

Snoring

Snoring results from the pharyngeal airway collapsing during inspiration. Snoring can disrupt sleep, cause a variety of important but nonspecific symptoms, and suggest the presence of the obstructive sleep apnea syndrome, which can lead to cor pulmonale and sudden death. Therefore, the review of systems for a child at any age should include questions regarding snoring and breathing during sleep. Most normal children snore at one time or another, and many, particularly those who have nasal allergies, snore almost nightly.

Physiologic Sources of the Problem

Snoring and obstructive sleep apnea do not represent structural upper airway narrowing alone, but rather an imbalance between the degree of airway narrowing and the ability of the respiratory centers in the brainstem to use the muscles of the pharynx and tongue to maintain airway patency. For each child who has tonsillar hypertrophy and who snores, there are many who have larger tonsils who do not snore because they use their pharyngeal muscles to keep the airway open during sleep. Conversely, children who have little or no structural airway narrowing may have severe obstructive sleep apnea solely because of a dramatic loss of pharyngeal muscle tone during sleep. In this light, it is not surprising that many children who have obstructive sleep apnea (the absence of airflow despite inspiratory efforts) also have central apneas (respiratory pauses of >15 seconds without airway obstruction) as another manifestation of respiratory center dysfunction, and that snoring and obstructive sleep apnea are particularly common in children who have underlying neurologic problems or hypotonia (eg, trisomy 21). Obstructive sleep apnea is overlooked easily in children who have neurologic deficits because they often have noisy breathing at baseline and other reasons to explain the nonspecific symptoms of sleep disruption.

Pathologic Progression

In most children who snore, increased respiratory effort successfully

compensates for airway narrowing, and both gas exchange and sleep are unaffected. With more severe obstruction, compensation is compromised by increased inspiratory effort tending to collapse the pharynx further and to exacerbate the obstruction. The earliest pathologic consequence of increasing obstruction is disruption of the normal structure and organization of sleep. For reasons that are poorly understood, disordered sleep (even in the absence of apnea or hypoxemia) can cause growth failure, daytime hypersomnolence, enuresis, systemic hypertension, headaches, school failure, and a host of other nonspecific symptoms. As obstruction becomes extreme, completely obstructed breaths and repetitive episodes of hypoxemia, with or without central apneas, result in cor pulmonale. Although obstructive sleep apnea does not seem to be a cause of the sudden infant death syndrome, infants and children who have severe obstructive sleep apnea are at a much increased risk of sudden death during sleep, particularly when airway patency is compromised by an upper respiratory infection. Pediatricians should identify patients who have pathologic snoring before severe obstructive sleep apnea has developed.

Ascertaining the Need for Further Evaluation

Snoring that is regular, is not interrupted by totally obstructed breaths or central apneas, is not associated with dramatic intercostal or substernal retractions, and that does not lead the child to assume unusual postures during sleep or to sweat profusely is unlikely to be pathologic. In the absence of potentially related signs or symptoms (eg, growth failure, enuresis, school failure), further evaluation of such children rarely is indicated. If parental concerns or uncertainty about the extent of snoring persist, the easiest next step is to ask the parents to record several minutes of the child's "worst" snoring on audio or, preferably, audio/video tape.

Review of a video tape or direct observation of a sleeping child is worth a thousand words. Age is not a critical factor in the diagnosis of pathologic snoring, but it is important to remember that young children who snore are likely to develop increasing obstruction as lymphoid tissue hypertrophies.

If respiratory compromise is not obvious from direct observation, but snoring is severe or the child has a nonspecific symptom that could be related to this problem, the next step is to evaluate oxygenation during sleep. This

can be done easily and reliably on most pediatric units by correlating transcutaneous oximetry and direct observation. If done at home, a video recording, which includes the oximeter reading and the child simultaneously, helps to confirm that desaturations are related to disordered breathing rather than being technical artifacts. Recurrent episodes of desaturation (SaO₂ <90%) during sleep is an indication for tonsillectomy, adenoidectomy, or another procedure. Evidence of right ventricular hypertrophy on electrocardiogram or echocardiogram, polycythemia, and elevated bicarbonate suggest hypoxemia or hypoventilation and also are indications for surgery. However, these are late signs and may be absent even in children who have severe problems.

Polysomnography

A difficult diagnostic problem is posed by children who do not have completely obstructed breaths, obvious sleep disorganization, or recurrent hypoxemia but who snore chronically or recurrently and have one or more nonspecific symptoms (enuresis, school failure, etc) that might be related to disordered sleep. Polysomnography (recordings of oximetry, respiratory airflow, snoring, respiratory effort, electrocardiogram, electroencephalogram, end-tidal CO₂, or other parameters during sleep) can help identify which children deserve surgery or further evaluation. A tracing of respiratory effort and heart rate (pneumogram) is not helpful because completely obstructed breaths can be missed unless a parameter sensitive to airflow is recorded simultaneously. Many tertiary care centers have sleep laboratories and consultants familiar with the evaluation of sleep and respiratory disorders who can help the pediatrician decide which children might benefit from such "high-tech" assessments. Consultants also may identify children who would benefit from nasal constant positive airway pressure during sleep rather than surgery and can help manage children in whom surgery has not helped resolve symptoms.

Treatment for Pathologic Snoring

Although respiratory stimulants and tricyclic antidepressants have been

used to treat obstructive sleep apnea, it rarely is possible to improve pharyngeal muscle tone and function significantly with drug therapy. Therefore, symptomatic snoring and obstructive sleep apnea usually are managed by enlarging the airway (tonsillectomy or adenoidectomy, pharyngoplasty, nasal reconstruction, or other procedures), bypassing the airway (tracheostomy), or supporting the airway during inspiration (nasal constant positive airway pressure). Although the pharyngeal airway may be narrowed by adipose tissue in the neck and pharynx (obesity, obstructive sleep apnea, and cor pulmonale comprise the Pickwickian syndrome), hypertrophy of the tonsils and adenoids is by far the most common cause of airway narrowing, snoring, and obstructive sleep apnea in children. Tonsillectomy or adenoidectomy often eliminates or ameliorates this problem, even in children whose tonsils and adenoids are not massively enlarged, and may be a reasonable first step in children who have other reasons for airway narrowing. This is particularly true when correction of the underlying abnormality (obesity, micrognathia, macroglossia, or other maxillofacial abnormalities) is difficult or must be delayed. Nevertheless, tonsillectomy or adenoidectomy is not indicated for the vast majority of snoring children, and just because this procedure may decrease snoring does not justify its widespread use in children who are otherwise normal.

Obstructive Sleep Apnea

The hallmark of obstructive sleep apnea is completely obstructed breaths in which the pharynx collapses completely and air flow (and snoring) cease despite continued inspiratory efforts. Flow then is reestablished with a loud snorting breath. Most parents of children who have obstructive sleep apnea can describe this distinctive respiratory pattern. Full-blown obstructive sleep apnea, with its characteristic snoring, hypoxemia, daytime hypersomnolence, and cor pulmonale, usually is recognized easily by history, video tape, or direct observation.

In such cases, it is worthwhile to obtain a baseline electrocardiogram or echocardiogram and a measurement of the serum bicarbonate level to assess hypoxemia and hypoventilation. When the diagnosis is straightforward, early surgery with careful anesthesia and postoperative monitoring is appropriate, and further evaluation is unnecessary. Administering oxygen to correct hypoxemia during sleep in such children carries the risk of acute hypoventilation. The aim of

therapy should be to establish and maintain a patent airway during sleep as soon as possible. Tonsillectomy, adenoidectomy, or other procedure to enlarge the airway also is justified when a tape or direct observation confirms frequent, completely obstructed breaths or grossly disturbed or irregular breathing during much of the night.

Many affected children assume unusual postures during sleep to help maintain airway patency. After surgery, it is appropriate to document by history or repeat studies that the problem has been resolved.