Clinical Management Review

Pediatric Sleep Apnea Syndrome: An Update

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Obstructive sleep apnea syndrome (OSAS) may be central neurologic (<5%) or obstructive (>95%) in origin and is a relatively prevalent condition in children. It affects 1%-5% of children aged 2-8 years and is caused by a variety of different pathophysiologic abnormalities. Cardiovascular, metabolic, and neurocognitive comorbidities can occur in both children and adults when left untreated. It also can cause severe behavioral problems in children. The American Academy of Pediatrics recommends that all children be screened with an appropriate history and physical examination for symptoms and signs suggestive of OSAS. The diagnosis is primarily made clinically and confirmed by polysomnographic findings. Treatment depends on the child's age, underlying medical problems, polysomnography findings, and whether or not there is upper airway obstruction usually secondary to enlarged adenoids and/or tonsils, allergic and nonallergic rhinitis, acute and chronic sinusitis, and other upper airway pathology. If enlarged adenoid or tonsils or both conditions exist, an adenoidectomy, tonsillectomy, or adenotonsillectomy remains the treatment of choice. Pharmacotherapy of OSAS has shown some effect in children with mild symptoms. This paper reviews the prevalence, pathophysiology, clinical presentation, diagnosis, and treatment of OSAS. © 2016 American Academy of Allergy, Asthma & Immunology (J Allergy Clin Immunol Pract 2016;■:■-■)

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Obstructive sleep apnea syndrome (OSAS) is a sleep disorder that usually results from upper airway obstruction in both children and adults and causes episodes of complete or partial airway obstruction during sleep. It leads to increased respiratory effort, sleep fragmentation, and alterations of gas exchange and is associated with numerous sequelae, primarily involving the cardiovascular, metabolic, and neurocognitive systems. Both central and peripheral factors can be related to OSAS. The former includes central nervous system impairment involving the respiratory control center. Examples of peripheral problems include structural abnormalities of the upper airway; obesity; adenoid and/or tonsil hypertrophy; inflammation of the upper airways; dental abnormalities, in particular, micrognathia; and neuromuscular diseases. Clinical signs and symptoms of OSAS can be both diurnal and nocturnal. Diurnal symptoms include mouth breathing, hyponasal speech, difficulty in awakening, morning headache, excessive daytime sleepiness, and napping. Depression, attention deficit, hyperactivity, aggressive behavior, and impulsivity also occur in children with OSAS often leading to poor school performance. Nocturnal symptoms include snoring, increased effort to breathe, witnessed apnea episodes, restless sleep, diaphoresis, unusual positioning during sleep, frequent awakenings, enuresis, and parasomnias. Polysomnograhy is the gold standard to diagnose the disease. Early recognition and treatment are very important with adenoidectomy and/or tonsillectomy (AT) remaining a first line of treatment for OSAS in most children. Medications including intranasal corticosteroid and oral montelukast may be helpful, in particular, for those subjects with OSAS associated with allergic rhinitis.

CASE

A 5-year-old boy complains of sneezing, itchy nose, nose rubbing, clear rhinorrhea, postnasal drip, nasal stuffiness, and intermittent sore throat for 3 to 4 years. Perennial nasal symptoms are worse in Florida during late January through April. His grandmother, the historian, states that he has been diagnosed with attention deficit hyperactivity disorder. He has insomnia, night sweats, props himself up on several pillows to sleep, and is a chronic mouth breather. He snores so loudly that it can be heard outside his bedroom. The grandmother thinks that he stops breathing periodically during sleep. His nasal symptoms are exacerbated by exposure to cats, dogs, dust, and mowing of the grass. He has no food, drug, or insect allergy. There are no animals, unusual hobbies or occupations practiced, or smoking in the home.

He has no history of nasal polyps, nasal or sinus surgeries, and trauma to the nose or face, and the teeth are in good condition. There is no history of recurrent ear infections, but he has had yellow and green nasal discharge for "months." There is no history of asthma.

The patient has a history of mild atopic eczema with associated pruritus since age 1, primarily in the antecubital and popliteal areas, which induces scratching. He does not scratch much at night.

Past medical, social, and family histories are remarkable for a family history of atopy and "sinus trouble." He has had no other illnesses, surgery, or injuries, and the review of systems is otherwise unremarkable and noncontributory.

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Abbreviations used
AASM- American Academy of Sleep Medicine's
AHI- Apnea-hypopnea index
AT- Adenoidectomy and/or tonsillectomy
CAI- Central apnea index
IGF- Insulin-like growth factor
MCP-1- Monocyte chemoattractant protein-1
OSAS- Obstructive sleep apnea syndrome
PAP- Positive airway pressure
Pcrit- Pharyngeal critical pressure
PSG- Polysomnography

Physical examination revealed a well-developed, well-nourished cooperative male oriented as to time and place who seemed hyperactive. Vital signs were within normal limits. He was a mouth breather. A white-yellow discharge was noted in both nares with edematous turbinates and nasal obstruction. Tonsils were moderately enlarged. The rest of the examination was unremarkable. A diagnosis of allergic rhinoconjunctivitis, mild atopic eczema, sleep apnea, and chronic sinusitis was made.

He underwent prick/puncture skin tests to the major aeroallergens of the Tampa Bay Area, which were markedly positive to tree pollens, consistent with the exacerbation of allergic rhinoconjunctivitis during the spring, and to the major weeds, grasses, cat, and dog.

Sleep apnea symptoms were reconfirmed in a 3-week follow-up. He subsequently underwent a tonsillectomy and adenoidectomy. He returned to the clinic 3 weeks after the surgery essentially asymptomatic. His insomnia, night sweats, and snoring had resolved and his hyperactive behavior improved dramatically. He continued on intranasal fluticasone 50 μg one puff each nostril twice daily. He was asked to remain on a daily basis of the lowest dose of fluticasone that controls his nasal symptoms and return to the clinic in late December or early January, before the oak season in Florida, at which time adjustments would be made in his medications in preparation for the spring season.

EPIDEMIOLOGY

Up to 50% of children may experience a sleep problem.[1,2] However, from that group only 1%-5% will end up been formally diagnosed with OSAS.[3-5] OSAS has a peak incidence around 2-8 years of age, most likely due to the relative size of the adenoids and/or tonsils versus the diameter of the upper airway.[6] Since the first case report of pediatric OSAS in 1976,[7] much has been learned about this disease. First, the prevalence of OSAS in children varies from 1% to 5%[3] and is more common in males than females.[8] Second, Americans of African descent and obese children are both at increased risk for OSAS.[8-10]

PATHOPHYSIOLOGY

The pathophysiology of OSAS is not fully understood; however, factors that effectively decrease airway caliber or increase upper airway collapsibility can predispose to airway collapse that include anatomic, genetic, and neuromuscular factors as well as consciousness alterations during sleep stages and anesthesia (Table I). Systemic or upper airway inflammation, associated with allergic and nonallergic rhinitis and acute and chronic sinusitis, is also a risk factor for airway occlusion. The proper interaction of the neurologic, muscular, and bony structures is very important to maintain airway patency, which follows the Starling resistor model with rigid upstream (nasal passages) and downstream (trachea) segments and a collapsible region between. The pharyngeal region, mostly surrounded by soft tissue, collapses with the high surrounding pressure. Pharyngeal critical pressure (Pcrit) is the term used for the pressure at which point the airway collapses. In children, with adenoid and/or tonsil hypertrophy, associated with OSAS, both the pressure from the nose (upstream) and trachea (downstream) are lower than the Pcrit, which causes partial or complete occlusion of the airway. The pharyngeal patency is maintained by a group of pharyngeal dilators that are modulated by the respiratory control center. During sleep, the central respiratory drive that contributes to the factors that cause dilatation decreases, causing a reduction in pharyngeal size and a concomitant increase in upper airway resistance.[11-13] The pharyngeal dilator activity decreases more during rapid eye movement (REM) sleep in children[14] compared with adults, which correlates with the fact that OSA occurs predominantly during REM sleep in children. This repetitive cycle of upper airway collapse during sleep results in OSA with hypoxia and sleep fragmentation.

TABLE I. Pathogenesis of pediatric OSAS

Anatomic obstruction	Adenotonsillar hypertrophy Craniofacial anomalies Hypertrophy and/or hyperplasia of cervical lymphoid tissue Nasal obstruction
Neuromechanical dysfunction	Peripheral: Congenital or acquired muscle hypertonia and/or hypotonia Central: Decreased central ventilator drive
Obesity	Upper airway fatty infiltrate Increased abdominal visceral fat Decreased functional lung capacity
Genetic and/or environmental factors	Ethnicity Genetic polymorphism Sedative drugs Airway irritants: Cigarette smoking, respiratory virus Family history
Inflammation	Rhinosinusitis Asthma Nasal polyps Increased systemic inflammatory markers

ETIOLOGY AND RISK FACTORS

Upper airway edema and narrowing

The most common anatomic cause of upper airway narrowing in children is adenoid and/or tonsil hypertrophy. The retropalatal area has the smallest cross-sectional area making it the most common site of obstruction. The adenotonsillar tissue is largest between ages 3 and 6, correlating with the peak incidence of OSAS.[15,16] However, the exact correlation between adenotonsillar size and OSAS severity is unclear.[17] Hypertrophy and/or hyperplasia of the lymphoid tissue in the upper airway, allergic or nonallergic rhinitis, and infectious rhinosinusitis are all associated with nasal mucosal edema and are risk factors for OSAS.[18] Histamine, cysteinyl leukotrienes, IL-1β, and IL-4 are all associated with allergic rhinitis. Children with craniofacial anomalies such as midfacial hypoplasia, retro/micrognathia, nasoseptal obstruction, and macroglossia are also at increased risk of