An approach to the upper airway evaluation in pediatric persistent obstructive sleep apnea

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ABSTRACT
In pediatrics, obstructive sleep apnea syndrome (OSAS) is a disorder associated with multiple consequences at the cognitive and behavioral level. The main associated risk factor is the presence of tonsillar hypertrophy and adenoids. An adenotonsillectomy is the first-line treatment.

The incidence of persistent OSAS varies from 15% to 75%, depending on comorbidities. This is a challenge in terms of management; it requires a comprehensive approach for an adequate diagnosis and treatment.

The objective of this bibliographic review is to propose a diagnostic and therapeutic approach for persistent OSAS.

Keywords: obstructive sleep apnea; pediatrics; tonsillectomy; endoscopy.
INTRODUCTION

OSAS is a syndrome that affects between 2% and 4% of the pediatric population in the United States. Its clinical manifestations are characterized by restless sleep, mouth breathing, snoring, and breathing pauses during sleep. These lead to the development of hyperactivity, inattention, alterations in academic performance, bedwetting, among other multiple manifestations.

The main risk factor is the presence of tonsillar hypertrophy and adenoids. Other risk factors include obesity, asthma, neuromuscular diseases, such as myotonic dystrophy, and some genetic syndromes, such as Down syndrome, among others.

The diagnosis of OSAS is based on clinical manifestations and is supported by an objective sleep study. The most common studies are the polysomnography (PSG) and the respiratory polygraphy (RP). The PSG includes the following: electroencephalogram, chin and leg electromyography, electro-oculography, electrocardiogram, pulse oximeter, respiratory effort recording with thoracic and abdominal belts, nasal flow recording with cannula and thermistor, snoring sensor, capnography, and body position. The RP only uses nasal flow, respiratory effort, and pulse oximeter sensors.

These studies are used to obtain an obstructive apnea-hypopnea index per hour (OAHI/h). Based on this index, the following commonly used classification is obtained for individuals aged 2 to 18 years:

- Normal: 0–1
- Mild: 1-5
- Moderate: 5-10
- Severe: greater than 10

The PSG and RP have a strong correlate in OAHI/h values. The RP tends to underestimate the rate of hypopneas, although such discrepancy does not affect therapeutic decisions at the extremes of the range (normal or severe), but may impact mild or moderate conditions. However, it is recognized that the RP is more cost-effective and less time-consuming to analyze. It is important to note that the RP has not yet been validated for children under 2 years of age or for patients with comorbidities.

Persistent OSAS is that which occurs after an adenotonsillectomy. Its incidence varies from 21% to 75%. A variety of risk factors, such as age (younger than 36 years or older than 7 years), obesity, severe OSAS, comorbidities (asthma, Down syndrome, craniofacial malformations) and genetic syndromes, such as Down syndrome, among others, have been associated with persistent OSAS. Pediatric sleep specialists may indicate different therapeutic alternatives due to its multifactorial etiology. Treatment options range from soft tissue surgeries, musculoskeletal surgeries, obesity management, positive pressure ventilation to dental treatments or myofunctional therapy.

An early identification and a multidisciplinary approach to residual OSAS is critical to prevent complications and define treatment and long-term follow-up.

MANAGEMENT

The diagnosis of persistent OSAS is based on clinical assessment and an objective sleep study. A clinical assessment should be performed at each post-operative control. Controls should be done from 6 weeks up to 1 year after the adenotonsillectomy and then continue annually.

History taking should be targeted at the persistence of signs and symptoms, such as restless sleep, snoring, apnea, mouth breathing, as well as at the patient’s daily life performance. The Pediatric Sleep Questionnaire (PSQ) is the only test that has been validated in Spanish to query about sleep-disordered breathing in pediatrics. The PSQ scores 0 to 1. The presence of symptoms and a PSQ score greater than 0.33 indicates the possibility of persistent obstructive events.

The objective sleep study will be requested not only in those patients with clinical suspicion, but also in those with risk factors for persistent OSAS: severe pre-operative OSAS, neuromuscular disorders, syndromic patients, obesity. The study should be performed 6 months after the surgery, since, if performed early, obstructive events may be under-reported.

A value of OAHI/h greater than 1 6 months after surgery is suggestive of a persistent OSAS diagnosis. The result of the objective sleep study should be correlated with the patient’s clinical condition.

A topographic diagnosis involves defining the site of obstruction in patients with residual OSAS. This helps to establish the site to treat when soft tissue surgery is desired. Some potential findings include turbinate hypertrophy, adenoid regrowth, collapse of soft palate, lateral collapse of oropharynx, tongue base collapse, lingual tonsil hypertrophy, and epiglottis collapse. Different study methods may and should be carried out in order to locate the site of obstruction.
Physical examination
Both an anterior rhinoscopy and a throat examination are simple assessments that should be performed in the office. Turbinate hypertrophy, septal deviation, and tonsillar remnants may be some possible findings.

Awake flexible laryngoscopy
This study may be performed in the office and allows visualization from the nostrils to the subglottis. It also allows visualization of adenoid growth and some alterations at the base of the tongue or epiglottis. A limitation of this study is that it is not widely tolerated by pediatric patients and that it may not replicate the dynamics of airway collapse during sleep.

Awake imaging studies
A lateral neck x-ray is a simple and inexpensive study that checks for the presence of enlarged adenoids and lingual tonsil hypertrophy. Its limitations are the difficulty in distinguishing soft tissues and the impossibility of a correct tissue measurement due to the interposition. Given its wide availability and low cost, it is a common study in our setting.

A computed tomography scan of the facial bones is another useful study, especially when nasal obstruction or skeletal alteration is suspected.

Drug-induced sleep endoscopy (DISE)
A DISE includes flexible fiberoptic visualization of the upper airway while the patient is spontaneously ventilating and sedated. Either dexmedetomidine or propofol can be used. Dexmedetomidine maintains ventilation and tone even at high doses, but the induction process is slow. Propofol is faster, but has a potential dose-dependent collapse effect. The DISE helps in the topographic diagnosis and to guide an eventual surgery in the site of collapse.

Cine magnetic resonance imaging
This technique is used for topographic diagnosis and allows a dynamic assessment of the airway with high resolution images during drug-induced sleep. It is difficult to access in Argentina due to the logistical limitations involved in the coordination between the imaging and anesthesiology teams.

Socarras et al. observed that both a surgery planned with DISE and a surgery planned with cine MRI generated statistically significant improvements in OAHI/h values and minimum oxygen saturation with similar results.

DIAGNOSTIC ALGORITHM
It is necessary to make a distinction in the follow-up of patients with and without risk factors for persistent OSAS.

Patients without risk factors
The suggestion is to provide clinical follow-up from 6 weeks to 1 year after the surgery, and then annually (Figure 1). In case of clinical suspicion, it is important to conduct an adequate history-taking aimed at symptoms and to administer the PSQ. If symptoms are present, an objective sleep assessment will be requested, either a PSG or an RP. In the case of mild symptoms, it is suggested to assess their clinical impact on the patient and, if this is significant, to continue with the treatment or topographic diagnosis. Otherwise, surgery and medical treatment (intranasal corticosteroids, montelukast) may be expected.

In cases of moderate or severe symptoms, the recommendation is to continue with the topographic diagnosis algorithm.

Patients with risk factors
For patients with risk factors for persistent OSAS, an objective sleep study is suggested 6 months after the surgery, regardless of their clinical condition. Subsequent management is the same as in patients without risk factors.

TOPOGRAPHIC DIAGNOSIS
Topographic diagnosis (Figure 2) should begin with a physical examination and a multidisciplinary assessment. If the patient has obvious nasal obstruction, a CT scan of the facial bones may be requested. These patients may eventually require nasal surgery.

If there are no findings in the physical examination, a DISE may be done to guide a soft tissue surgery. Potential sites of obstruction are detailed in Figure 2, together with potential surgical treatments. Both surgery, if there are modifiable sites of obstruction, and continuous positive airway pressure (CPAP) are reasonable options for persistent OSAS. The latter is a device that provides positive pressure to the airway, reducing obstructive events. The American Academy of Pediatrics recommends it as one of the most effective treatments for persistent OSAS.
CONCLUSION

It is worth noting that the approach to persistent OSAS in children requires a multidisciplinary collaboration that adjusts a therapeutic model to each patient individually. The proposed approach is the implementation of an algorithm attempting to simplify the complexity of the patient with persistent OSAS, also understanding that there is no single treatment option. Teamwork among the different specialty areas is critical for a satisfactory outcome.

REFERENCES

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Figure 2. Topographic diagnosis algorithm for persistent obstructive sleep apnea syndrome and potential management

Persistent OSAS

Management with CPAP

TOPOGRAPHIC DIAGNOSIS

Physical examination

Obvious site of obstruction

CT scan of the facial bones

No obvious site of obstruction

DISE

Adenoid regrowth

Collapse of soft palate

Adenoidectomy

Pharyngoplasty

Pharyngoplasty

Midline posterior glossectomy

Glossopexy

Partial epiglottectomy

Glossoepiglottopexy

Lateral collapse of oropharynx

Collapse of tongue base

Collapse of epiglottis

OSAS: obstructive sleep apnea syndrome; CPAP: continuous positive airway pressure; DISE: drug-induced sleep endoscopy.