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Challenges in Management of Pediatric Sleep Apnea

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Conflict of Interest Disclosures for Speakers

1. I do not have any relationships with any entities producing, marketing, re-selling, or distributing health care goods or services consumed by, or used on, patients, OR

2. I have the following relationships with entities producing, marketing, re-selling, or distributing health care goods or services consumed by, or used on, patients:

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<tr>
<th>Type of Potential Conflict</th>
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<td>Grant/Research Support</td>
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3. The material presented in this lecture has no relationship with any of these potential conflicts, OR

4. This talk presents material that is related to one or more of these potential conflicts, and the following objective references are provided as support for this lecture:

   1.
   2.
   3.
Objectives

• Review presenting signs and symptoms of pediatric sleep apnea
• Review importance of testing prior to treatment
• Discuss treatment options, and individualized approach to treatment
Obstructive Sleep Apnea
Obstructive Sleep Apnea

**Epidemiology**
- 10% children snore frequently, according to parents
- 1.2-5.7% school age children have OSA based on PSG
- Peak age 2-8 years
  - Corresponds to the peak of lymphoid hyperplasia, and adenotonsillar hypertrophy
- Boys and girls equal until adolescence, when boys outnumber girls (similar to adult patterns)
- More frequent in African-American and Asian children
OSA Risk Factors

• Enlarged tonsils and/or adenoids
• Allergies
• Facial abnormalities
  • Small chin
  • Narrow hard palate
  • Cleft palate repair
• Down syndrome
• Obesity
• Neuro-Muscular disorders
OSA – Night Symptoms

• Snoring most common complaint
  • With or without snorting, choking, gasping, or witnessed pauses in breathing
• Restless sleep (tossing and turning)
  • Sleeping in strange positions (extending neck to open airway)
• Sweats
• Bed wetting
OSA – Daytime Symptoms

• Daytime sleepiness *not* present in most kids (less than 10%)
• Behavioral problems
• Inattention
• Hyperactivity
• Irritability
• Decreased school performance
• Morning headaches
OSA – Medical Consequences

• Hypertension
• Pulmonary hypertension
• Failure to thrive (slow growth)
• Heart failure
Diagnosis of OSA

• Clinical history cannot predict presence or absence of childhood OSA
  • Severe OSA can be present even with soft snoring and minimal symptoms
  • Physical examination is often normal
    • Degree of tonsillar hypertrophy does not correlate with presence of OSA
  • Parental perception varies widely

• CHAT study 2013 found OSA was present in only 50% of children clinically thought to be good T&A candidates
PSG Needed prior to treatment?

• Disagreement in guidelines

• American Academy of Otolaryngology - Head and Neck Surgery
  • PSG should be performed if
    • Age <2
    • Obesity
    • Down syndrome
    • Craniofacial abnormalities
    • Neuromuscular disease
    • Sickle cell disease
    • Mucopolysaccharidoses
  • PSG should be advocated for
    • Need for T&A is uncertain
    • Discordance between physical exam and reported severity of obstructive symptoms

• American Academy of Pediatrics
  • PSG should be performed in children/adolescents with snoring and symptoms/signs of OSAS
    • If PSG is not available, alternative diagnostic tests or referral to specialist for more extensive evaluation may be considered
Treatment

• If and how to treat OSA is an individualized decision depending on multiple considerations
  • Clinical symptoms
  • Severity of sleep apnea based on PSG
  • Age
  • Medical comorbidities
  • Anatomic features
  • Family preference for aggressiveness of care

• Options include
  • Adenotonsillectomy
  • CPAP/BPAP
  • Orthodontic interventions
  • Medication therapy
  • Watchful waiting
  • Positional therapy
  • Weight loss
Adenotonsillectomy

• Generally indicated for healthy children with adenontonsillar hypertrophy (>= 1+ tonsils) for moderate to severe OSA
• 2nd most common surgical procedure in United States
  • 289,000 annually
  • Becoming more frequent over the last 35 years
  • SDB being the primary indication in 67%
• Risks
  • Most patients will have throat pain, otalgia, halitosis, and odynophagia for up to 2 weeks
  • Bleeding 0.2-3%, immediate or delayed
  • 3.9% have secondary complications that require readmission
  • Mortality in the US
    • 1 per 2360 for inpatient tonsillectomy
    • 1 per 18,000 for ambulatory
T&A

- Risk factors for Postoperative complications
  - Age younger than 3
  - Severe OSA*
    - AHI >24 (>10 by ENT guidelines)
    - SpO2 nadir <80%
    - Hypercapnia (peak PCO2 >60 mmHg)
  - Cardiac complications of OSA
  - Failure to thrive
  - Obesity
  - Craniofacial anomalies
  - Neuromuscular disorders
  - Current respiratory infection

- For high-risk patients, recommend overnight inpatient monitoring
Efficacy of T&A

• Success rates are estimated 27-80% depending on definition

• 2010 review of 578 children
  • AHI reduced from 18 to 4
  • 27% had complete resolution (AHI<1)

• 2009 meta-analysis of 1079 patients
  • Cure rate 60%

• 2013 CHAT study including 464 randomized children
  • 79% AHI normalization with early T&A group
  • Less likely in obese, worse AHI, and African American
Watchful Waiting?

A Randomized Trial of Adenotonsillectomy for Childhood Sleep Apnea

Carole L. Marcus, M.B., B.Ch., Reneé H. Moore, Ph.D., Carol L. Rosen, M.D.,
Bruno Giordani, Ph.D., Susan L. Garetz, M.D., H. Gerry Taylor, Ph.D.,
Ron B. Mitchell, M.D., Raouf Amin, M.D., Eliot S. Katz, M.D., Raanan Arens, M.D.,
Shalini Paruthi, M.D., Hiren Muzumdar, M.D., David Gozal, M.D.,
Nina Hattiangadi Thomas, Ph.D., Janice Ware, Ph.D., Dean Beebe, Ph.D.,
Karen Snyder, M.S., Lisa Elden, M.D., Robert C. Sprecher, M.D., Paul Willging, M.D.,
Dwight Jones, M.D., John P. Bent, M.D., Timothy Hoban, M.D.,
Ronald D. Chervin, M.D., Susan S. Ellenberg, Ph.D.,
and Susan Redline, M.D., M.P.H., for the Childhood Adenotonsillectomy Trial (CHAT)
CHAT Study

• Single blind randomized controlled trial evaluating T&A vs watchful waiting for OSA
  • 464 children diagnosed with OSA and considered good candidates for T&A
  • oAHI between 2-30 (very severe OSA excluded) with median 4.7
  • Age 5-9
  • PSG, cognitive, behavioral, and health outcomes assessed at baseline and again at 7 months

• Primary outcomes were negative – no difference in measured executive functioning between groups

• Normalization of AHI favored T&A group
  • 79% vs 46%

• T&A group improved behaviors and QOL as rated by parents and teachers (moderate to large improvement)
Watchful waiting

• 46% had resolution of OSA based on PSG at 7 months
• Only 15% had symptomatic resolution

• Predictors of spontaneous resolution
  • Lower AHI
  • Better O2 saturations
  • Smaller waist and neck
  • Non-Black race
  • Higher positioned soft palate

• Habitual snoring resolves in half to 2/3 children over 1-3 years

Chervin et al. CHEST 2015; 148(5): 1204-1213
Positive Airway Pressure

• Indicated for OSA in children if
  • Minimal adenotonsillar tissue
  • Parents prefer non-surgical approach
  • Persistent OSA after T&A

• Observational studies only: PAP improves symptoms, signs and PSG findings in at least 85% of children

• Complications are minor and usually related to mask fit

• Concern about midfacial development
Rapid Maxillary Expansion

• Orthodontic treatment to widen the palate and nasal passages
• Reduces airway obstruction
• 2004 study of 31 children, nonobese, with maxillary contraction, and no adenotonsillar hypertrophy
  • OSA confirmed with PSG (average OAH1 12)
  • Palate expansion over 10-20 days, and appliance retained 6-12 months
  • Reevaluation on PSG repeated at 4-6 weeks, and then again 4 months after the device was removed

After 4-6 weeks 29 of the 31 had AHI <5
At completion AHI <1 in 100% of cases

Table 1—Polysomnographic Data for 31 Subjects

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<thead>
<tr>
<th>Parameter</th>
<th>T₀</th>
<th>T₁</th>
<th>T₂</th>
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<tbody>
<tr>
<td>Obstructive apnea-hypopnea index</td>
<td>12.18 ± 2.6</td>
<td>9.8 ± 2.7</td>
<td>0.4 ± 1.1</td>
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<tr>
<td>Range</td>
<td>5.7-21.1</td>
<td>0-8.1</td>
<td>0-2.1</td>
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<tr>
<td>Nadir SpO₂, %</td>
<td>78.5 ± 8.2</td>
<td>89.6 ± 5.9</td>
<td>95.3 ± 1.7</td>
</tr>
<tr>
<td>Duration of longest obstructive apnea, sec</td>
<td>35.2 ± 18.6</td>
<td>28.3 ± 14.1</td>
<td>12.6 ± 7.4</td>
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<tr>
<td>Duration of desaturation (SpO₂ &lt; 92%), % total sleep time</td>
<td>19.7 ± 3.5</td>
<td>6.6 ± 1.9</td>
<td>1.3 ± 1.1</td>
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<tr>
<td>Sleep efficiency, %</td>
<td>87.1 ± 8.8</td>
<td>88.6 ± 6.4</td>
<td>89.2 ± 7.7</td>
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T₀ refers to time before any orthodontic therapy; T₁, after 4 to 6 weeks with the device; T₂, 4 months after the end of the orthodontic treatment. All data are displayed as mean ± SD, unless otherwise indicated.

Corticosteroids and Anti-inflammatory Rx

- Small studies have shown benefit with nasal steroids
  - 2000 blinded RCT in 25 children with OSA
  - Treated with placebo or fluticasone x 6 weeks
  - OAHI reduced from 10.7 to 5.8 in treatment arm

- 2012 Montelukast study
  - 46 children randomized with placebo x 12 weeks
  - OAHI reduced from 6 to 3.6 in treatment arm
  - Adenoid size also reduced

- Systemic steroids not effective

Goldbart A et al. Pediatrics 2012; 130:e757-e580
Combination

• Several studies show benefits of nasal steroid + montelukast
• 2014 retrospective study 752 children with mild OSA
  • Beneficial effects in 80%
  • 62% normalized AHI on follow up PSG
  • 17% worsened or had no improvement

Kheirandish-Gozal et al. CHEST 2014; 146(1):88-95

• 2006 open label controlled study 22 children s/p T&A with mild residual OSA
  • Treated for 16 weeks with budesonide and montelukast
  • AHI decreased from 3.9 to 0.3 in the treatment arm
  • No change in untreated arm

Kheirandish L et al. Pediatrics 2006; 117;e61

• Anti-inflammatory drugs are less effective if older or obese
Central Sleep Apnea

• Usually periodic breathing in children
• Most frequent in premature infants
• Rare in older children
• Usually a sign of structural brain abnormalities or neurologic disorders
  • Arnold Chiari malformation
  • If significant, MRI brain is recommended
• Treatment protocols for central apnea are not defined
  • Treat OSA if present (start with T&A)
  • Neurosurgical consultation for Chiari malformation
  • Oxygen
  • CPAP
  • BPAP ST or ASV
12 year old with brain stem tumor
Trial of BiPAP with backup rate 12
Trial of BiPAP ASV
Hypoventilation

- Defined in children as CO2 > 50 mmHg for more than 25% of TST
  - Transcutaneous or End-tidal
- Congenital Central Hypoventilation Syndrome
  - Rare genetic disorder of autonomic dysregulation
  - Linked with PHOX2B gene
  - Usually present in infancy, but late-onset can occur
  - PSG shows severe hypoventilation
    - Worse in NREM relative to REM
    - Normal respiratory rate but low tidal volumes
- Obstructive hypoventilation
  - Part of OSAS
  - Present in 13% of pediatric patients with OSA
  - Correlates with AHI, but can be present with normal AHI
  - Improves with T&A but less than AHI

Paruthi et al. SLEEP 2015; 38(11):1719-1726
Obstructive Hypoventilation
Obesity hypoventilation

• Can be seen in kids
  • Associated with Prader-Willi
  • Down Syndrome

• 7 year old boy with obesity and prior T&A, #213, with snoring, excessive daytime sleepiness and nightly enuresis
Case images
Summary Recommendations

- Children with suspected OSA should have consultation with a sleep apnea clinician and PSG prior to treatment.
- Assessment of symptoms, clinical history, exam are important to making recommendations after sleep testing.
- For mild to moderate OSA (oAHI 1.5-9.9):
  - If symptomatic, recommend nasal steroid + montelukast or referral to ENT for T&A evaluation.
  - If not symptomatic, no treatment needed but reassess in 6 months.
  - Reassess target symptoms 3 months after T&A or medication therapy.
  - Repeat sleep study if not improved.
- For severe OSA (OAHI>10):
  - ENT evaluation for T&A.
  - CPAP if parent/patient preference or if no significant adenotonsillar tissue.
Recommendations, continued

• Nasal steroid and montelukast for residual mild-moderate OSA s/p T&A
• Orthodontic palate expansion if narrow palate
• Nutritional counseling and weight loss program if obese
• CPAP requires a lot of support
  • Most kids can do well
  • Important to get buy in from parents/guardians!!
  • Desensitization to PAP prior to titration studies
  • Use pediatric friendly masks
    • Nasal masks better accepted than full masks
  • Reward efforts to use
  • Frequent visits early on
• Pediatric sleep psychologist available for PAP struggles due to anxiety or behavioral resistance
THANK YOU