An update on childhood sleep-disordered breathing

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Sleep-disordered breathing

- Primary snoring
- Upper airway resistance syndrome
- Obstructive hypopnea
- Obstructive apnea
Pathophysiology

NORMAL BREATHING

OBSTRUCTIVE SLEEP APNEA
Patency of the upper airway during sleep

Neuromuscular factors
Pharyngeal dilating muscle
- Tonic activity
- Phasic contraction in response to negative upper airway pressure

Structural factors
- Upper airway structure
- Enlarge tonsils and adenoid
- Nasal mucosa swelling
- Pharyngeal fat pad
Update: SDB and inflammation
Plasma C-reactive protein levels among children with SDB

AHI >5  AHI >1  AHI <1

Tauman R. Pediatrics 2004;113:564-569
Comparison of P-selectin levels, a marker of platelet activation

O’Brien LM. Chest 2006;129:947-953
IL-6 and IL-10 in children with SDB

IL-10, anti-inflammatory cytokines

IL-6, pro-inflammatory cytokines

Gozal D. Sleep Medicine 2007
### Urine cysteiny1 - LT in children with SDB

<table>
<thead>
<tr>
<th>Severity</th>
<th>Log- transformed urine cyst-LT Mean</th>
<th>SD</th>
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</thead>
<tbody>
<tr>
<td>Mod to severe</td>
<td>2.39</td>
<td>0.51</td>
</tr>
<tr>
<td>Mild</td>
<td>2.06</td>
<td>0.26</td>
</tr>
<tr>
<td>Primary snoring</td>
<td>2.11</td>
<td>0.25</td>
</tr>
<tr>
<td>Control</td>
<td>1.86</td>
<td>0.28</td>
</tr>
<tr>
<td><strong>P value</strong></td>
<td>&lt;0.05</td>
<td></td>
</tr>
</tbody>
</table>

Kaditis AG. Chest 2009: Epub ahead of print
Leukotriene in exhaled breath condensate of children with OSA

Goldbart AD. Chest 2006;130:143-148
Leukotriene receptor 1 and 2 in tonsils of children with OSAS or recurrent infection

Chest 2004;126:13-18
Inflammation in SDB

- C-reactive protein
- Adhesion molecules
- Cysteinyl leukotriene in urine
- Cysteinyl leukotriene in exhaled breath
- Interleukin-6 (pro-inflammatory cytokines): increase
- Interleukin-10 (anti-inflammatory cytokines): decrease

Pathogenesis of SDB
- End-organ morbidity
- Marker for diagnosis
Predisposing factors

- Adenotonsillar hypertrophy
- Allergic rhinitis
- Obesity
- Neuromuscular disease
- Craniofacial abnormalities
Prevalence

- Primary snoring 7-9%
- Obstructive sleep apnea 0.7-2%
- Peak incidence 2-5 year, male = female
- OSA in obese children 13 - 46%
Questionnaire-based study
allergic rhinitis patients 12-17 years

- Difficulty obtaining a good night’s sleep 78%
- Unable to get to sleep 75%
- Awakened during the night 64%

Juniper EF et al, J Allergy Clin Immunol 1994;93:413-423
Allergic rhinitis and sleep-disordered breathing

- Nasal congestion
  - Negative pressure in the nasal airway generated during inspiration
  - Nasal collapse
    - Airway obstruction
      - Obstructive sleep apnea

Mediators
  - Circadian rhythm
  - Adenoid-tonsil
Classification of allergic rhinitis

**Intermittent symptoms**
- < 4 days per week
- or < 4 weeks

**Persistent symptoms**
- > 4 days per week
- and > 4 week

**Mild**
- normal sleep
- normal daily activities, sport, leisure
- normal work and school
- no troublesome symptoms

**Moderate-severe**
- one or more items
- abnormal sleep
- impairment of daily activities, sport, leisure
- problems caused at work or school
- troublesome symptoms
Distribution of risk factors in habitual snorers

Adenoid hypertrophy in children with allergic rhinitis

Percentage

With
Without
Adenoid hypertrophy

Frequency of Sleep Disorders

1-3 yr 4-6 yr 7-12 yr 12-18 yr

I II III IV

85 95 82 75

34 50 62 45

Ann Allergy Asthma Immunol 2001;87:350-355
Clinical presentation

- Snoring
- Allergic rhinitis
- Obesity
- Complication
History

- Habitual snoring
- Difficulty breathing
- Restless sleep
- Apnea
- Mouth breathing
- Neck hyperextension
- Secondary enuresis
- Excessive daytime sleepiness
Physical Examination

- Normal during awake
- Signs of underlying diseases
- Growth:
  - Obesity
  - Failure to thrive
Test to determine the etiology of OSA

Film adenoid
Test to confirm diagnosis of OSA

- Polysomnography
- Observe during sleep
- Overnight oximetry
- Audiotape and videotape
- Nap polysomnography
Polysomnography

- EEG
- EMG
- EOG
- EKG
- Pulse oximetry
- End tidal CO$_2$
- Oronasal airflow
- Chest and abdominal movement

Gold standard
Comparison of Home Oximetry Monitoring With Laboratory Polysomnography in Children*

Valerie G. Kirk, MD, FCCP; Shelby C. Bohn, BSc; W. Ward Flemons, MD; and John E. Remmers, MD

**Study objectives** To measure the accuracy and reliability of a portable home oximetry monitor with an automated analysis for the diagnosis of obstructive sleep apnea (OSA) in children.

**Design:** Prospective cohort study.

**Setting:** Alberta Lung Association Sleep Center, Alberta Children's Hospital Sleep Clinic.

**Study subjects:** Consecutive, otherwise healthy children, aged 4 to 18 years, presenting to the Pediatric Sleep Service at the Alberta Children's Hospital for assessment of possible OSA.

**Interventions:** All subjects underwent 2 nights of monitoring in the home with an oximetry-based portable monitor with an automatic internal scoring algorithm. A third night of monitoring was done simultaneously with computerized laboratory polysomnography according to American Thoracic Society guidelines.

**Measurements and results:** Both test-retest reliability of the portable monitor-based desaturation index (Di) between 2 nights at home and between laboratory and home were high using the Spearman correlation coefficient. Sensitivity 67%, specificity 60%.

**Apnea (polysomnography AHI > 5/h) were 67% and 60%, respectively.**

**Conclusion:** Portable monitoring based only on oximetry alone is not adequate for the identification of OSA in otherwise healthy children. *(CHEST 2003; 124:1702–1708)*

**Key words:** abbreviated monitoring; ambulatory monitoring; children; diagnosis; obstructive sleep apnea; oximetry; sleep apnea syndromes

**Abbreviations:** AHI = apnea-hypopnea index; DI = desaturation index; OSA = obstructive sleep apnea; RDI = respiratory disturbance index.
Overnight oximetry monitoring

Oxygen sat < 90%
At least 3 times/night

Positive predictive value 97%
Negative predictive value 47%

Brouilette RT. Pediatrics 2000;105:405-412
Screening OSA by home videotapes recording

Thirty minutes of home video-recordings

- Highly correlation between PSG results and video test results
- Overall sensitivity 94%, specificity 68%

Sivan Y. Eur Respir J. 1996;9:2127-2131
## Nap and overnight PSG

### Sensitivity, specificity, PPV, NPV of nap parameters

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>PPV</th>
<th>NPV</th>
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</thead>
<tbody>
<tr>
<td>Abnormal nap</td>
<td>69</td>
<td>60</td>
<td>77</td>
<td>49</td>
</tr>
<tr>
<td>OSA</td>
<td>23</td>
<td>85</td>
<td>76</td>
<td>36</td>
</tr>
<tr>
<td>Hypopnea</td>
<td>40</td>
<td>69</td>
<td>72</td>
<td>37</td>
</tr>
<tr>
<td>Hypoxemia</td>
<td>26</td>
<td>85</td>
<td>78</td>
<td>37</td>
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<tr>
<td>Hypoventilation</td>
<td>25</td>
<td>88</td>
<td>80</td>
<td>37</td>
</tr>
</tbody>
</table>

Saeed MM. Chest 2000;118:360-365
Medical or surgical treatment

- Adenotonsillar hypertrophy
- Allergic rhinitis
- Obesity

*****Concurrent infection*****
Update: management of adenotonsillar hypertrophy

- Adenotonsillectomy
- Role of intranasal corticosteroid
- Role of leukotriene antagonist
Intranasal corticosteroid for adenoid hypertrophy and obstructive sleep apnea

- Beclomethasone
- Fluticasone propionate
- Budesonide
- Momethasone fuorate
- Budesonide
Beclomethasone 336 mcg/day for 8 weeks

Demain JG. 1995;95:355-364
Fluticasone 200 mcg/day in the 1st week then 100 mcg/day for 5 weeks

Brouillette RT. 2001;138:838-44
Budesonide 200 mcg/day for 4 weeks

Before treatment

2 weeks after the end of treatment

9 months after the end of treatment

Alexopoulos EI. Pediatr Pulmonol 2004;38:16-167
Intranasal corticosteroids for moderate to severe adenoidal hypertrophy

Limited evidence suggests that intranasal corticosteroids

1. Significantly improve nasal obstruction symptoms in children with moderate to severe adenoid hypertrophy

2. Improvement may be associated with a reduction of adenoid size

3. The long-term effect remains to be defined

Zhang L, Mendoza-Sassi RA, César JA, Chadha NK
Cochrane Database of Systematic Reviews, Issue 1, 2009
Leukotriene modifier therapy in SDB

16 weeks treatment with montelukast in 24 children with SDB

<table>
<thead>
<tr>
<th></th>
<th>Montelukast</th>
<th></th>
<th>No treatment</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Pre</td>
<td>Post</td>
<td>Pre</td>
<td>Post</td>
<td></td>
</tr>
<tr>
<td>A/N ratio</td>
<td>0.76±0.03</td>
<td>0.56±0.03</td>
<td>&lt;0.001</td>
<td>0.78±0.04</td>
<td>NS</td>
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<tr>
<td>Respiratory arousal index</td>
<td>7.2±0.8</td>
<td>3.0±0.3</td>
<td>&lt;0.001</td>
<td>9.4±0.7</td>
<td>&lt;0.03</td>
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<tr>
<td>Obstructive AHI</td>
<td>3.0±0.22</td>
<td>2.0±0.3</td>
<td>0.017</td>
<td>3.2±0.2</td>
<td>&lt;0.03</td>
</tr>
</tbody>
</table>

Goldbart AD. Am J Respir Crit Care Med 2005;172:364-370
Montelukast + budesonide 12 weeks in 22 children with residual SDB after adenotonsillectomy, AHI 1-5/hr

<table>
<thead>
<tr>
<th></th>
<th>Montelukast/budesonide</th>
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<tr>
<td></td>
<td>Pre</td>
<td>Post</td>
</tr>
<tr>
<td>Respiratory</td>
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<tr>
<td>arousal index</td>
<td>4.6±0.6</td>
<td>0.8±0.03</td>
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<tr>
<td>Obstructive AHI</td>
<td>3.9±1.2</td>
<td>0.3±0.3</td>
</tr>
</tbody>
</table>

Kheirandish L. Pediatrics 2006;117:61-66
OSAS

Respiratory Infection
Respiratory failure

CVS
Right heart failure
Pulmonary hypertension
Systemic hypertension

Hypoxia & Hypercarbia

Growth
Growth failure

Cognitive & behavior
Poor learning
Attention deficit
Hyperactivity
Prevalence of the metabolic syndrome in increasingly severe categories of SDB

Redline S. AJRCCM 2007;176:401-408
Complication of primary snoring
BP in children with primary snoring

Kwok KL. Chest 2003;123:1561-1565
Neurobehavioral complication in primary snoring

Children with primary snoring:
   worse on measures related to
   - Attention
   - Social problem
   - Anxious
   - Depressive
   - IQ

Author suggestions
   - Larger studies are required
   - Current guidelines for treatment for primary snoring may require reevaluation

Pediatrics 2004;114:44-49
J Pediatric 2005;146:780-786
Thank you