Evaluation of the Child with Sleep-Disordered Breathing Scheduled for Adenotonsillectomy

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KEYWORDS

• Pediatrics • Obstructive sleep apnea syndrome • Oximetry
• Perioperative adverse respiratory events

KEY POINTS

- The primary treatment of pediatric obstructive sleep apnea syndrome (OSAS) is adenotonsillectomy, and the safety of ambulatory adenotonsillectomy programs is predicated on the admission of the child with severe OSAS.
- The challenge is to identify the child with severe OSAS in the preoperative period.
- Preoperative evaluation with a combination of sleep-disordered breathing questionnaires plus an assessment with nocturnal oximetry has several advantages.
- It aligns with the diagnostic approach recommended by sleep physicians.
- It provides a useful prediction of perioperative respiratory adverse events and the medical interventions required to manage them.

INTRODUCTION: THE NATURE OF THE PROBLEM

Sleep-disordered breathing (SDB) is a nonspecific term encompassing a continuum from habitual benign snoring to the obstructive sleep apnea syndrome (OSAS). The prevalence of parent-reported snoring in children is 7.5%,[1] The gold standard to diagnose the severity of SDB is polysomnography (PSG). Recorded during a sleep study, PSG measures indices of apnea (defined as >90% reduction in tidal volume), hypopnea (defined as >50% reduction in tidal volume), hypoxia (defined as a saturation <92%), and hypoventilation.[2] The apnea-hypopnea index (AHI) and respiratory disturbance index (RDI) are measures of both central and obstructive apnea and hypopnea. Both are expressed as the number of events per hour of sleep. The nadir saturation ($nSaO_2$) and cumulative times below saturation thresholds provide an assessment of hypoxia. Hypoventilation is assessed by the cumulative times above a threshold carbon dioxide (CO_2) level.[2,3] An elevated bicarbonate level on a blood gas drawn on awakening is also consistent with a diagnosis of OSAS.[4] The prevalence of test-positive OSAS is 1% to 4%.[2,5] Pediatric OSAS is therefore as prevalent as childhood asthma.

PATIENT HISTORY

Diagnostic Features of Sleep-Disordered Breathing in Children

A consensus statement for diagnostic criteria in pediatric OSAS has yet to be achieved. However, PSG findings in OSAS are often an AHI greater than 2 and $nSaO_2$ less than 92%. Dayyat and colleagues[2] proposed a classification of OSAS severity based on PSG measures of obstructive airway events, sleep disruption, hypoxia, and

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Sleep Med Clin 8 (2013) 149–155
http://dx.doi.org/10.1016/j.jsmc.2012.11.010

hypoventilation (**Table 1**). SDB also includes habitual snoring, the upper airway resistance syndrome, and obstructive alveolar hypoventilation. The PSG findings in these entities are an AHI less than 2 and nadir SaO_2 greater than 92%. Obstructive alveolar hypoventilation is also accompanied by hypercarbia. As SDB has been linked to neurocognitive dysfunction, poor school performance, and metabolic derangements including childhood obesity and cardiovascular sequelae, and as therapeutic options vary, all nuances of SDB are of interest to sleep physicians.[1,2] The primary treatment of SDB is adenotonsillectomy (T&A), and it has long been recognized that a diagnosis of OSAS increases the risk for perioperative respiratory adverse events (PRAEs). Herein the agendas of sleep physicians and anesthesiologists diverge. Whereas sleep physicians consider an AHI score greater than 10 diagnostic of severe pediatric OSAS,[2] the American Academy of Pediatrics recommends a higher threshold (AHI >24) to exclude children with OSAS from ambulatory T&A programs.[6] The goal of anesthesiologists is to identify the child at risk for PRAEs and to implement risk-reduction strategies.

In the 1980s, ambulatory programs for T&A were developed in North America. From the onset the OSAS was an exclusion criterion for day surgery.[7] However, 3 decades ago SDB was the indication for T&A in only 20% of the caseload.[8] The diagnosis of OSAS was based on parent questioning, and admission of children with obstructive breathing symptoms was not a burden. In 2005, obstructive breathing represented 75% to 80% of the annual caseload of T&As.[8] Admission of all children with positive symptoms for SDB threatens to overburden North American health care systems.

Evaluation of the Child with SDB

In 1976 Guilleminault and colleagues[9] reported 8 snoring children with PSG evidence of severe OSAS and symptoms of daytime somnolence, morning headaches, poor school performance, behavioral disturbances, and new-onset enuresis. Over the subsequent 3 decades dozens of SDB questionnaires (SBD-Q) have been developed with the aim of diagnosing pediatric OSAS from clinical criteria alone. Loud snoring, parental reports of cyanosis and apnea during sleep, an impression that their child is struggling to breathe, and fearfulness while watching their child sleep are key questions.

The pitfalls of a diagnosis based on clinical criteria alone are well published. Many SBD-Qs are able to distinguish normal children from snoring children. Chervin and colleagues[10] compared results from PSG with responses from a 22-item SDB-Q, the Sleep-Related Breathing Disorder (SRBD), and reported correct classification of 85%. However, when applied to a population of snoring children, SDB-Qs are of limited value. Carroll and colleagues[11] compared the historical features in children with primary snoring (AHI <1) and OSAS (AHI $\geq$1). In the primary snoring group 83% of parents reported extremely loud snoring, 96% reported snoring most nights, and 50% were fearful of their child's breathing pattern during sleep. In the OSAS children, parents reported positive responses respectively 91%, 97%, and 90% of the time. Brietzke and colleagues[12] calculated the combined positive predictive value for OSAS from 10 different SDB-Qs. Overall, SDB-Qs agreed with PSG only 55% of the time, and clinical criteria tended to overdiagnose OSAS. Constantin and colleagues[13] reported that OSAS-18, an 18-item SDB-Q, missed 60% of children with OSAS severe enough to cause repetitive oxygen desaturation during sleep. Despite these limitations, the use of clinical criteria was endorsed by the American Society of Anesthesiologists.[3] In a preoperative assessment of more than 2000 children, parents reported snoring in 940 (46%).[14] The ratios between habitual snoring and

Table 1
Classification of OSAS severity proposed by Dayyat and colleagues

	Obstructive Breathing	Sleep Disruption	Hypoxia	Hypoventilation
OSAS Severity	OAHI (#/h)	RAI (#/h)	$nSaO_2$ (%)	T_{EtCO2} >50 mm Hg (%TST)
Mild	2–5	2–5	88–92	10–15
Moderate	5–10	5–8	80–88	15–20
Severe	>10	>8	<80	>20

Abbreviations: EtCO2, end-tidal CO_2; $nSaO_2$, nadir saturation; OAHI, obstructive apnea-hypopnea index; RAI, respiratory arousal index; TST, total sleep time.

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