Anesthetic and Postoperative Management of the Obstructive Sleep Apnea Patient

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KEYWORDS
• Complications • OSAS surgery
• Obstructive sleep apnea • Anesthesia
• Post op management
• Avoid complications in sleep apnea surgery

Clinically significant obstructive sleep apnea hypopnea syndrome (OSAHS) occurs in 4% of men and 2% of women1 and is caused by a decrease in upper airway size and patency during sleep. During sleep, a patient may develop a complete obstruction of the airway (apnea), partial obstruction of the airway leading to a desaturation or arousal from sleep (hypopnea), or partial obstruction of the airway leading to an arousal but no significant desaturation (respiratory effort–related arousal). Although the number of these respiratory events per hour (respiratory disturbance index [RDI]) of sleep is currently used as the determinant of sleep apnea severity (Table 1), this disease leads to morbidity and mortality because of the physiologic consequences of the respiratory events rather than as a direct result of the respiratory events. These physiologic changes include reductions in oxygen saturation, increases in sympathetic output and tone, hypercarbia, and arousals from sleep. Arousals lead to cessation of the respiratory event, only to be followed by repetitive airflow obstructions and arousals. The arousals cause sleep fragmentation and secondary daytime symptoms, including nonrestorative sleep, excessive daytime somnolence, and problems with concentration and memory. Arousals also led to a rise in sympathetic tone, with secondary increases in blood pressure, pulse, and cardiac output. The reduction of oxygen saturation can directly lead to cardiac arrhythmias, myocardial infarction, and stroke.

Safe perioperative management of patients with obstructive sleep apnea requires special attention to preoperative, intraoperative, and postoperative care. Sleep apnea is a common condition and may be present even if a planned surgical procedure is not being performed for this indication. These patients are more likely to have comorbidities, including hypertension, insulin resistance, diabetes, coronary artery disease, gastroesophageal and laryngopharyngeal reflux disease, and obesity.

These patients typically have anatomic features (retrogнатho, micrognathia, macroglossia, tonsil and uvula hypertrophy, nasal obstruction, abnormal epiglottis position, anterior positioning of the larynx, or elongation of the airway) that may lead to difficulty with intraoperative ventilation and intubation. Apnea severity may worsen after

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surgery due to a combination of these anatomic features along with airway edema caused by a difficult intubation or due to drug effects leading to a reduction of the arousal response. Anesthetic agents, narcotic analgesics, and sedative hypnotics reduce the brain’s arousal response and may lengthen respiratory events and worsen hypoxemia and hypercarbia during sleep. These factors may predispose to postoperative airway obstruction and, ultimately, myocardial infarction, stroke, cardiac arrhythmia, and sudden death.

There is growing evidence that sleep apnea is a risk factor for anesthesia-related morbidity and mortality. These risks are present when undergoing any surgical procedure, including upper airway surgery. The care of these patients requires vigilance before, during, and after surgery to minimize risks associated with their underlying diseases. This article reviews potential complications from surgery along with avoidance strategies.

### PREOPERATIVE CONSIDERATIONS

#### Selection of a Surgical Facility

When operating on patients with obstructive sleep apnea, surgeons must select a facility with personnel and equipment adequate for an elective and controlled management of patient airway before and after the procedure. Unfortunately, there is insufficient literature to offer guidance regarding which patients can be safely managed on an outpatient as opposed to an inpatient basis or how long patients need to be monitored postoperatively.\(^2\) Most publications suggest, however, that patients with more severe sleep apnea are at greater risk for perioperative complications. The concern is not the number of respiratory events per hour but rather the degree of oxygen desaturation, because patients with severe desaturation have minimal respiratory reserve and are already on the steep-sloped portion of the oxygen desaturation curve.

Surgery may be performed in an office, outpatient surgery center, or hospital operating room. After surgery, patients may be monitored in a recovery unit for a short or extended time, transferred to a 23- to 48-hour observation unit, transferred to the hospital by ambulance, or admitted to a regular hospital room, a room with telemetry, or an intensive care unit (ICU). The choice of surgical setting and postoperative setting is best determined preoperatively\(^2\) and should be made after consideration of associated comorbidities, severity of apnea, sites of airway narrowing, type of anesthesia and surgery, anticipated length of surgery, and need for postoperative narcotic agents. Consultants to the American Society of Anesthesiologists\(^2\) were surveyed using a nonvalidated scoring system about opinions regarding “outpatient surgery” in patients with OSAHS. Their opinions were that patients with mild sleep apnea undergoing uvulopalatopharyngoplasty (UPPP) or nasal surgery were not at increased risk for complications, whereas patients with moderate sleep apnea undergoing UPPP were at increased risk of complications.\(^2\) The goal of postoperative monitoring is to document severity of the sleep apnea and oxygen desaturation in patients while they are sleeping without supplemental oxygen, so they can be treated if needed, thereby preventing complications.

Hospital policies and protocols and the quality of the hospital nursing care can also have an impact on the level and type of postoperative monitoring. For example, some facilities can perform continuous pulse oximetry in an extended recovery unit whereas others require an ICU for the same level of care. It is the author’s opinion that nonairway surgery in most patients with mild or moderate sleep apnea may be done safely only as outpatient, whereas those with severe sleep apnea or undergoing pharyngeal surgery require some observation, preferably with time observed while asleep, before discharge. When performing surgery for reasons other than sleep apnea, the same issues need to be considered.

#### Choice of Anesthesia Technique (Local, General, or Monitored Anesthesia Care)

There is insufficient literature to evaluate the effects of different anesthetic techniques on surgical complications in patients with OSAHS. Because airway reconstructive surgery for sleep

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Sleep apnea severity</th>
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<tr>
<td></td>
<td>RDI</td>
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<tr>
<td>Mild</td>
<td>5–14</td>
</tr>
<tr>
<td>Moderate</td>
<td>15–29</td>
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<tr>
<td>Severe</td>
<td>&gt;30</td>
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The American Academy of Sleep Medicine currently recommends use of the RDI in determination of sleep apnea severity. RDI is defined as the total number of apneas, hypopneas, and respiratory effort–related arousals during the study divided by the number of hours of recorded sleep. In contrast, the Apnea Hypopnea Index is defined as the total number of apneas and hypopneas during the study divided by the number of hours of recorded sleep.

**Abbreviation:** LSAT, lowest oxygen saturation.

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\(^2\) Mickelson
apnea causes blood to enter the airway, it is typically felt to be safest to perform these surgeries while patients are intubated, to control and protect the airway. When patients with sleep apnea are undergoing nonairway surgery, then local anesthesia, or monitored anesthesia care may be preferred. Sedation must be performed carefully, as sleep apnea patients are more sensitive to sedatives, causing more muscle relaxation and prolongation of respiratory events. When using conscious sedation, continuous pulse oximetry, cardiac monitoring, and CO₂ monitoring should be used. General anesthesia with a secure airway is preferred if patients require moderate or deep sedation.

**Use of Preoperative Continuous Positive Airway Pressure**

Before surgery, patients are often sleep deprived due to anxiety about the upcoming surgery. In those with poor positive airway pressure (positive airway pressure [PAP], continuous PAP [CPAP], bilevel positive airway pressure [BiPAP], or auto-PAP) compliance, sleep deprivation persists.³,⁴ Once surgery is completed, however, patients are likely to have a rebound of delta and rapid eye movement sleep and may be predisposed to more severe sleep apnea.⁵ It is likely that measures that can improve sleep quality prior to surgery may reduce the rebound of deep sleep postoperatively. Although most patients undergoing sleep apnea reconstructive surgery are doing so because they are poorly compliant with PAP, even modest use of PAP prior to surgery may be beneficial. If PAP is available, patients should be asked to use their machine for several weeks prior to and after surgery and to bring their machine into the hospital for perioperative use.

**Use of Narcotics and Sedative Agents**

Routine use of sedative hypnotics, anxiolytic agent, and narcotics should be avoided prior to surgery in patients with obstructive sleep apnea syndrome (OSAHS) as these agents may lead to sudden death, even in a preoperative holding area.⁶ Narcotics suppress respiratory drive, blunt the arousals response, and may lead to life-threatening hypoxemia. Benzodiazepine agonists reduce upper airway dilator muscle tone and worsen sleep-disordered breathing.⁷ Flurazepam increases the apnea index⁸ whereas triazolam reduces oxygen saturation and the arousal response and increases the duration of respiratory events.⁹ If sleep apnea patients require one of these drugs immediately prior to surgery, they should be monitored with continuous pulse oximetry and may require supplemental oxygen.

**Reflux/Aspiration Precautions**

Obesity is common in patients with OSAHS and is associated with increased intra-abdominal fat, higher intra-abdominal pressure, and a higher incidence of hiatal hernia and gastroesophageal reflux.¹⁰,¹¹ Obese patients have a larger volume of gastric fluid and a lower gastric pH and are at increased risk of aspiration during induction of anesthesia¹² or on extubation. To reduce these risks, obese patients should receive an H₂ blocker, proton pump inhibitor, or esophageal motility stimulant prior to surgery,¹³ and the stomach should be suctioned out during or on completion of surgery.

**Preoperative Medical Clearance**

Consultation with a primary physician, cardiologist, anesthesiologist, or other appropriate specialists should be considered in patients with complicated comorbid conditions or multiple comorbidities. Medical issues that may warrant medical clearance include hypertension requiring multiple medications, poorly controlled diabetes, coronary artery disease, cerebrovascular disease, or underlying pulmonary disease. The purpose of the preoperative clearance is to optimize control of the comorbidities prior to surgery and, hopefully, reduce the risk of surgical complications. Patients with OSAHS have a higher prevalence of hypertension due to an increased sympathetic output during respiratory events.¹⁴,¹⁵ Blood pressure should be checked prior to surgery and, if significantly elevated, these patients should be referred for treatment prior to surgery.

**Communication with the Anesthesia Team**

As the head of the surgical team, it is the surgeon’s responsibility to communicate with the anesthesia team about any potential difficulties that may arise during surgery. The anesthesiologist should be told about the severity of the sleep apnea and any upper airway abnormalities, such as macro-glossia, retrognathia, or micrognathia, that could pose a challenge to ventilate, intubate, or secure an airway. In these patients, a surgeon may request to have difficult airway tools or a tracheostomy set in the operating room.

**INTRAOPERATIVE CONSIDERATIONS**

**Patient Ventilation**

An antireflux agent and antisialogogue should be administered preoperatively to reduce the risk of
aspiration and excess saliva production. After induction of anesthesia, patients require positive pressure breathing by mask, head, and neck extension; jaw protrusion; and insertion of a properly sized oral airway or long nasal airway that can extend beyond the tongue base. A two-person ventilation approach may be needed, one for jaw positioning and mask seal and the other for squeezing the bag. A variety of methods are available to maintain ventilation of a difficult airway (Box 1). The simplest approach is to insert a long oral airway or nasopharyngeal airway that extends below the tongue base. A laryngeal mask airway (LMA) is another excellent way to stabilize the airway and allow ventilation. The LMA is inserted blindly, keeping the base of tongue and epiglottis from collapsing posteriorly. A 3- to 5-minute period of ventilation is used to increase oxyhemoglobin saturation prior to intubation.

**Intubation Techniques**

Sleep apnea patients can be a challenge to intubate due to the combination of mandibular or maxillary deficiency, a long floppy airway, excessive oropharyngeal and hypopharyngeal soft tissue, and a relatively anterior larynx. If easily ventilated, then short-acting paralyzing agents, such as succinylcholine, may be used prior to intubation. If the larynx cannot be visualized, alternative methods (Box 2) may be required. New techniques have mostly replaced the older approaches of awake oral or nasal intubation and a planned awake transnasal fiberoptic intubation performed with patients in a sitting or semisitting position. The newest development is the video laryngoscope (currently marketed as the GlideScope, Burnaby British Columbia, Canada), which uses a small video camera on the end of a curved laryngoscope Mac blade, allowing anesthesiologist to visualize the larynx on a screen and then guide the endotracheal tube through the vocal cords. The advantage of the technique is the ability to view the larynx “around the corner” in patients who have micrognathia or retrognathia and an anteriorly positioned larynx. One disadvantage is the large size of the blade, making it difficult to insert in patients with trismus.

A planned tracheostomy should be considered in those with severe sleep apnea, failure of CPAP, life-threatening cardiac arrhythmias, severe oxygen desaturation, or failed intubation at a prior surgery or if significant postoperative airway edema is expected. An emergency tracheostomy or cricothyrotomy may be needed if patients cannot be ventilated or intubated.

**Extubation**

Another critical time for airway complications is extubation. Before extubation, anesthesiologists should verify full reversal of neuromuscular blockade; patients should have purposeful movement, recovery of neuromuscular activity, sustainable head lift for at least 5 seconds, and an adequate voluntary tidal volume. Ventilation is typically easier for patients in the semiupright or lateral position. Patients should be extubated with appropriate personnel and equipment present so as to be able to replace the tube if necessary. It is generally accepted that patients should be extubated awake because if patients are still “deep,” the airway may obstruct. When performing upper airway surgery, however, if extubated light or awake, patients may cough or buck on the tube and cause bleeding into the airway. The decision to extubate light or deep, therefore, is made by the surgeon and anesthesiologist.
patients were easy to ventilate with induction, and surgery did not cause significant airway edema, then there should be no difficulty ventilating after extubation.

It is unclear whether or not use of local anesthetic agents effect safety. Use of a long-acting local anesthetic during surgery may reduce the need for narcotic analgesics but may worsen apnea due to their effect on airway mechanoreceptors that contribute to the arousal stimulus and apnea termination.\(^{21}\) Narcotic agents should be minimized during surgery, as their effect may persist postoperatively leading to postoperative complications.

**Surgeon Availability**

A surgeon and anesthesiologist should both be in the operating room at time of induction, intubation, and extubation for all sleep apnea patients.

**POSTOPERATIVE CONSIDERATIONS**

**Postoperative Monitoring**

Several studies have shown that when all healed, reconstructive surgery improves apnea severity, but sleep apnea is typically unchanged or worse for the first two nights.\(^{22,23}\) It is believed that the first 24 hours after surgery is the most critical time for complications, although postoperative deaths have occurred later, most commonly due to the accumulated effects of sleep deprivation, narcotic agents, and rapid eye movement rebound.\(^{24,25}\) Unfortunately, the literature is insufficient to offer guidance about how long monitoring is needed or if there is any preferred type of monitoring: standard hospital room, telemetry unit, ICUs, or intermediate ICUs.\(^{2}\)

The reason for postoperative monitoring is early detection or prevention of complications. Continuous pulse oximetry with an audible alarm is the easiest and most reliable method for early detection of postoperative hyperventilation. Intermittent oximetry monitoring has minimal benefit for this patient population because patients usually are awakened by putting on the oximetry probe and, once awake, would not be having apnea. Continuous pulse oximetry should be used for all OSAHS patients after nonairway surgery or upper airway reconstructive surgery. Although there is no consensus as to whether or not electrocardiographic monitoring is beneficial for those with sleep apnea, it should be considered in patients with significant cardiac disease or arrhythmias.

Most older publications have recommended monitoring oxygen saturation and cardiac arrhythmias in the ICU\(^{22,26}\) whereas others have advocated ICU monitoring due to the high reported incidence of serious airway complications (13%–25%) after UPPP.\(^{27,28}\) Older studies suggest that ICU monitoring may decrease the risk of complications after OSAS surgery.\(^{27,29}\) More recent publications, however, note a much lower risk of airway complications (1.4%), likely due to more aggressive perioperative treatment of tissue edema and avoidance of excessive sedation.\(^{30–32}\) Except for the sickest of sleep apnea patients and those undergoing maxillomandibular advancement, the author believes that ICU monitoring is rarely required for soft tissue surgeries.

Many surgeons, anesthesiologists, and hospitals have standard protocols governing preoperative and postoperative standard orders before and after surgery.\(^{33}\) Institution and anesthesia protocols should be reviewed to verify that routine recovery room, surgical ward, or extended recovery unit orders are appropriate for the sleep apnea patient (Boxes 3 and 4). In general, monitoring of vital signs for sleep apnea patients should be more frequent than for patients without OSAHS. Nursing checks should specifically monitor for respiratory rate, depth of breathing, and presence of snoring and to verify that there is no apnea, hypopnea, or labored breathing.

**Patient Positioning**

The apnea hypopnea index and hypoxemia tend to improve when these patients sleep in the lateral or

<table>
<thead>
<tr>
<th>Box 3 Standard preoperative orders for sleep apnea surgery</th>
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<tbody>
<tr>
<td>1. Famotidine (or other H(_2) receptor antagonist) (_) mg by mouth 30 to 60 minutes before surgery</td>
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<tr>
<td>2. Metoclopramide (_) mg by mouth 30 to 60 minutes before surgery</td>
</tr>
<tr>
<td>3. Glycopyrrolate (or other anticholinergic agent) (_) mg intramuscularly (IM) 30 to 60 minutes before surgery</td>
</tr>
<tr>
<td>4. Cephazolin (or other appropriate antibiotic) (_) mg intravenously (IV) piggy-back (PB) 30 to 60 minutes before surgery</td>
</tr>
<tr>
<td>5. Dexamethasone sodium phosphate (_) mg IV 30 to 60 minutes before surgery</td>
</tr>
<tr>
<td>6. Oxymetazoline nasal spray, (_) sprays each nostril, given 10 to 20 minutes preoperatively if patients are to undergo nasal surgery or nasal intubation</td>
</tr>
<tr>
<td>7. No narcotic or sedative agents given before surgery</td>
</tr>
</tbody>
</table>
prone positions or with head of bed elevated. Sleep apnea tends to be worse when supine, due to posterior collapse of the base of tongue. After surgery, elevation of the head of the bed reduces soft tissue edema and turbinate swelling and reduces nasal airway resistance. Because there are no valves in the veins of the head and neck, lying flat increases venous pressure and worsens tissue edema. Although the literature is insufficient to provide definitive guidance in the postoperative period, most physicians agree that after airway surgery, the head of bed should be elevated and the supine position should be avoided.² Sleep positioning maneuvers should be recommended in the hospital and after discharge to home.

### Box 4

<table>
<thead>
<tr>
<th>Standard postoperative orders after sleep apnea surgery</th>
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<tbody>
<tr>
<td>1. Recovery room orders: no IV or IM narcotics 30 minutes before transfer to room</td>
</tr>
<tr>
<td>2. Try to wean oxygen to room air; maintain ( O_2 ) saturation above 90%</td>
</tr>
<tr>
<td>3. Vitals: per recovery room, then routine</td>
</tr>
<tr>
<td>4. Check patient breathing effort and record results at least every 2 hours</td>
</tr>
<tr>
<td>5. Continuous pulse oximetry</td>
</tr>
<tr>
<td>6. Elevate head of bed 30° to 45°</td>
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<tr>
<td>7. Ice collar to neck as needed</td>
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<tr>
<td>8. Sequential compression stockings to be on while in bed</td>
</tr>
<tr>
<td>9. Clear liquid diet; advance as tolerated; encourage oral intake; monitor oral intake</td>
</tr>
<tr>
<td>10. IV dextrose 5% in lactated Ringer’s injection at ___ mL per hour</td>
</tr>
<tr>
<td>11. Cefazolin (or other appropriate antibiotic) ___ mg IVPB every 8 hours</td>
</tr>
<tr>
<td>12. Chlorhexidine, 0.5-oz swish and spit 3 times a day (if patient had palate or base of tongue surgery)</td>
</tr>
<tr>
<td>13. Patients are to wear their own CPAP/BiPAP machine, whenever sleeping, beginning in recovery room. If patient underwent nasal surgery, use a CPAP/BiPAP full face mask. Do not use CPAP/BiPAP if patient underwent maxillary or mandibular advancement.</td>
</tr>
<tr>
<td>14. For pain:</td>
</tr>
<tr>
<td>1. Chloroseptic spray to oral cavity as needed, keep at bedside</td>
</tr>
<tr>
<td>2. Mild: hydrocodone/acetaminophen elixir 2.5/166 mg/5 mL; contains 2–5 mg of hydrocodone and 166 mg of acetaminophen, as an elixir in each 5 mL of solution. ___ mL by mouth every 6 hours as needed</td>
</tr>
<tr>
<td>3. Moderate: oxycodone/acetaminophen elixir 5/325 mg/5 mL; contains 5 mg of oxycodone and 325 mg of acetaminophen, as an elixir in each 5 mL of solution. ___ mL by mouth every 6 hours as needed</td>
</tr>
<tr>
<td>4. Severe: nalbuphine hydrochloride ___ mg IM or slow IV every 3 to 6 hours as needed.</td>
</tr>
<tr>
<td>15. Dexamethasone sodium phosphate ___ mg IVPB at ___ PM today and ___ AM tomorrow</td>
</tr>
<tr>
<td>16. Oxymetazoline nasal spray: ___ sprays to each nostril every 8 hours</td>
</tr>
<tr>
<td>17. For blood pressure elevation: systolic greater than 160 or diastolic greater than 90 give</td>
</tr>
<tr>
<td>1. Hydralazine HCl ___ mg IV (if heart rate [HR] &lt;80); may repeat every 15 minutes ( \times 4 ) doses total</td>
</tr>
<tr>
<td>2. Labetalol HCl ___ mg IV (if HR &gt;80); may repeat every 15 minutes ( \times 4 ) doses total</td>
</tr>
<tr>
<td>18. Cough, deep breathing and incentive spirometry every 2 hours while awake</td>
</tr>
<tr>
<td>19. Call physician for:</td>
</tr>
<tr>
<td>1. Active bleeding from nose or mouth</td>
</tr>
<tr>
<td>2. Any evidence of respiratory distress</td>
</tr>
<tr>
<td>3. Oxygen saturation below 90% or inability to wean off supplemental oxygen</td>
</tr>
<tr>
<td>4. Temperature above 101°F (oral)</td>
</tr>
<tr>
<td>5. Systolic BP greater than 160, diastolic greater than 90, not controlled with prescribed medication</td>
</tr>
</tbody>
</table>
Postoperative Analgesia

Opiates drugs (morphine, meperidine, hydromorphone, fentanyl, and so forth) lead to a dose-dependent reduction of respiratory drive, respiratory rate, and tidal volume, causing hypventilation, hypoxemia and hypercarbia. These agents must be used with caution in sleep apnea patients as the frequency and severity of respiratory events worsen after narcotic administration. Because upper airway reconstructive surgeries may require narcotic agents for 10 to 14 days for adequate pain control, there may be a dilemma between giving adequate pain control and avoiding complications. It has been assumed that narcotic agents administered through IM or IV routes cause more respiratory suppression that those given by an oral route. It is clear that patient-controlled analgesia (via a pump) does not seem to prevent airway-related complications, although the literature is insufficient to evaluate whether or not nurse-administered narcotics are safer than patient-controlled analgesia in OSAHS patients.

In general, however, narcotic agents should be titrated for pain severity and used only when non-narcotic agents are ineffective. Mild to moderate pain can be treated with oral opioid agents (codeine, hydrocodone, oxycodone, or propoxyphene), as these agents appear to have only mild effects on the respiratory system. Non-narcotic options (acetaminophen) or centrally acting agents (tramadol hydrochloride) have no effects on the respiratory system. Nonsteroidal anti-inflammatory agents (ibuprofen, naproxen, and ketolorac tromethamine) or the cyclooxygenase 2 agents (celecoxib) may also be helpful but should be used with caution due to the potential for increased bleeding. Topical anesthetics (benzocaine) are also useful supplements to control pain.

Use of Continuous Positive Airway Pressure and Supplemental Oxygen

Because narcotics and anesthetic agents cause hypoventilation, and microscopic atelectasis causes hypoxemia, supplemental oxygen is typically used after surgery until normal oxygen saturation can be maintained while breathing room air. Severe oxygen desaturation can lead to cardiac arrhythmias, myocardial infarction, or stroke. In sleep apnea patients, the goal is to keep both the waking and sleeping oxygen saturation in a normal range (above 90%). Use of supplemental oxygen does not prevent apneas and hypopneas and may actually reduce awareness of the respiratory events, because there may be no desaturation with shorter apneas or hypopneas. As a result, the preferred approach is to use supplemental oxygen to maintain the waking oxygen saturation, PAP to maintain the sleeping oxygen saturation, and oxygen and PAP for patients with both waking and sleeping hypoxemia.

Except for certain limitations, PAP can be safely used after most upper airway surgeries to prevent respiratory events during sleep and should be used in all patients able to use it before surgery. After surgery, PAP may also reduce the risk of gastroesophageal reflux. Patients should be instructed to bring their own PAP machine to the surgery facility for postoperative use at the preoperative pressure setting. The PAP pressure may be changed, if needed, to a higher pressure in the presence of tissue edema or persistent desaturations during sleep or to a lower pressure if unable to tolerate higher pressures. PAP should not be used after mandibular or maxillary advancement due to the potential of subcutaneous emphysema. After nasal surgery, PAP can still be used with a full face mask instead of a nasal mask or nasal pillows.

Reducing Airway Edema

Upper airway surgery or a difficult intubation may cause airway edema and airway compromise in patients with severe sleep apnea, multiple sites of airway narrowing, or who are undergoing multiple airway surgeries. Tissue edema occurs in all surgeries, even after laser and radiofrequency procedures. Administration of systemic steroids reduces edema in the upper airway and, for optimal effect, should be administered before surgery and several times postoperatively. The preferred corticosteroid agent is dexamethasone (10–15 mg every 6–12 hours in adults) as it has the least sodium retention of available steroids.

Soft tissue edema may also be reduced by cooling of the tissue before incision or after surgery. Precooling with ice has been shown to reduce edema in thermal wounds from lasers or cautery units. Application of external ice packs or sucking on ice chips reduces pain and swelling. Antibiotics may also limit edema by reducing bacterial contamination of a surgical wound. Systemic antibiotic prophylaxis given within 1 hour of incision reduces the risk of infection in contaminated oral surgical fields and reduces pain after procedures, such as tonsillectomy. For oropharyngeal surgeries, pre- and postoperative topical chlorhexidine rinses reduces bacterial counts in the oral cavity. Perioperative use of a broad-spectrum antibiotic agent with anaerobic coverage should
be considered for sleep apnea patients undergoing any upper airway surgery.

Nasal obstruction and nasal packing worsen sleep apnea and improving the nasal airway can reduce apnea severity. After nasal surgery, it is best to use methods that avoid nasal packing, such as quilting septal sutures, septic splints, nasal tubes, or nasopharyngeal airways sewn into place. A decongestant nasal spray (oxymetazoline) or oral decongestant is also effective in reducing nasal resistance after nasal surgery or nasal intubation.

**Postoperative Sedatives**

Because of the frequency of insomnia, it is common to prescribe a sedative hypnotic before and after surgery. Sedative hypnotics and anxiolytics, however, should be avoided due to their adverse effects on arousal thresholds, apnea duration and frequency, and oxygen desaturation. If a sleep aid is necessary, there are two short-acting nonbenzodiazepine hypnotic agents that have only a minimal effect on sleep apnea severity. Zolpidem had no significant effect on the apnea/hypopnea index compared with placebo in mild to moderate sleep apnea patients and had no effect on oxygen saturation. Zolpidem also had no significant effect on the apnea/hypopnea index in these patients but did reduce the lowest oxygen saturation and the total time with oxygen saturation less than 90% and 80%.

**Deep Vein Thrombosis Prophylaxis**

Obesity, prolonged bed rest, advanced age, and long surgical procedures predispose to deep vein thrombosis (DVT) and pulmonary embolii. The risk of DVT can be reduced by application of sequential compression stockings, elastic stockings, early ambulation, and subcutaneous heparin or enoxaparin sodium. Because many sleep apnea patients are overweight, DVT prophylaxis is indicated for most patients undergoing surgery for sleep apnea.

**Blood Pressure Control**

Hypertension is more common in OSAHS patients due to increased sympathetic tone, and these patients are at increased risk of postoperative hypertension. More than half of OSAHS patients undergoing upper airway surgery require treatment with an antihypertensive agent in the recovery room to maintain a systolic blood pressure below 160 mm Hg and diastolic below 90 mm Hg (Samuel A. Mickelson, MD, unpublished data, 2001). Blood pressure control is especially important after osteotomies, because bleeding from bone is blood pressure dependent and cannot be controlled with ligatures. Elevated blood pressure is important to reduce the risk of postoperative bleeding, hematomas, and secondary tissue edema.

**Criteria for Discharge**

The literature is insufficient to offer guidance about which criteria must be met before patients are ready to go home. Consultants to the American Society of Anesthesiologists agreed that the room air oxygen saturation should return to its preoperative baseline, that patients should not be hypoxemic or develop airway obstruction when left undisturbed, and that patients should be monitored for 7 hours after the last episode of airway obstruction or hypoxemia while breathing room air in a nonstimulating environment. Unfortunately, these guidelines are not reasonable. Most patients with OSAHS undergo surgery because they will not or cannot use PAP. Because surgery is not instantly curative in most patients, most continue to have apnea after surgery. A more practical recommendation is that the waking oxygen saturation, respiratory event frequency, and degree of hypoxemia are no worse at discharge than at baseline (preoperative sleep study). If there is continued significant sleep apnea or desaturation noted in the hospital, then patients should be discharged with the same edema preventing measures that were used in the hospital (head of bed elevation, decongestants, and so forth) or supplemental oxygen if needed.

Other discharge guidelines should include adequate swallowing to be able to maintain hydration and nutrition and pain controlled with oral analgesics. In addition, patients’ vital signs (temperature, pulse, blood pressure, and respiratory rate) should be stable before discharge.

**SUMMARY**

Sleep apnea patients pose a challenge for surgeons, anesthesiologists, and surgical facility as there is an increased risk for anesthetic and postoperative complications, including airway obstruction, myocardial infarction, stroke, cardiac arrhythmia, and sudden death. Precautions are required before and after surgery to minimize these risks. Screening for sleep apnea should be done for all surgical patients as many patients have not yet been diagnosed. Safe perioperative management requires judicious use of narcotics and sedating medications, reducing upper airway edema, prevention of aspiration and DVT, blood pressure control, use of PAP if possible, and proper postoperative monitoring. Although the literature is lacking for each specific recommendation, the guidelines
presented here are based on more than 20 years of experience and are supported by the peer-reviewed medical literature.

REFERENCES


