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ANESTHESIA RECOMMENDATIONS FOR THE SURGICAL MANAGEMENT OF OBSTRUCTIVE SLEEP APNEA SYNDROME: A NARRATIVE REVIEW

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Abstract

Background: *Obstructive sleep apnea syndrome is a prevalent disorder. Characterized by recurrent upper airway collapse during sleep. Pathophysiologically, the condition results from an imbalance between pharyngeal dilator and occlusive forces, leading to intermittent hypoxia, hypercapnia, and sympathetic activation. Major risk factors include obesity, male sex, advanced age, and anatomical abnormalities such. Clinically, obstructive sleep apnea manifests with loud snoring, witnessed apneas, and excessive daytime sleepiness, and is associated with cardiovascular, metabolic, and neurocognitive sequelae. Continuous positive airway pressure remains the gold standard treatment. Surgical intervention is indicated for patients with a comprehensive preoperative assessment. Key selection criteria include identifiable anatomical obstruction, favorable Friedman staging, low body mass index, and moderate Apnea-Hypopnea Index (AHI). Drug-induced sleep endoscopy (DISE) may allow dynamic airway evaluation to guide personalized surgical planning, utilizing agents such as propofol, dexmedetomidine, or midazolam under controlled sedation.*

Methodology: *A narrative review of the literature in English language is presented, addressing the most common issues on the anesthesia for sleep apnea patients.*

Results: *The literature shows that anesthesia in the surgical management of patients with sleep apnea should be individualized according to the characteristics of each patient and the comorbidities associated with the underlying condition.*
Conclusions: Anesthetic management demands a multidisciplinary, preventive approach. Preoperatively, systematic screening and optimization of comorbidities are essential. Regional anesthesia is preferred and airway management should employ ramped positioning, maximal preoxygenation, and immediate access to rescue devices. Short-acting anesthetics (e.g., propofol,

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remifentanil) and complete neuromuscular reversal with sugammadex are recommended. Postoperatively, continuous capnography and pulse oximetry, opioid-sparing multimodal analgesia, semi-recumbent positioning, and early CPAP resumption are critical. Successful outcomes depend on presumptive diagnosis in at-risk patients, minimization of respiratory depression, and vigilant monitoring during the initial 24 postoperative hours.

Keywords: *Obstructive Sleep Apnea, Surgical management, Anesthesia.*

INTRODUCTION

Obstructive sleep apnea syndrome (OSAS) is the most common sleep-related breathing disorder and one of the leading causes of perioperative morbidity and mortality. It is defined as a disorder characterized by partial or complete obstruction of the upper airway during sleep, resulting in recurrent episodes of interrupted breathing. The key components required to understand this condition include:(1,2)

1. Definition and Technical Criteria

An apnea is defined as the cessation of oronasal airflow for at least 10 seconds. A hypopnea is a significant reduction in airflow (generally between 30% and 50%) lasting at least 10 seconds and accompanied by either oxygen desaturation or an arousal. In obstructive sleep apnea, the patient maintains and may even increase thoracic and abdominal muscular effort in an attempt to overcome the mechanical obstruction within the pharynx.(3,4,5)

The gold standard for the diagnosis of OSAS is polysomnography (PSG). The diagnosis is confirmed when the Apnea-Hypopnea Index (AHI) is 5 or more events per hour associated with clinical symptoms, or 15 or more events regardless of symptoms.(6,7)

The severity of apnea is determined according to the number of respiratory events per hour of sleep (AHI):(6,8)

- Mild: AHI between 5 and 14.9.
- Moderate: AHI between 15 and 29.9.
- Severe: AHI of 30 or more.

2. Pathophysiology and Mechanism

OSAS occurs due to an imbalance between the forces that dilate the pharynx and those that occlude it. During sleep, there is a physiological relaxation of the pharyngeal dilator muscles (particularly the genioglossus muscle); in individuals with OSAS, this relaxation allows the soft tissues (tongue, palate, uvula) to collapse, obstructing airflow. This collapse generates intermittent hypoxia, hypercapnia (increased CO2), and activation of the sympathetic nervous system as the body attempts to restore breathing through micro-arousals.(9,10)

There are clearly established risk factors associated with obstructive sleep apnea. Among the most common are:(11,12)

- Obesity: It is the most significant risk factor; fat deposition in the neck reduces upper airway caliber.
- Demographic Variables: It is more common in men (2:1 or 3:1 ratio compared with women), in individuals older than 50 years, and in postmenopausal women.
- Anatomy: Large neck circumference (>40–43 cm), retrognathia (posteriorly positioned mandible), macroglossia (large tongue), or tonsillar hypertrophy.
- Underdiagnosis: It is estimated to affect one billion people worldwide, yet more than 80% of patients remain undiagnosed at the time they undergo surgery.(13)

3. Clinical Manifestations and Consequences

Cardinal symptoms include loud snoring, witnessed apneas by the bed partner, nocturnal gasping or choking sensations, and excessive daytime sleepiness. If left untreated, OSAS is associated with serious health risks:(14,15)

- Cardiovascular: Hypertension (particularly resistant hypertension), arrhythmias (such as atrial fibrillation), heart failure, and myocardial infarction.
- Metabolic: Type 2 diabetes mellitus and metabolic syndrome.
- Others: Cognitive impairment, depression, and a significantly increased risk of motor vehicle accidents due to fatigue.(16)

Gold Standard Treatment for Obstructive Sleep Apnea

Continuous positive airway pressure (CPAP) is considered the gold standard treatment for obstructive sleep apnea (OSA). This system functions as an internal pneumatic splint that maintains upper airway patency through the delivery of constant positive airway pressure, thereby preventing tissue collapse during sleep and allowing normal respiration.(6,17)

- Efficacy: It is the first-line treatment, particularly for moderate-to-severe OSA, due to its high effectiveness in eliminating apnea and hypopnea events, improving oxygenation, reducing daytime sleepiness, and decreasing associated cardiovascular risks.
- Adherence Challenge: Despite being the most effective treatment, patient compliance remains a significant issue. Adherence rates are estimated at approximately 50%, mainly due to factors such as mask discomfort, nasal dryness, claustrophobia, or congestion.(18)
- Titration: The process consists of identifying the minimum pressure required to prevent pharyngeal collapse, which may be performed manually in a sleep laboratory or through automatic devices (APAP) at home.
- Alternatives in Cases of Failure: In patients who do not tolerate CPAP or refuse its use, alternative therapeutic options are considered, including mandibular advancement devices (MADs), upper airway surgery (such as uvulopalatopharyngoplasty or maxillomandibular advancement), hypoglossal nerve stimulation, and behavioral modifications such as weight loss and positional therapy.

Role of Surgical Management in OSAS and Criteria for Patient Selection

Surgery plays a fundamental and evolving role in the management

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of OSAS as an alternative for, among others, patients who do not tolerate or refuse CPAP therapy, whose adherence rates are approximately 50–60%. However, intolerance to CPAP should not be considered an absolute indication for surgery. Appropriate patient selection is essential to improve the likelihood of postoperative success, and upper airway anatomy, neck circumference, and the presence of obesity are undoubtedly factors that must be considered.(4,6,9)

Surgical intervention does not have a single role but rather adapts to the specific objectives of each patient. The goal is to eliminate or minimize the neurocognitive and pathophysiological alterations associated with OSA when medical treatment fails. The ideal objective is to achieve outcomes equivalent to CPAP therapy (normalization of the AHI and elimination of hypoxemia).

Many surgical procedures (particularly nasal surgeries) do not cure apnea by themselves, but they improve CPAP adherence by reducing nasal resistance and allowing the use of lower pressure settings. On the other hand, in patients with a low AHI, clearly identified sites of obstruction in the upper airway, and no significant comorbidities, surgery may be successful in resolving socially unacceptable snoring. Unlike adults, adenotonsillectomy is the first-line treatment in the pediatric population and is often curative, although in recent years emphasis has also been placed on complementary management through myofunctional therapy or maxillary expanders.

Surgical techniques are generally divided into soft tissue surgery, such as uvulopalatopharyngoplasty, different types of pharyngoplasty, and tongue base reduction, and maxillofacial skeletal surgery, such as maxillomandibular advancement.

METHOD AND MATERIALS

A narrative review of the literature in English language is presented, addressing the most common issues on the anesthesia for sleep apnea patients: Criteria for surgical candidates, preoperative optimization, postoperative considerations, the role of DISE and recommended medications.

Criteria for Selecting Surgical Candidates

The key to surgical success lies in meticulous selection based on patient anatomy and phenotype. The principal criteria include:(4,6,9,10)

- Failure of Conservative Treatment: The patient should have attempted and failed CPAP therapy, mandibular advancement devices, or sleep hygiene measures. This criterion must be interpreted cautiously, as intolerance to CPAP or other non-surgical alternatives does not automatically make a patient a surgical candidate nor guarantee successful surgical outcomes.
- Identification of the Site of Obstruction: It is imperative to determine whether the obstruction is nasal, palatal, tongue-base related, or multilevel. Tools such as drug-induced sleep endoscopy (DISE) are essential for dynamically mapping airway collapse.
- Anatomical Phenotype vs. Functional Collapse: Surgery has a high likelihood of success when clearly obstructive anatomical structures are present (e.g., hypertrophic tonsils or macroglossia). If the problem consists of generalized pharyngeal wall collapse due to central obesity, surgery is generally discouraged.
- Body Mass Index (BMI): Obesity and a neck circumference greater than 43 cm are two contraindications for considering surgical management.
- Severity of OSA: Surgery is generally offered to patients with an AHI lower than 20. However, in patients with favorable anatomy, higher AHIs may also be considered for surgery.
- Friedman Staging: Stage I patients (large tonsils, visible palate, low BMI) demonstrate the highest success rates (up to 80%), whereas in Stage III success rates decline dramatically (approximately 8%).
- Contraindications: Patients with severe pulmonary disease, coagulation disorders, unstable cardiovascular disease, obesity, or unrealistic expectations should be excluded.

WHAT SHOULD BE CONSIDERED IN THE ANESTHETIC MANAGEMENT OF PATIENTS WITH OSAS?

The anesthetic management of patients with obstructive sleep apnea syndrome (OSAS) requires a multidisciplinary, individualized, and highly vigilant approach due to the elevated risk of perioperative respiratory and cardiovascular complications. Given that more than 80% of these patients remain undiagnosed at the time of surgery, the implementation of standardized screening and management protocols is essential. The following are the main anesthetic considerations in this patient population, divided by perioperative phases:(19,20,21,22)

1. Preoperative Evaluation and Optimization

- Systematic Screening: The use of validated tools such as the STOP-Bang questionnaire is recommended (scores greater than 3 indicate risk, and scores greater than 5 indicate a high probability of moderate-to-severe OSAS) to identify at-risk patients. However, it is important to note that definitive diagnosis must be established through PSG.
- Optimization of Comorbidities: Stabilization of associated conditions such as hypertension, heart failure, and morbid obesity prior to surgery is crucial.
- CPAP Therapy: In patients with diagnosed OSAS, the use of CPAP for at least one month before surgery is recommended to improve respiratory stability, in addition to reducing hemoglobin and erythrocyte levels, thereby decreasing the risk of thromboembolic events.

2. Intraoperative Considerations(23,24)

- Choice of Technique: Regional or neuraxial anesthesia is preferred whenever possible, as it avoids airway manipulation and markedly reduces opioid requirements.
- Airway Management: Patients with OSAS have a 3- to 4-fold increased risk of difficult intubation and ventilation. Therefore:
- The ramped (head-elevated) or sniffing position should be used to optimize glottic visualization and delay desaturation.
- Maximal preoxygenation should be performed; the use of high-flow nasal oxygen (HFNO) or CPAP during induction may prolong safe apnea time.

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- Rescue devices such as videolaryngoscopes or fiberoptic bronchoscopes should be readily available.
- Pharmacological Management:
- Avoidance of Sedatives: Benzodiazepines are discouraged as premedication because they relax pharyngeal muscles and suppress arousal responses to hypoxia.
- Use of Short-Acting Agents: Drugs such as remifentanil and propofol (TIVA) are preferred because they allow more rapid recovery.
- Neuromuscular Reversal: Complete reversal of neuromuscular blockade (preferably with sugammadex) must be ensured prior to extubation to maintain airway patency.

3. Postoperative Monitoring and Care(25,26)

- Continuous Monitoring: The use of capnography together with pulse oximetry is imperative, as capnography detects apnea and hypoventilation much earlier than oxygen desaturation occurs.
- Multimodal Analgesia: Opioid-sparing strategies including acetaminophen, NSAIDs, regional blocks, ketamine, or dexmedetomidine should be prioritized in order to minimize respiratory depression
- Positioning: The patient should recover in a lateral or semi-seated position (strictly avoiding the supine position) to minimize pharyngeal collapse.
- Use of CPAP: Immediate resumption of CPAP after extubation is recommended in patients already using CPAP or in those with suspected severe OSAS who demonstrate frequent airway obstruction during recovery
- Discharge Criteria: The patient should not be discharged until baseline oxygen saturation can be maintained during spontaneous sleep on room air and pain is controlled with minimal analgesic requirements.

What Is the Role of Drug-Induced Sleep Endoscopy (DISE) in the Evaluation of OSAS? Which Sedative Medications Should Be Used?

Drug-induced sleep endoscopy (DISE) is an invasive diagnostic tool that allows dynamic, real-time evaluation of upper airway structures while the patient is under sedation. Its principal role is to identify the site, degree, and specific pattern of obstruction (such as anteroposterior, lateral, or concentric collapse) in order to guide personalized therapeutic decisions. Its main disadvantage is that it involves pharmacologically induced sleep and, therefore, sleep architecture differs from physiological sleep. Furthermore, airway collapse during sedation may be modified by anesthetic agents, making its true utility controversial, especially because recent reports have demonstrated that the use of DISE does not significantly alter postoperative outcomes.(27)

Role of DISE in the Evaluation of OSAS

- Identification of the Site of Obstruction: Unlike polysomnography, which confirms the diagnosis of OSAS but does not localize the obstruction, DISE allows visualization of whether collapse occurs at the level of the soft palate, oropharynx (lateral walls), tongue base, or epiglottis.
- Surgical Planning: It is essential for selecting the most appropriate surgical technique, such as palatal surgery or tongue base reduction. According to some sources, the treatment plan may change in 40% to 75% of cases after DISE is performed.
- Selection for Non-Surgical Therapies: It is used to predict response to mandibular advancement devices (MADs) and is an essential requirement in protocols for hypoglossal nerve stimulator implantation, where complete concentric palatal collapse must be excluded.
- Patients with Treatment Failure: It is recommended for airway exploration in patients who do not tolerate CPAP or in whom primary surgery has failed.
- Controversy Regarding Its Efficacy: Although it is considered a clinical standard for topographic mapping, some studies suggest that its performance does not necessarily guarantee greater surgical success compared with awake evaluation.

Recommended Sedative Medications

Sedation must be carefully titrated by an anesthesiologist in a controlled environment (operating room or endoscopy suite) with continuous monitoring. The most commonly used agents are:

- Propofol: This is the most frequently used agent, often administered via target-controlled infusion (TCI). It is notable for its rapid onset and recovery, allowing standardization of the procedure. However, it may cause dose-dependent respiratory depression and increase airway collapsibility more than natural sleep.
- Dexmedetomidine: This alpha-2 agonist offers the advantage of inducing a state similar to physiological sleep with minimal respiratory depression while better preserving pharyngeal dilator muscle tone. Its disadvantages include slower onset, longer half-life, and possible cardiovascular effects such as bradycardia and hypotension.
- Midazolam: Sometimes used alone or in combination with propofol. It may produce greater collapse at the velopharyngeal level and tongue base compared with propofol. If the study lasts longer than 90 minutes, it may allow a sleep architecture more similar to natural sleep (including REM sleep).
- Ketamine: It may be used as an adjunct because it has the beneficial property of not reducing upper airway muscle activity, although it generally needs to be combined with other agents to counteract its dissociative effects.

The use of the bispectral index (BIS) has been proposed to monitor sedation depth, maintaining values between 50 and 70, a level at which obstructive events and snoring commonly appear. However, it is critically important to understand that BIS levels do not represent physiological sleep architecture and are not equivalent to it.

CONCLUSIONS

The anesthetic management of patients with OSAS requires a multidisciplinary and preventive approach, given that these patients

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present a significantly increased risk of perioperative respiratory and cardiovascular complications.

Both the surgical and anesthetic teams must work closely together to identify perioperative risks in order to improve both postoperative outcomes and prognosis. A complete and accurate diagnosis favors surgical success, but anesthesiologists must also actively identify and optimize associated conditions such as systemic hypertension, heart failure, and morbid obesity, which may increase surgical risk. As previously discussed, the use of positive airway pressure devices before surgery helps reduce intraoperative and postoperative risks and therefore should always be considered, particularly in patients with severe OSAS or significant comorbidities.

The choice of anesthetic technique is of paramount importance, and anesthesiologists should, whenever possible, attempt regional or neuraxial anesthesia, since it avoids airway manipulation. However, this may be feasible in patients with OSAS undergoing surgery for unrelated reasons, but not when the upper airway itself is the surgical target.

Regarding the upper airway, induction should be performed with the head elevated in order to improve glottic visualization and prolong safe apnea time. The use of CPAP or high-flow nasal cannula during induction helps prevent rapid desaturation, and because patients with OSAS often present difficult airways, immediate availability of videolaryngoscopes and other rescue devices for difficult intubation is mandatory.

The use of sedatives as premedication should be avoided because they relax pharyngeal muscles and suppress arousal responses to hypoxia. The use of TIVA with propofol and remifentanil is associated with shorter recovery times compared with volatile anesthetics such as sevoflurane. Complete reversal of neuromuscular blockade (preferably with sugammadex) prior to extubation is recommended in order to avoid residual airway obstruction.

Continuous capnography together with pulse oximetry is recommended postoperatively because it detects apnea and hypoventilation long before oxygen saturation declines. Opioid-sparing regimens should be implemented. During the days following the surgical procedure, it is recommended that the patient remain in a semi-Fowler position (45°), thereby reducing the risk of oropharyngeal and hypopharyngeal collapse.

Success in these patients depends on assuming the presence of OSAS in at-risk individuals, minimizing pharmacological depression of the respiratory center, and maintaining close monitoring during the first 24 postoperative hours.

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