MECKLENBURG EAR NOSE AND THROAT, PLLC

Issue 1

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SPECIAL POINTS OF INTEREST:

- **1-3% of the pre-school population have obstructive sleep apnea.**
- **Sleep disordered breathing is associated with sleepwalking, hyperactivity, and nocturnal enuresis among others.**

See the Pediatric Sleep Questionnaire for sleep disordered breathing on the back page

CLINICAL NEUROPSYCHIATRIC EFFECTS OF OBSTRUCTIVE SLEEP APNEA IN CHILDREN

Pediatric obstructive sleep apnea, first defined in 1975, is a disorder most often due to hypertrophy of Waldeyer's ring (Goldstein 2004). The most common treatment, adenotonsillectomy, is generally very successful with a 85-95% cure rate. This newsletter is designed to familiarize the pediatrician and family physician with recent literature illustrating the adverse neurocognitive and behavioral effects of snoring and obstructive sleep apnea in children.

Definitions of Pediatric Obstructive Sleep Apnea (OSA), Upper Airway Resistance Syndrome, and Snoring:

Obstructive Sleep Apnea

Obstructive sleep apnea is defined by the following sleep study results.

1) Apnea Hypopnea Index (AHI) > 1. This is the number of apneas (cessation of breathing for 6 seconds) plus hypopneas (30% airflow reduction with desaturations or arousals) per hour of sleep or...

2) Respiratory Disturbance Index >5. Arousals due to respiratory events greater than 5 times per hour.

Obstructive sleep apnea is suspected in children with the following symptoms:

> Snoring, gasping, choking, restless sleep, night sweats, frequent awakenings, enuresis, extended neck during sleep, daytime fatigue, headache, irritability, hyperactivity, developmental delay, poor school performance, mouth breathing, rhinorrhea, and recurrent tonsillitis.

Upper airway resistance syndrome (UARS)

UARS can be measured in the sleep lab by adding esophageal manometry. However, this is not commonly performed. This can be considered on the continuum from primary snoring to obstructive sleep apnea and most likely has similar neurocognitive and behavioral effects of other sleep disordered breathing syndromes.

Snoring

Primary snoring is seen in patients with a polysomnogram that does not meet the criteria of obstructive sleep apnea as previously defined.

This is the child that "sounds like grandpa" down the hallway. Primary snoring occurs in 10-12% of preschool children which decreases by age nine.

Sleep Disordered Breathing

This is a general term that encompasses the above-mentioned problems: obstructive sleep apnea, upper airway resistance syndrome, and primary snoring.

Neurocognitive and Behavioral Effects of Sleep Disordered Breathing:

Primary snoring: Children with a negative sleep study who have primary snoring can have problems of attention, anxiety, depression, and social problems. Why would this occur? Most likely, the polysomnogram underestimates the significance of snoring in children. Snoring without sleep apnea may cause changes in EEG patterns associated with arousals (Lopes 2006). Primary snoring is associated with: difficulty sleeping, sleepwalking, prob-

SNORING LIKE GRANDPA IS NOT CUTE!

Primary snoring, even with a negative sleep study, can cause inattention, depression, anxiety and hyperactivity in children.

Baseline snoring 5 days per week predicted a 4– to 5-fold increased risk for newly developed hyperactivity at follow up.

lems waking up, school difficulties, hyperactivity, irritability, inattention and daytime fatigue.

Dr. O'Brien compared children with habitual snoring to those without snoring. The study reveals differences in attention, anxious/depression symptoms, social problems, language and visual spatial testing and general conceptual ability (O'Brien 2004).

The symptoms of primary snoring can look very much like ADHD. In another cohort of children, snoring is more common in children with behavior characteristics of mild or significant ADHD (O'Brien 2003). O'Brien summarizes in her article: "Therefore, in a child who presents with parental complaints of hyperactivity and who does not meet the diagnostic criteria of ADHD after undergoing a thorough evaluation as recently recommended by the American Academy of Pediatrics, a careful sleep history should be taken, and if snoring is present, then an overnight polysomnographic evaluation should be performed." This study supports the finding that mild, not severe, hyperactivity may be related to sleep disordered breathing.

Although most of these studies are retrospective questionnaires, a few prospective studies definitively link snoring to hyperactivity. Dr. Chervin, has prospectively looked at 229 children with a Pediatric Sleep Questionnaire (PSQ) with and without snoring. "Baseline snoring predicted a 4– to 5-fold increased risk for newly developed hyperactivity at follow up four years later (Chervin 2005)."

Primary snoring even with a negative sleep study, can have many neurocognitive and behavioral effects. Often with medical or surgical treatment, these effects can be reversed. Therefore, it is important to take a careful sleep history from parents when children present with the abovementioned complaints.

Obstructive Sleep Apnea (OSA):

Obstructive sleep apnea causes a wide variety of behavioral and cognitive changes. There are impairments in auditory verbal learning and delayed recall but no differences in verbal IQ, full scale IQ, reading or math scores (Kaeming 2003). In addition, children with suspected sleep disordered breathing report depression and decreased health related quality of life.

A recent article examined children with *symptoms* of obstructive sleep apnea and adenotonsillar hypertrophy on exam. The best predictor of cognitive function was nightly snoring rather than polysomnogram results. The end result of the study argues that habitual snorers, five times per week, may have a decline of one standard deviation from the mean in Vocal and Similarities subsets of the Weschler Intelligence Scale (Suratt 2006). This effect is similar to chronic lead exposure with blood concentrations of 10 µg/dL.

The relationship between obstructive sleep apnea and behavioral changes is complex and interdependent. Dr. Owens in her review article writes: "the relationship between sleep problems and ADHD is essentially bidirectional and may be manifested in several ways: sleep problems may mimic ADHD symptomatology, may exacerbate underlying ADHD symptoms, may be themselves associated with or exacerbated by ADHD, and psychotropic medications used to treat ADHD may result in sleep problems (Owens 2005)."

When examining the relationship of ADHD to obstructive sleep apnea, the hyperactivity/impulsive subtype is the most closely related. There is almost a three fold increase in cognitive and behavioral abnormalities in children with obstructive sleep apnea compared to those without sleep disordered

OBSTRUCTIVE SLEEP APNEA ALTERS: MOTOR SKILLS, ALERTNESS, MOOD, MEMORY, AND BEHAVIOR

breathing. However, when a population of ADHD children is compared to a control group, the prevalence of obstructive sleep apnea appears equivalent. Because of this, we can not infer a direct causal relationship between obstructive sleep apnea and ADHD.

ADHD and Sleepiness

When examining ADHD patients *without* obstructive sleep apnea, some of these children have problems going to bed, falling asleep, maintaining sleep, and returning to wakefulness. Unfortunately, there seems to be no consistent differences in sleep architecture between patients with ADHD and control subjects. Despite this, it is important to take a proper sleep history in patients with behavioral changes consistent with ADHD. Why? Because many primary sleep problems including OSA, restless leg syndrome, and narcolepsy, occur in these patients. If an underlying sleep disorder is not addressed, this will affect the success of ADHD treatment overall.

We know that ADHD symptoms include hyperactivity, but did you know that excessive daytime sleepiness (EDS) is also seen in ADHD? Daytime hypersomnolence is caused by sleep interruptions, lack of sufficient sleep, and sleep debt. This results in increased impulsivity, hyperactivity, and aggressiveness. Hypersomnolence can also result in decreased cognitive flexibility, poor abstract reasoning, impaired motor skills, decreased attention and vigilance, and memory impairments (Owens 2005). These include decreases in verbal memory and general memory (Suratt 2006).

How do you sort out whether the patient has ADHD with secondary sleep disruption or sleep disordered breathing with secondary hyperactivity? How do you diagnose other primary sleep abnormalities that can be responsible for behavioral and cognitive abnormalities seen in ADHD?

This is a difficult diagnosis and no individual study clarifies this completely. Polysomnography, physical examination, and most importantly, a thorough sleep history are helpful.

Helpful sleep questions are included on the back page. The most useful are the frequency of snoring on a daily basis or more than half the time, the loudness of the snoring, chest caving in with breathing, and whether the child falls asleep in school, naps after school, is a mouth breather, or complains of feeling tired during the day.

Treatment

Although sorting through this data may be confusing, treatment options for children with documented obstructive sleep apnea in the presence of adenotonsillar hypertrophy are much simpler. Treatment with adenotonsillectomy results in improved quality of life, behavior, and cognition. This includes decreased hyperactivity and impulsivity. Other options such as allergy assessment and inhaled nasal steroids can be tried in the appropriate setting.

Children with severe sleep apnea are also at risk for systemic hypertension, heart failure, failure to thrive, and pulmonary hypertension. Treatment with adenotonsillectomy typically reverses all of these complications.

In summary, neurocognitive sequelae occur in both primary snoring and obstructive sleep apnea. Your patients may present with symptoms of hyperactivity *and* sleepiness. Children with a *clinical* history of sleep disordered breathing despite a *negative* sleep study can still benefit from an adenotonsillectomy. Physicians should take a detailed sleep history in all patients with ADHD.

- Joshua Levine, MD

In a recent study, the best predictor of abnormal cognitive function is severe snoring rather than positive sleep study results.

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O'Brien, Louise et al "Neurobehavioral Implications of Habitual snoring in Children" Pediatrics, 114(1) 2004:44-49.

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Interesting facts…

- **Snoring occurs in 10-12 percent of preschool children.**
- **Sleepiness can result in hyperactivity and ADHD is associated with excessive daytime sleepiness.**

Helpful Questions for Parents of Children with Hyperactivity and Sleep Problems

(Chervin 2005)

While sleeping does your child…

Snore more than half the time?
Snore loudly?
Have heavy breathing or loud breathing?
Have trouble breathing or struggle to breathe?
Always snore?

Have you ever…

Seen your child stop breathing during the night?

Does your child…

Tend to breathe through the mouth during the day?
Have a dry mouth on waking up in the morning?
Occasionally wet the bed?
Wake up feeling unrefreshed in the morning?
Have a problem with sleepiness during the day?

Do you notice…

That teachers or other supervisors comment that your child appears sleepy during the day?
It is hard to wake your child up in the morning?
That your child wakes up with headaches in the morning?
That your child stopped growing at a normal rate at any time since birth?
That your child is overweight?

This child often…

Does not seem to listen when spoken to directly.
Has difficulty organizing tasks and activities.
Is easily distracted by extraneous stimuli.
Fidgets with hands or feet or squirms in seat.
Is “on the go” or often acts as if “driven by a motor.”
Interrupts or intrudes on others