Controversies in Obstructive Sleep Apnea Surgery

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KEYWORDS

• Obstructive sleep apnea • Upper airway obstruction • Continuous positive airway pressure
• Polysomnography • Maxillomandibular advancement (MMA) • Surgical management/treatment

KEY POINTS

- Obstructive sleep apnea (OSA) is a common chronic disease characterized by repetitive pharyngeal collapse during sleep.
- Untreated OSA results in sleep fragmentation, which leads to excessive daytime somnolence. Untreated OSA is associated with decreased quality of life, increased risk of cardiovascular disease and all-cause mortality, and impaired cognitive function.
- Continuous positive airway pressure (CPAP) is first line therapy for OSA, but is not always tolerated. Alternative treatments are reviewed.
- Dynamic assessment of the airway in the OSA patient allows targeted intervention and plays a crucial role in surgical planning.
- Maxillomandibular advancement (MMA) is the most successful surgical intervention for OSA aside from tracheostomy; outcomes have been equated to those with CPAP.
- Multiple controversies and unresolved questions surrounding OSA remain and are explored in this article.

Obstructive sleep apnea (OSA) is a common chronic disease characterized by repetitive pharyngeal collapse during sleep. The estimated prevalence of OSA in middle-aged adults is between 20% and 25%,[1,2] and the overall prevalence of moderate to severe OSA is estimated to be 6.7% to 10.0%.[2,3]

Untreated OSA results in sleep fragmentation, which decreases time in deep sleep and leads to excessive daytime somnolence. Hypoxia and hypercarbia occur, and sympathetic activation increases.[4–6] Decreased vigilance, motor coordination, and executive functioning may result.[7] Depression[8] and decreased quality of life[9] may be seen. Untreated OSA has also been linked to hypertension,[1,10–12] arrhythmias,[10,12] congestive heart failure,[12] and increased risk of cardiovascular events,[13] as well as type 2 diabetes mellitus.[14,15] Stroke and all-cause mortality are associated with untreated OSA; risk seems to increase with OSA severity.[16] Because of the significant impact of untreated moderate to severe OSA, there is no question that treatment is indicated.

DIAGNOSIS

OSA is diagnosed based on polysomnography (PSG). This multimodal analysis reports several

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metrics, among which are the apnea hypopnea index (AHI), respiratory disturbance index (RDI), nadir oxygen saturation, and percentage of time spent with oxygen saturation below specified thresholds. Severity of OSA is based on the AHI or RDI (mild OSA: 5–15 events per hour, moderate OSA: >15–30 events per hour, severe OSA: >30 events per hour), although other metrics must be considered during patient assessment. Per the American Association of Sleep Medicine, streamlined, more convenient and cost-effective home studies may be used in patients with a high pretest probability of moderate to severe OSA without certain comorbidities.[17] Additional components of the diagnostic evaluation are discussed later in this article.

NONOPERATIVE TREATMENT OF OBSTRUCTIVE SLEEP APNEA

Continuous positive airway pressure (CPAP) is the first-line treatment for OSA; it works by splinting the upper airway open to improve patency during sleep. When used appropriately and regularly, CPAP is highly effective for most patients. CPAP virtually eliminates OSA[18] and improves quality of life and sleepiness.[5,19,20] Unfortunately, nonadherence rates (with adherence defined as CPAP use for 4 or more hours nightly) of 46% to 83% have been reported.[21] Multiple mask designs and alternative positive airway pressure (PAP) delivery modes (eg auto-PAP) are available, and should be explored to help improve adherence. Intranasal steroids and nasal surgery may also improve PAP tolerance. The surgical provider should help encourage PAP use if possible. Nonetheless, treatment alternatives are necessary for patients who refuse or cannot tolerate CPAP.

Oral appliances (OAs) improve the upper airway by modifying the position of the tongue and associated upper airway structures. Custom, titratable, tooth-borne appliances designed to advance the mandible are the preferred OA.[22] OAs reduce AHI and improve nadir SpO2, although to a lesser degree than CPAP.[22] They improve sleepiness, control of hypertension, and quality of life.[22] Adherence to OAs appears to be similar to or slightly higher than adherence to CPAP.[23] OAs tend to work better for nonobese patients with skeletofacial deformities,[24] and patients must have reasonable protrusive range of motion to derive benefit from OAs. Monitoring for dental and skeletal changes is requisite.[22,25]

Additional nonoperative management strategies include positional aids if AHI is worse in the supine position,[5] sleep hygiene (including avoidance of alcohol, caffeine, and screen time before bed),[5] and weight loss. A 10% weight loss has been linked to a 26% reduction in AHI[26]; however, OSA can recur even in the absence of weight gain, so follow-up is crucial.[27] Bariatric surgery may be used to help facilitate weight loss, and has also been linked to a decrease in AHI.[28]

Sleepiness that is unresponsive to OSA therapy may be managed by modafinil as long as other causes of daytime somnolence have been ruled out.[5]

SURGICAL TREATMENT OF OBSTRUCTIVE SLEEP APNEA

Many surgical approaches to adult OSA have been described. The more common are briefly reviewed.

Tracheostomy bypasses the upper airway and is thus nearly universally successful in managing OSA. However, the significant morbidity associated with tracheostomy limits its application in the OSA population.[29]

Bariatric surgery, as mentioned previously, is a surgical option in patients with morbid obesity.

Tonsillectomy with adenoidectomy is the first-line surgical therapy for children with OSA without craniofacial anomalies.

Nasal surgery may play a role in OSA management by improving nasal airflow. Particularly for those with moderate to severe sleep apnea, isolated nasal surgery is unlikely to lead to resolution of OSA. However, it may increase CPAP use in some patients.[30]

Multiple palatal procedures have been described; the most common is uvulopalatopharyngoplasty (UPPP), which involves removal of the tonsils, uvula, and posterior velum. Multiple variations of UPPP have been described. One meta-analysis reported a mean reduction in AHI of 33% to a mean postoperative AHI of 29.8[31]; however, UPPP does not reliably result in AHI normalization and is thus not recommended by the American Academy of Sleep Medicine (AASM) as a sole procedure for treating moderate to severe OSA.[32] A recent meta-analysis evaluated predictors for successful UPPP and found that only Friedman stage I (large tonsils and relatively normal palatal position) predicted surgical success; Friedman stage III and low hyoid position were negative predictors.[33]

Myriad tongue base procedures, robotic or conventional, have been described and may involve partial glossectomy or various ablative techniques to volumetrically reduce the tongue. Reported surgical success varies from 20% to 83%.[34]

Genioglossal advancement (GA) involves advancement of the genial tubercles, and may be accompanied by hyoid suspension. In