have clinical evaluation post–op to assess for residual symptoms. If so, PSG recommended
- PSG indicated post–op if preop mod–severe OSA, obesity, craniofacial anomalies, neurologic d/o
- PSG indicated for suggestion of congenital central alveolar hypoventilation syndrome or sleeprelated hypoventilation due to neuromuscular d/o or chest wall deformities.
- PSG indicated for apparent life–threatening event
- PSG indicated in children being considered for T&A to treat OSA
- Children treated with oral appliance should have clinical follow–up and PSG to assess response.
“We believe that polysomnography is indicated in any child who snores and has labored breathing during sleep, and who has any predisposing physical exam findings or daytime symptoms.” Beck, SE, Pediatric Polysomnography, Sleep Med Clin. 2009:4(3):393–406
To PSG or not to PSG, that is the question

- Average cost of PSG 3,000. Number of tonsillectomy in US/year=500,000. Majority are for UAO. (350,000?). If all had PSG→1 billion. Estimated pediatric population in US=76.7 million. Estimated 2–3% of pediatric population has OSA. If all 2% (1.5 million) underwent PSG—4.6 billion dollars.
AAOHNS Clinical Practice Guideline:

Polysomnogram for sleep-disordered breathing prior to tonsillectomy in children

July 2011
# 1 Polysomnogram indicated for patient with complex medical conditions including:

Obesity, Down syndrome, craniofacial abnormalities, neuromuscular d/o, sickle cell disease, mucopolysaccharidoses
# 2 No comorbidities listed in #1 and need for surgery is uncertain.

OR

When there is discordance between tonsil size on physical exam and reported severity of OSA
#3 In children for whom Sleep Study (PSG) is indicated, clinicians should obtain laboratory–based (attended) study when available.
Followed more than 11,000 British children from infancy until 7 yo. Parental questionnaires at 6, 18, 30, 42, 57, 69 months in regards to sleep disordered breathing (snoring, apnea, mouth-breathing) as well as behavior (inattention/hyperactivity, anxiety, depression, peer problems, conduct problems (agressiveness and rule breaking) ).

No sleep studies.

By 4 years children in the symptomatic clusters were 20–60% more likely to exhibit behavioral difficulties; by 7 years they were 40–100% more likely. This, despite control for multiple other influences (ie family adversity, smoking, birth weight, home environment, etc).

The worst symptoms were associated with the worst behavioral outcomes.

Hyperactivity was the domain most affected.

Even very early symptoms (peak at 6–18 months) are associated with 40–50% increased behavioral morbidity at 7 years. ?Lasting brain development impact

Diagnostic Connundrum—what to do?

- 29 children with symptoms suggestive of OSAS, but with negative PSG randomized to either T&A or observation.
- At 6-month follow up 82% of surgical patients showed resolution of symptoms vs. 22% of the non-surgical patients. Median symptom reduction was 49 in surgical patients and 8 for non-surgical patients.
- There is room for the “art” of medicine.
Pedictric OSAS -- Treatment

- Weight loss / ? Bariatric Surgery: Major Risks
- CPAP – use will increase in future: obese teens
- T&A (10–20% residual OSAS)
- Mandibular Advancement
- Distraction Osteogenesis
- Tracheostomy
- Repair Choanal Atresia
- Tongue Reduction
- Hyoid Advancement
- Uvuloplatopharyngoplasty (UPPP)
- Medication
Treatment Options – Pharmacologic Treatment

- Can be used for mild SDB or snoring, for those with seasonal symptoms or for those who cannot undergo surgery.


Treatment Options – Oral Appliances

- Concern for long-term consequences for myofascial functional and orthodontia.
- No good data to support use.
- Palate expansion appeared to be helpful in one small study.
Treatment Options (PAP)

- May be considered for those for whom surgery is high-risk or contraindicated.
- Real-life experience—much less than this.
- Few empirical data to prove efficacy.
- No data to show treatment of end-organ dysfunction
Difficulty with cpap

- Difficulty wearing
- Skin breakdown
- Nasal congestion
- Midface hypoplasia
- Social implications

- Reserve for complex cases
Treatment Options: Tonsillectomy & Adenoidectomy

- Tonsillectomy effective 60–70% of children with significant tonsillar hypertrophy
- Tonsillectomy produces resolution (AHI<1) of OSA in only 10–25% of obese children. However, dramatic improvement was noted in nearly all. No clear indication as to which obese children will be cured by surgical intervention.
- Treatment of OSA with T&A improves behavior, attention, quality of life, neurocognitive functioning.
Tonsillectomy & Adenoidectomy

- Enuresis resolves or improves in most children with SDB after tonsillectomy. This effect has been noted to persist for at least one year. Firoozi F:Resolution of diurnal incontinence and nocturnal enuresis after adenotonsillectomy in children. J Urol. 2006; 175: 1885–1888
- NIH Randomized Controlled Study of Adenotonsillectomy (CHAT) looking at adenotonsillectomy within 1 month or within 7 months of diagnosis is ongoing.
Complications of tonsillectomy

- Hemorrhage: 0.1–3%
- Trauma: dental, larynx, palate (stenosis),
- Difficult intubation
- Laryngospasm, laryngeal edema, aspiration
- Airway fires
- Cardiac arrest
- Mandibular condyle fracture
- Lip burn
- Eye injury
- Dehydration
- Postobstructive pulmonary edema
- VPI (velopharyngeal insufficiency)
- Nasopharyngeal stenosis
- Mortality: 1 in 16,000–35,000 surgeries

- Obese children at much higher risk of perioperative complications (40x higher)
AAOHNS Clinical Practice Guideline: Tonsillectomy in Children

- Tonsillectomy is appropriate for sleep disordered breathing.
- Ask caregivers of children with sleep–disordered breathing and tonsil hypertrophy about comorbid conditions that might improve after tonsillectomy, including growth retardation, poor school performance, enuresis, behavioral problems.
- Counsel caregivers about tonsillectomy as a means to improve health in children with abnormal PSG who also have tonsil hypertrophy and sleep–disordered breathing.
- Counsel caregivers that sleep–disordered breathing may persist or recur after tonsillectomy and may require further management.
- Children younger than 3 yo or those with more severe OSA should be observed overnight in the hospital.
AAP recommendations

- All children/adolescents should be screened for snoring
- PSG should be performed in children with snoring and symptoms/signs of OSA
- T&A recommended as the first-line treatment for children with ATH
- High-risk children monitored overnight after T&A
- CPAP recommended if T&A not performed or OSA persists
- Topical nasal steroids are an option for mild OSA after T&A or patients who cannot undergo T&A
- (Clinical Practice Guideline, Pediatrics 2012)
To know even one life has breathed easier because you lived. This is to have succeeded.
Ralph Waldo Emerson
Clinical Scenario #1 – Little Bobby

- 8 yo
- Trisomy 21
- Heroic snoring nightly
- Observed apneas
- BMI = 30
- PE with 2+ tonsils, narrow OP, large tongue
Little Bobby

- PSG demonstrates AHI=13
- OPTIONS?
Little Angie

- 6 yo
- Enuresis (primary)
- Poor focus, hyperactive
- Snores nightly, but doesn’t appear to be struggling. No gasping or apneas noted.
- PE demonstrates 3+ tonsils and adenoid hypertrophy
- BMI=24
Little Angie

- Diagnostic options?
- Treatment options?
Little Rhonda

- 17 yo
- PCOS
- BMI = 29
- Heroic snoring
- “Tired all the time.”
- 12am–6:30am
- PE demonstrates 3+ tonsils
Little Rhonda

- Diagnostic options
- Treatment options
- Counselling?
Little Rudy

- 4 yo
- “Loud breathing” at night, but no observed apneas
- Nasal obstruction and rhinorrhea—constant
- No hyperactivity or behavioral issues
- No enuresis
- PE demonstrates 4+ tonsils and nasopharyngeal obstruction secondary to adenoid hypertrophy
Little Rudy

- Diagnostic options
- Treatment options
- Counselling
Nocturnal Enuresis

- 90% dry by age 6, 97% by age 12
- Primary vs. Secondary
- Secondary enuresis consider UTI, spina bifida occulta, DM, seizures, OSA
- 1 parent–45%, 2 parents–75%
- Follows motor skill development. If this lags, so will urinary control
- 15% cure each year
- Bed-wetting alarms 75% success rate (4–6 weeks)
Pediatric PLMD

- PLM > 5/hour with sleep disturbance resulting. Often (50%) with parent with this diagnosis
Pediatric RLS

- Urge to move legs
- Urge worse during rest/inactivity
- Discomfort lessened by movement
- Urge worse at night
- Definite: All four
- Probable: All except #3, and parent with RLS
- Possible: PLMD, Parent with RLS (but child does not)
Pediatric RLS – Workup/Treatment

- Serum ferritin/CBC
- Control sleep hygiene issues, ensure adequate sleep time
- Dopaminergics (ropinirole)—long-term effects unknown
- Antiadrenergics (clonidine)—soporific, helpful in children with hyperactivity, rapidly effective, few side effects
- Opioids —used for painful refractory RLS
- Anticonvulsants—Gabapentin. Few side effects.
- Benzodiazepines—clonazepam
- Bupropion—may be helpful