Pediatric sleep apnea

Five things you might not know

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Summary

Obstructive sleep apnea is a frequently overlooked, treatable disorder that is common among children. This article discusses 5 important aspects of this disorder that might not be known to the general pediatric practitioner or pediatric neurologist. These aspects are important in screening, properly evaluating, and treating children with obstructive sleep apnea.

Obstructive sleep apnea (OSA) is a frequently overlooked, treatable disorder that is common among the pediatric population. The syndrome is characterized by periods of partial or complete obstruction of airflow during sleep that results in hypoxia or fragmented sleep and produces significant clinical sequelae. As few as one obstructive event per hour meets criteria for OSA in children, with over 10 events per hour commonly deemed as the severe range.¹ This article highlights 5 important points that will help guide recognition, evaluation, and treatment of pediatric OSA.

Daytime symptoms of OSA can be subtle and easily overlooked.

Sleep apnea in children can present with subtle and often overlooked symptoms. Children may have resistance to waking in the morning, be more irritable, have trouble paying attention in school, or even be overactive during the day. More subtle symptoms may include restless sleep, morning headaches, enuresis, sleep walking, and decline in school performance or decreased growth rate, while more startling long-term effects may involve changes to the cardiovascular system. Numerous studies show the broad range of effects on behavioral, neurologic, and medical domains (table).

Daytime behavioral symptoms for these children include many nonspecific symptoms. The classic symptom of excessive sleepiness seen in adults is not typical of children with sleep apnea. In fact, children are more likely to have behavioral symptoms such as hyperactivity, aggression, irritability, and somatization.^{2,3} There is a strong overlap between the symptoms of attention-deficit/hyperactivity disorder (ADHD) and those of sleep-disordered breathing (SDB), which can range from simply snoring to OSA syndrome. Studies show frequent resolution of

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ADHD manifestations with treatment of SDB.⁴ Perhaps the most robust data for sequelae of OSA is in the neurocognitive realm. Studies show decreased academic performance with SDB.⁵ Children may have decreases in verbal fluency, analytical thinking, visual spatial skills, and mathematical abilities, owing to the broad effects that sleep has on the brain.

See the table for a complete list of sequelae of OSA. Clinicians need to be astute to the daytime symptoms as an opportunity to ask about snoring.

Sleep apnea is more common in children with neurologic disorders.

Children with neurologic disorders are at higher risk of OSA.⁶ Children with hypoxic-ischemic encephalopathy, meningitis, or other CNS insult may have poor pharyngeal tone, thereby increasing susceptibility to OSA.

Children with neuromuscular disorders also have a high risk of OSA due to poor pharyngeal motor movement, but are also at risk of hypoventilation due to respiratory muscle weakness. OSA is a comorbidity of epilepsy, with evidence of improved seizure frequency with treatment of OSA.⁷ Finally, patients with neurogenetic disorders such as Down syndrome, Prader-Willi syndrome, and Beckwith-Wiedemann syndrome are particularly prone to OSA not just from a decrease in muscle tone, but also due to complicating factors such as obesity or macroglossia.⁶ The predisposition to OSA in neurologically impaired children was explored in a study of 16 neurologically impaired children compared to 40 controls. Children with neurologic abnormalities were found to have a significantly higher rate of OSA and lower oxygen saturation nadirs than normal controls. The neurologic disorders included cerebral palsy,

Table Sequelae of sleep-disordered breathing in children

Systemic hypertension
Ventricular hypertrophy
Insulin resistance
Enuresis
Decreased growth hormone secretion
Behavior problems
Headache
Failure to thrive
Poor school performance
Excessive daytime sleepiness
Hyperlipidemia
Attention-deficit/hyperactivity disorder
Poor vigilance
Poor memory
Decreased quality of life
Depression

Children younger than 6 and those with medical conditions or behavioral difficulties will often need one-on-one technician monitoring through the night.

meningomyelocele, severe global delay, Prader-Willi syndrome, tuberous sclerosis, Duchenne muscular dystrophy, Crouzon syndrome, and microcephaly with seizures.⁶ Clinicians should have a high index of suspicion in any child with a neurologic disorder who snores, thereby leading to further evaluation.

Children who snore and have daytime symptoms need nocturnal polysomnography. These studies should include CO₂ and nasal pressure measurements.

Sleep apnea in children is much more subtle than that seen in adults and thus requires more thorough investigation. The American Academy of Pediatrics published guidelines for the diagnosis and management of OSA.⁸ Polysomnography is the gold standard for diagnosis. The guidelines recommend polysomnography or sleep clinic referral if snoring is accompanied by an additional sign/symptom of OSA. These additional signs/symptoms include observed apneas, sleep enuresis, morning headaches, ADHD, learning difficulties, and tonsillar hypertrophy, among other factors. Of note, snoring is a less sensitive screen for OSA in infants or in children with neuromuscular weakness/hypotonia. Nocturnal polysomnography should be performed in a laboratory specialized in assessing children. Children younger than 6 and those with medical conditions or behavioral difficulties will often need one-on-one technician monitoring through the night. A complete pediatric polysomnogram should incorporate EEG channels, electro-oculogram, chin electromyography, arm/leg electromyography, EKG leads, nasal pressure transducer, oronasal temperature transducer, pulse oximetry, chest/abdominal belts, CO₂ measurement (end-tidal or transcutaneous), and video. Nasal pressure transducers are more sensitive to decreases in air flow, and are vital for scoring hypopneas and respiratory effort-related arousals (RERAs). The temperature transducers are more sensitive to cessation of airflow and important for scoring apneas. The ability to accurately determine the type and frequency of respiratory events is especially vital in children, as a handful of events can change the diagnosis and subsequent treatment. Likewise, CO₂ measurements should be a routine part of pediatric studies given the possibility of hypoventilation (defined as greater than 25% of the total sleep time with a CO₂ measurement above 50 mm Hg), even in the absence of an elevated apnea-hypopnea index (AHI).^{9,10} This underscores the wide range of findings in sleep disordered breathing, apart from only frank OSA. Given the frequency of parasomnias amongst children, video with audio recording of the polysomnogram should be available for clinician review. Subtle features such as head position (hyperextension of neck) and airway noise provide significant clues to airway obstruction. Anyone suspected of having nocturnal seizures should have an expanded EEG montage during the study.

Adenotonsillectomy does not always cure OSA, especially in obese children.

The first line of therapy for OSA in most children is surgery. Since the majority of obstructions in pediatric OSA cases are due to adenotonsillar hypertrophy, therapy is directed toward tonsillectomy and adenoidectomy (T&A). Studies show improvement in OSA and clinical sequelae following T&A.¹¹ However, follow-up polysomnography shows residual respiratory events in over 20% of cases.¹² A variety of other factors such as anatomy, allergies, obesity, genetic predisposition, and lymphoid tissue regrowth may contribute to this residual

breathing dysfunction. In a study of 110 children who underwent a PSG before and after T&A, complete normalization of follow-up polysomnogram was seen in only 25% of patients. Obese children were found to have a higher AHI after surgery than nonobese children.¹² Although T&A should be considered in any child with OSA and adenotonsillar hypertrophy, other options should also be explored. This is particularly important in the obese population or those prone to obstruction from regions other than adenotonsillar tissue, such as patients with craniofacial abnormalities or neuromuscular disease. Therapeutic options include positive airway pressure, oral appliances for maxillary expansion, or conservative therapies such as nasal trumpets and positioning.⁸ Each of these therapies has associated risks and benefits but the patient should be restudied to assure improvement in airway patency during sleep.

Pediatric sleep apnea: Five things you might not know

- Daytime symptoms from OSA can be subtle and easily overlooked.
- Sleep apnea is more common in children with neurologic disorders.
- Children who snore and have daytime symptoms need a sleep study that includes CO₂ and nasal pressure measurements.
- Adenotonsillectomy does not always cure OSA, especially in obese children.
- Treatment of OSA has a variety of benefits.

Treatment of OSA has a variety of benefits.

Given the abundance of data linking OSA to medical, behavioral, cognitive, and psychiatric comorbidities, there is great interest in determining the effects of OSA treatment. Various studies support the beneficial effects of treating OSA, with the sequelae often being completely reversible.

In a study of 19 children with OSA who underwent PSG and neurocognitive testing before and after T&A, baseline neurocognitive scores were found to be lower than in age-matched controls. However, following surgery, the PSG normalized compared to controls, as did the neurocognitive scores.¹³ Attention should be paid to early recognition and treatment, as evidence of persistent learning deficits with delayed treatment correlates with worse cognitive outcomes.¹⁴ Similarly, the behavioral and psychological comorbidities of OSA, which may manifest with ADHD-like features, irritability, aggression, or excessive daytime sleepiness, appear to improve with treatment.¹⁵

Apart from neurocognitive and behavior improvements, treatment of OSA is also associated with improvements in quality of life, increased growth, and reversal of cardiovascular sequelae.^{16–18} Given the evidence for widespread dysfunction from OSA and the prominent benefits from treatment, the importance of screening every child for sleep-disordered breathing is evident.

Overall, neurologists should view that sleep apnea in children is an opportunity to improve many neurologic, behavioral, and medical consequences of the disease. Clinicians must be astute to the subtle signs of presentation, ask frequently about snoring, and utilize appropriate diagnostic studies that include nasal pressure and CO₂ measurements. The clinicians also should recognize that therapies for OSA extend beyond simple T&A surgery and verification of improvement is important in patients with moderate and severe disease. With a comprehensive approach toward sleep apnea, many of our patients with clinical sequelae can improve.

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