Pediatric Obstructive Sleep apnea

_An update … What else is there to know?

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Disclosure

No Financial Relationships
Pediatric Obstructive Sleep Apnea (OSA):

1. **One or more clinical symptoms:** snoring, labored, paradoxical or obstructed breathing **behavioral problems or aggressive behavior**, during sleep, excessive sleepiness, growth impairment, **learning problems**

2. One or both on polysomnogram
   a. Apnea-Hypopnea Index >1
      Apnea: cessation of airflow for two breaths
      Hypopnea: decrease in airflow by 30% with a drop in O2 by 3% or an associated arousal
   b. PCO2 greater than 50mm Hg for more than 25% of the sleep time + snoring, paradoxical thoracoabdominal movement or flattening of the nasal airway pressure waveform

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**Pediatric OSA Severity**

- AHI 1-5 mild OSA
- AHI 5-10 moderate OSA
- AHI >10 severe OSA or SaO2 nadir <80%

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Ehsan & Ishman 2016
Lee et al 2016
OSA Sequela: Why we care

- Neurocognitive deficits
- Behavioral issues
- Growth Failure

- Systemic Hypertension
- Pulmonary hypertension, core pulmonale and right heart failure

- Increased use of health care resources

Pediatric OSA?
Adenotonsillectomy Failure

- 20-40% pediatric patients will have persistent OSA
- 53-88% of obese children will have persistent OSA
Sleep Disordered Breathing

- Snoring
- Upper airway resistance syndrome
- Mild obstructive sleep apnea
- Moderate obstructive sleep apnea
- Severe obstructive sleep apnea

Adenotonsillectomy: CHAT 2013

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Childhood Adenotonsillectomy Trial

Multi-Institutional study that randomly assigned 464 children with obstructive sleep apnea to surgery versus watchful waiting.

<table>
<thead>
<tr>
<th>Table 2: Outcome Measures</th>
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<tbody>
<tr>
<td>Outcome</td>
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<tr>
<td>Primary outcome (NIPS attention and executive function score)</td>
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<tr>
<td>Secondary outcome (Covariates)</td>
</tr>
<tr>
<td>Computer rating</td>
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<tr>
<td>Teacher rating</td>
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<tr>
<td>BRIEF score</td>
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<tr>
<td>Computer rating</td>
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<tr>
<td>Teacher rating</td>
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<tr>
<td>PedsQL-PIR score</td>
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<tr>
<td>Apnea-hypopnea index</td>
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<tr>
<td>Interquartile range</td>
</tr>
</tbody>
</table>

Marcus et al 2013
Childhood Adenotonsillectomy Trial

Watchful Waiting Group

Of the 203 patients that were randomized to watchful waiting, **46%** had resolution of their AHI after 7 months.

Sleep Disordered Breathing

- Snoring
- Upper airway resistance syndrome
- Mild obstructive sleep apnea
- Moderate obstructive sleep apnea
- Severe obstructive sleep apnea

Does it have to be surgery?

Adenotonsillectomy: CHAT 2013
Non surgical Treatment Options for Pediatric Obstructive OSA

- Watchful Waiting
- Medical Management
  - Nasal steroid sprays
  - Montelukast
- Orthodontic evaluation
- Weight loss
- Non invasive positive pressure ventilation (NIPPV)
Montelukast

- Goldbart et al 2012: Improved AHI and decreased adenoid size in 23 children randomized to receive 12 week course of montelukast versus 23 children that received placebo.

- Kheirandish-Gozal et al 2014:
  - 80% of 836 children avoided surgery with a 12 week course of montelukast AND nasal steroid spray.
  - 62% of 445 children had normalization of sleep study.

- Kheirandish-Gozal et al 2016: Improved AHI 28 children randomized to receive 16 week course of montelukast versus no change in AHI in 29 that received placebo.
Non surgical Treatment Options for Pediatric Obstructive OSA

- Watchful Waiting
- Medical Management
  - Nasal steroid sprays
  - Montelukast
- Orthodontic evaluation
- Weight loss
- Non invasive positive pressure ventilation (NIPPV)
Orthodontic Evaluation

- Transverse maxillary deficiency (high arched and/or narrow palate)

Orthodontic Evaluation

- Dental crowding
- Malocclusion

- Narrow nasal cavity
- Narrow nasopharynx
- Affect mandibular growth and thus retroglossal airway
Rapid Maxillary Expansion

Camacho et al 2016: Meta-analysis. 17 studies with 314 pediatric patients

- < 3 year follow up:
  - AHI decreased from 8.9 to 2.7 (314 patients)
  - Oxygen saturation nadir increased from 87% to 96% (90 patients)

- >3 year follow up:
  - AHI decreased from 7.1 to 1.5 (52 patients)
Rapid Maxillary Expansion

Camacho et al 2016: Metanalysis. 17 studies with 314 pediatric patients

<table>
<thead>
<tr>
<th>TABLE III. Pre- and Post-Rapid Maxillary Expansion Outcomes Based on Prior Adenotonsillectomy and Tonsil Size.</th>
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</thead>
<tbody>
<tr>
<td>Tonsil Status</td>
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<tr>
<td>----------------</td>
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<tr>
<td>No tonsils, n = 46</td>
</tr>
<tr>
<td>Mixed: no or small tonsils, n = 60</td>
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<tr>
<td>Small tonsils, n = 71</td>
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<tr>
<td>Large tonsils, n = 33</td>
</tr>
<tr>
<td>Mixed: small or large tonsils, n = 45</td>
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</tbody>
</table>

Small tonsils = grade 1; large tonsils = grades 2-4; Mixed = not stratified in the studies.
AH = apnea-hypopnea index; RME = rapid maxillary expansion.

Sleep Disordered Breathing

- Snoring
- Upper airway resistance syndrome
- Mild obstructive sleep apnea
  - Moderate obstructive sleep apnea
  - Severe obstructive sleep apnea
- Persistent obstructive sleep apnea

Watchful Waiting
- Nasal steroid sprays
- Montelukast
- Orthodontic evaluation
- Weight loss
- NIPPV
- Adenotonsillectomy
Alternative Surgical options for Pediatric Obstructive OSA

- Drug Induced Sleep Endoscopy
- Lingual Tonsillectomy
- Supraglottoplasty
  - Turbinate Surgery
  - Septoplasty
  - Lateral pharyngoplasty, UPPP
  - Partial glossectomy, tongue base reduction
  - Tongue base suture suspension
  - Mandibular distraction
  - Genioglossus advancement
  - Tracheotomy

Drug Induced Sleep Endoscopy (DISE)

- Indications
  - Persistent OSA after adenotonsillectomy
  - When size of tonsils and adenoids are not concordant with severity of OSA
  - Co-morbidities: i.e. Down Syndrome, craniofacial anomalies, neuromuscular disorders

- Controversies: Anesthesia
  - Variety of anesthetics used
  - No anesthesia mimics REM sleep
  - Use of anesthesia in kids

Wilcox et al. 2017
Sleep Laryngomalacia
- Arytenoid redundancy and prolapse during DISE
- Treatment: Supraglottoplasty

Lingual Tonsillar Hypertrophy
- Prominent lymphoid hyperplasia at the tongue base
- Treatment: Lingual tonsillectomy
Sleep Disordered Breathing

- Snoring
- Upper airway resistance syndrome
- Mild obstructive sleep apnea
- Moderate obstructive sleep apnea
- Severe obstructive sleep apnea
- Persistent obstructive sleep apnea

Watchful Waiting
Nasal steroid sprays
Montelukast
Orthodontic evaluation
Weight loss
NIPPV
Adenotonsillectomy
DISE
Supraglottoplasty
Lingual Tonsillectomy
Other surgeries