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Perioperative Care Of Patients With Obstructive Sleep Apnea

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Opinion statement

It has been demonstrated that patients undergoing surgical procedures are at increased risk for complications if they have obstructive sleep apnea. It is believed that this increase in risk is related to more difficult intubations, use of ventilatory depressant medications, and perhaps body positioning. Although identifying patients with a preexisting diagnosis of sleep apnea is important so they can be triaged appropriately during the perioperative period, a bigger challenge is trying to identify patients who require a surgical procedure and may have undiagnosed sleep apnea. Hospitals and surgical centers should have policies in place to assist in such identification preoperatively, with a protocol on how to manage such patients perioperatively. Such guidelines exist, but many institutions do not have such protocols in place or fail to ensure that they are consistently followed.

The key to the perioperative management is close observation of these high-risk patients. In ambulatory surgery populations, these patients should be observed for an extended period before being discharged to home. In inpatient settings, the observation can be tailored to the patient's postoperative risks based on the type of surgery and the severity of his or her sleep apnea.

Patients undergoing bariatric surgery are at particularly high risk. These patients have a very high prevalence of sleep apnea and comorbid conditions. Screening this population for obstructive sleep apnea is mandatory, and a plan for postoperative observation should be in place in all institutions performing such surgery.

Introduction

The incidence of obesity and obstructive sleep apnea (OSA) continues to rise in the Western world. In the Wisconsin Sleep Cohort Study, the percentage of obese individuals (with a BMI [body mass index] > 40) with an apnea-hypopnea index (AHI) of 15 or higher is 42% to 55% in men and 16% to 24% in women [1, Class I]. Obese patients tend to have more elective surgical procedures, and early identification of OSA in the surgical patient may be important to allow for specific interventions that can improve postoperative outcomes. The problem is further hindered by the difficulty of diagnosing OSA. Clinical examination carries a diagnostic sensitivity and specificity of only 50% to 60% for sleep apnea, even when performed by experienced sleep physicians [2, Class II]. Although data to guide the perioperative management of patients with moderate to severe OSA are scarce, heightened awareness is recommended. The purpose of this review is to identify interventions and management strategies that best facilitate improved perioperative care for patients with OSA.

Prevalence of OSA in surgical patients

No epidemiologic studies have been conducted to determine the prevalence of OSA in the general surgical population. Prevalence reports vary on the basis of whether all patients were consecutively screened or a questionnaire was used. In a series of 433 patients undergoing general surgery, 18 of 41 patients suspected to have sleep apnea agreed to undergo polysomnography, and 78% of these patients were found to have an AHI greater than 5 [3, Class II]. When the Berlin Questionnaire was used for preoperative screening, the reported prevalence of OSA among patients undergoing surgery was 24% [4, Class II]. It was notable that OSA had not been diagnosed in the majority of these individuals. Thus a significant number of patients with sleep apnea may present for surgery without receiving a prior diagnosis.

Treatment

Perioperative assessment

Patient history and screening questionnaires

- Inquiry about heavy snoring, sudden awakenings with a choking sensation, and witnessed apneas by a bed partner should be a routine component of the preoperative visit. The severity of these items in the history correlates with the severity of sleep study–proven OSA [5, Class I]. It should be recognized that patients with a known diagnosis of OSA who have undergone uvulopalatopharyngoplasty and no longer snore may still have residual OSA and may warrant further evaluation.
- The Berlin Questionnaire is an 11-item self-report instrument. It has been validated in the primary care setting, with a sensitivity of 0.89 and a specificity of 0.71, but the scoring procedure is complex.
- The American Society of Anesthesiology (ASA) checklist requires a clinician to complete the evaluation.
- A tool that is much easier to use is the STOP (S, Snore loudly; T, day-time Tiredness; O, Observed to stop breathing during sleep; P, high blood Pressure) questionnaire. The STOP-BANG questionnaire adds more variables (B, BMI>35; A, Age>50 years; N, Neck circumference >40 cm; and G, male Gender), and at a cutoff score of ≥3, it has 93% sensitivity and 47% specificity for an AHI cutoff of greater than 15. For an AHI cutoff greater than 30, the STOP-BANG sensitivity is 100% and its specificity is 37% [6, Class II].

Physical examination

- Physical examination may reveal the characteristic stigmata of OSA, including a short, thick neck; nasal obstruction; tonsillar hypertrophy; narrow oropharynx; and retrognathia. Although these clinical features are typical, they are not reliable predictors of the presence or severity of OSA [7, Class III].
- Clinical suspicion for OSA may also first be recognized intraoperatively if the patient has problems with maintenance of the airway, proves difficult to intubate, or is observed postoperatively to be snoring or having obstructions. Airway obstruction out of proportion to the apparent degree of sedation can also suggest undiagnosed OSA. The degree of difficulty in visualizing the faucial pillars, the soft palate, and the base of the uvula predicts difficulty with intubation and should increase the suspicion of OSA [8, Class II]. Eastwood et al. suggest that sleep-disordered breathing should be considered in all patients with a pronounced tendency for upper airway obstruction during anesthesia or recovery from anesthesia [9, Class II].

Overnight oximetry

- Polysomnography remains the "gold standard" for diagnosing and treating OSA, but restrictions on access and practical application may limit its utility in the preoperative setting. Therefore, alternative screening tools have been tested to assess for the severity of sleep-disordered breathing preoperatively. In their study using preoperative overnight oximetry in 24 patients, Reeder et al. [10, Class II]. demonstrated "significant abnormalities of respiration" (SARs) postoperatively in all patients with preoperative SARs. SARs were defined as dips in oxygen saturation of 4% or more at least five times in 1 hour. However, the preoperative nocturnal oximetry identified only one third of those who experienced postoperative SARs. Home nocturnal oximetry has been studied as a potential screening tool, but a wide range of sensitivity and specificity for OSA has been reported [11, 12, Class II].
- In contrast, a multicenter Japanese study [13, Class II] conducted with patients having elective surgery established that the presence of preoperative sleep-disordered breathing, as evidenced by an elevated preoperative Oxygen Desaturation Index (ODI), measured by the number of episodes of oxygen desaturation of 4% or more per hour, and witnessed apneas was positively associated with the severity of postoperative nocturnal desaturations. ODI is presumed to detect a pattern of deoxygenation most consistent with sleep-disordered breathing, and thus it has been used as a surrogate marker, rather than

a marker for severity of OSA. In the outpatient setting, an ODI of 10 or higher has been reported to have sensitivities of 71% to 85% and specificities of 90% to 93% [14, Class II].

- In a more recent study using home nocturnal oximetry testing in patients who were preselected with clinical features of OSA during a preoperative evaluation, perioperative complications were noted in about 10% of the patients. About 88% of these complications occurred in the 57% of patients who had five or more episodes of 4% oxygen desaturation per hour. The OR, adjusted for sex and BMI, was 7.2 compared with the group having fewer than five episodes ($P = 0.012$) [15, Class II]. This study is limited by the fact that screening oximetry was not used in unselected preoperative patients, and technical factors such as oximetry sampling may affect the determination of the ODI.
- We do not yet know which tool is the most efficient, cost-effective, and reliable in assessing the presence and severity of OSA. Until further data have answered this question, a formal polysomnogram should be performed in high-risk patients, if it is feasible in the given clinical situation. This recommendation may be particularly important for highly suspect surgical patients such as those undergoing open Roux-en-Y gastric bypass.

Decisions regarding surgical setting: ambulatory or inpatient?

- Factors to consider when evaluating how patients with suspected OSA should be monitored postoperatively include the preclinical suspicion of the severity of OSA, the type of surgery being performed, the need for postoperative narcotics, and the clinical course in the recovery room. Surgery requiring only regional anesthesia or a limited need for postoperative narcotic analgesia should be considered for the outpatient setting. These patients can be sent home when fully conscious if they are not snoring and do not have an obstruction in the recovery room. The ASA guidelines recommend outpatient surgery for superficial surgeries using local or regional anesthesia, minor orthopedic surgery with local or regional anesthesia, and lithotripsy [16, Class III], but as they are only consensus-based, they are equivocal about ambulatory scheduling of superficial or minor orthopedic surgeries and gynecologic laparoscopy done under general anesthesia.
- Patients who are expected to have significant pain or require opioid therapy, who have severe OSA at baseline that requires continuous positive airway pressure (CPAP) therapy at home, or who have an observed obstruction or episodic desaturations that are evident in the recovery room should be considered for

continued inpatient monitoring. A recent study by Stierer et al. [17•, Class II] reported no unplanned hospital admissions after ambulatory surgery in patients with greater than 70% propensity for OSA based on their prediction model. Increased propensity for OSA was associated with difficult intubation; intraoperative tachycardia and use of intravenous labetalol, ephedrine, or metoprolol; and increased desaturation in the postanesthesia care unit (PACU), but no need for assisted ventilation.

Choosing the head position

- Different schools of thought exist regarding the head position required for optimal upper airway stability in surgical patients with OSA. Positioning of obese patients with known or anticipated OSA should include positioning with a ramp of blankets to elevate the torso and head and achieve the “sniffing position” [18, Class II]. Upper body elevation relieves OSA by increasing the stability of the upper airway. Lateral (nonsupine) head position has been suggested by some to improve upper airway stability during sleep and also to allow for reduction of therapeutic levels of CPAP [19, Class II]. ASA guidelines recommend a semi-upright position for extubation and recovery and a nonsupine postoperative position [16, Class III].

Selecting sedation and analgesia

- Alterations in consciousness from sedative medication or induction of anesthesia can exacerbate the collapsibility of the upper airway of the patient with OSA [20, Class III]. The immediate preoperative period often includes administration of sedative agents to relieve anxiety or provide analgesia. In patients with OSA, this can lead to obstruction, so sedation should always be given to the OSA patient in a supervised setting with continuous observation of the patient. Local or regional anesthesia should be considered for the surgical procedure or as an adjunct to general anesthesia [21, Class II]. These techniques may reduce concerns about upper airway collapse during procedures. In addition, the use of regional anesthesia may allow decreased use of opioids and other sedatives throughout the perioperative period.

- Anatomy associated with OSA (increased neck circumference, macroglossia, retrognathia, and maxillary constriction) can narrow the airway, making mask ventilation and intubation challenging. A high incidence of OSA has been found in patients with unexpectedly difficult intubation [22, Class II]. Preparation for induction and intubation should follow the ASA difficult-airway guidelines [23, Class IV]. Preoxygenation, performed by providing 100% oxygen via a tightfitting anesthesia mask for 3 minutes, can increase the time of tolerance of apnea in case of difficulties with intubation [24, Class II]. Alternative airway devices (such as a laryngeal mask airway, videolaryngoscope, or fiberoptic scope) should be easily available as options in case intubation is more challenging than anticipated.

- Avoiding long-acting anesthetic medications may be preferred in OSA patients, as their effects may persist after surgery. Short-acting agents such as desflurane, propofol, and succinylcholine are recommended, although there is limited literature in this area. Dosing of medications should be adjusted for obese patients. For example, basing a fentanyl dose on pharmacokinetic mass will decrease the relative dose of fentanyl as total body weight increases [25, Class II].

Postoperative care

Sedation and analgesia

- Many surgical procedures require the use of long-acting, nondepolarizing muscle relaxants. Full reversal of the effects of muscle relaxants is important in these patients to avoid postoperative upper airway obstruction; the reversal should be assessed with the use of a nerve stimulator before extubation [26, Class III]. Certain procedures may require special precautions with extubation. Surgery on the neck or in the patient's mouth, or procedures that require long periods of Trendelenburg positioning or large amounts of intravenous fluids, can require time and repeated reassessment before extubation. Besides confirming complete reversal of neuromuscular blockade, it is important that the patient be fully awake, hemodynamically stable, normothermic, and breathing spontaneously (with an adequate respiratory rate and tidal volume) prior to extubation.
- Assessment in the immediate postoperative period includes monitoring for evidence of obstruction and asynchrony of respiratory efforts. Providing safe postoperative analgesia in patients with OSA can be challenging. Opioids, the most commonly used class of analgesics, decrease hypoxic and hypercapnic ventilatory drive [27, Class III]. Regional blocks or catheters may be useful in decreasing the need for opioids [16, Class III], but it is important to keep in mind the risk from opioids administered intrathecally or via epidural injection [28, Class II].
- Multimodal analgesia can be used to decrease the need for opioids and thus the complications that may result in OSA patients [20, Class III]. Multimodal analgesia can include the use of nonsteroidal anti-inflammatory drugs, including

acetaminophen, tramadol, ketamine, pregabalin, and COX-2 inhibitors. Perioperative oxygen desaturations are more likely to occur in OSA patients receiving opioids than in those using nonopioid analgesic agents [29, Class III].

Supplemental oxygen

- Although the literature to support its use is scarce, postextubation supplemental oxygen should be used in patients with OSA until they are able to maintain their baseline oxygen saturation on room air. The ASA task force cautions that supplemental oxygen may increase the duration of apneic episodes and may hinder the detection of transient apnea, atelectasis, and hypoventilation.

Monitoring

- Guidelines to address postoperative and intensive care monitoring have been proposed by some authors, though they are based more on expert opinion than on evidence [30, Class IV]. It should be recognized that an unsupervised holding area is inappropriate for a premedicated patient with sleep apnea. The ASA guidelines recommend that continuous oximetry may be used in the critical care or step-down unit for patients with increased perioperative risk from OSA, but these guidelines do not support the need for intermittent or continuous oxygen monitoring in all patients. The guidelines are equivocal about full monitoring in the ICU setting or continuous oximetry by a dedicated observer in the patient's room or for low-risk patients no longer receiving continuous parenteral narcotics.
- Bolden et al. [29, Class III], in a study of 221 surgical patients with OSA, reported more likely postoperative hemoglobin oxygen desaturation in patients receiving intravenous opioids (OR,14; 95% CI, 3–65; P<0.001), as opposed to those receiving oral opioids (OR, 12; 95% CI, 3–58; P <0.001), particularly in first 24 hours after surgery (OR, 21; 95% CI, 6–74; P <0.0001). All patients were managed per a perioperative OSA protocol as part of a patient safety initiative; 88% were admitted to a designated OSA bed on a general nursing floor and the other 12% were in a step-down or ICU setting.
- In a more recent clinical practice improvement initiative, Gali et al [31••, Class II] tested sleep apnea clinical score (SACS) criteria based on Flemons criteria [32, Class II], using neck circumference, history of hypertension, and reported clinical symptoms to screen for patients at high risk for oxygen desaturation after PACU discharge. An SACS of 15 or higher has been reported to predict a likelihood ratio of 5.17 and a posttest probability of 81% for OSA [31••, Class II], and hence unplanned ICU admission was much less frequent among patients

with a low SACS (0.5%) versus those with a high SACS (8.8%; RR, 16.9; 95% CI, 8.2–35.2) [33, Class III]. An ODI greater than 10 after PACU discharge was reported in 29% of patients with SACS of 15 or higher and in 44% of patients with this high SACS and recurrent PACU events, compared with 19% in those with SACS lower than 15 and 24% in those with low SACS and recurrent PACU events [31••, Class II]. The patients with a high SACS and recurrent PACU events had the highest likelihood of respiratory complications (33%), but polysomnography was not performed to confirm OSA in any of these patients.

- Based on clinical experience, patients that are considered to have high risk for OSA by prescreening and have recurrent PACU respiratory events should receive a higher level of care. The ASA recommends longer (3 hours) postoperative monitoring in OSA patients after ambulatory surgery and 7 hours prior to discharge from the facility after the last episode of airway obstruction or hypoxemia while breathing room air in an unstimulated environment [16, Class III]. The definition of higher level of care is institution-dependent, as some institutions have remotely monitored oximetry. This is continuous observation of oximetry data by a trained respiratory therapist, who can alert nurses caring for a patient when any significant changes or downward trends occur in a patient's oximetry. Alternatively, a step-down unit with a higher nurse-patient ratio should be considered in hospitals who do not have remote oximetry capability.
- The need for opioids and patient positioning should also be considered in the recovery period. If a patient shows a high risk for OSA on screening or has recurrent PACU respiratory events and requires high-dose opioids and a supine position, this patient should also be considered for remote oximetry or placement in a step-down unit.

Perioperative CPAP

- No studies have conclusively shown CPAP therapy to be beneficial in the postoperative setting, although adequate randomized controlled trials to assess its efficacy have not been performed. Routine use of CPAP in the immediate postoperative period in CPAP-naïve or previously noncompliant patients is not usual practice. However, if frequent episodes of severe obstruction occur, CPAP use should be considered [16, Class III].
- In individuals with a known diagnosis of OSA who are receiving CPAP therapy, it is thought that the perioperative use of CPAP will reduce the risk of postoperative complications [34, Class III]. Nasal CPAP therapy is highly effective at preserving airway patency during sleep, and over several weeks it can

improve the diminished reflex responses to hypoxia and hypercapnia [35, Class III]. Hemodynamic fluctuations accompanying early episodes of respiratory obstruction in a patient with undiagnosed sleep apnea after aortic reconstructive surgery were abolished with nasal CPAP therapy [36, Class IV]. Gupta et al. found that use of home CPAP therapy in patients with an established diagnosis of OSA produced possible carryover protection, resulting in a significantly lower rate of complications even though most of these patients did not receive CPAP therapy in the hospital [37, Class III]. This effect may in part be related to upper airway stabilization, which is a residual effect of CPAP therapy following as little as 4 hours of use [38, Class II]. Treatment with CPAP significantly reduces the total duration of ST-segment depression in persons with sleep apnea [39, Class II]. In patients cardioverted for atrial fibrillation, the likelihood of recurrence of the atrial fibrillation within 12 months was double in those with untreated sleep apnea versus the patients with OSA who received CPAP therapy [40, Class II]. These data suggest that there may be some benefit to the use of CPAP in the perioperative setting for patients with suspected OSA, although this benefit remains to be proven. ASA guidelines did not reach any consensus on whether CPAP should be administered if there is evidence of apneas and desaturation, or if hypoxia persists with supplemental oxygen. Bolden et al. reported no possible prevention of oxygen desaturations with the use of CPAP [29].

- One suggested approach to surgical patients who are suspected of having OSA but are unable to undergo polysomnographic evaluation would be to empirically start administering CPAP in the perioperative setting, using self-adjusting or autoadjusting CPAP devices. This approach has not been studied and may have significant limitations on its implementation. If the patient is not familiar with CPAP therapy, technical difficulties in initiating CPAP therapy postoperatively may limit its effectiveness. In addition, titrating CPAP for the first time in the postoperative period is less likely to be successful.

Perioperative management of OSA in patients undergoing bariatric surgery

Preoperative assessment

- Recent series of patients evaluated for bariatric surgery have reported varying prevalences of OSA in these patients: O’Keeffe and Patterson [41, Class II] reported a 77% prevalence, whereas Hallowell et al. reported 91% prevalence [42, Class III]. Among all these studies, there was no correlation between BMI and severity of OSA; in fact, Hallowell et al. reported higher prevalence of OSA in severely obese patients (BMI, 35–39.9) than in morbidly obese patients (BMI, 40–49.9) [42, Class II]. Additionally, routine polysomnography alone prior to bariatric surgery demonstrated a 91% prevalence of OSA, compared with 58% when clinical parameters and Epworth Sleepiness Scale (ESS) scores alone were used to screen for OSA [42, Class III]. Mandatory screening by polysomnography also reduced the number of ICU stays related to respiratory complications to 9% of the ICU transfers, compared with 34% of ICU transfers in the group not screened prior to bariatric surgery [43, Class III]. These and other authors strongly recommend polysomnography for all patients undergoing bariatric surgery [41, Class II; 42, 43, Class III].

Perioperative interventions to improve oxygenation

- At present, three approaches are suggested to improve ventilation and increase oxygenation in obese patients: high tidal volume, positive end-expiratory pressure (PEEP), and the vital capacity maneuver [44, Class III].

Reverse Trendelenburg position

The reverse Trendelenburg position (RTP) is presumed to improve oxygenation in anesthetized obese patients, as well as enabling better exposure of the subdiaphragmatic region, allowing mechanical ventilation with safe levels of airway pressure [45, Class II]. It also decreases the push of abdominal contents on the diaphragm, thereby increasing functional residual capacity (FRC) [45, Class II]. Dixon et al. demonstrated that the decrease in oxygen saturation during apnea under anesthesia is slower when the patient is positioned head-up as compared with a flat position, but any advantage with regard to lung function, atelectasis, and shunting in the 25º head-up position is lost when positive-pressure ventilation is commenced [46, Class II].

Pre-induction and maintenance PEEP

The prevention or reduction of atelectasis from the induction and maintenance of general anesthesia would improve arterial oxygenation. Preoxygenation with 100% fraction of inspired oxygen (FIO_2) and PEEP at a level of 10 cm H_2O for 5 minutes before the induction of general anesthesia, followed by PEEP of 10 cm H_2O during mask ventilation and after intubation reduce atelectasis immediately after intubation, as assessed by CT scan, and improve postintubation arterial oxygenation on 100% FIO_2 (PAO_2 of 457 ± 130 mm Hg vs 315 ± 100 mm Hg in the control group) [47, Class II]. Whether this reduction in atelectasis is maintained (and for how long) is not known. In obese patients without reflux, the improvement in oxygenation that can be achieved with the preinduction use of PEEP is significant and will increase the time before desaturation begins. In contrast, in normal-weight patients, PEEP neither increased the paO_2 nor decreased the A-a gradient. Practitioners should strongly consider taking advantage of the improved arterial oxygenation offered by preinduction PEEP.

Perioperative CPAP

Prophylactic use of CPAP in the first 24 hours after surgery significantly reduces the risk of the pulmonary restrictive syndrome that occurs in morbidly obese patients after gastroplasty [48, Class II]. In one study, there was a 16% (95% CI, 2.9%–29.3%) absolute risk reduction in the rate of respiratory failure in severely obese patients with the use of noninvasive ventilation applied during the first 48 hours after extubation [49, Class II]. However, it is believed that postoperative use of CPAP carries the theoretical risk of increasing the incidence of anastomotic leaks resulting from increased flow of pressurized air into the stomach and proximal anastomosis of Roux-en-Y gastric bypass (RYGB). Huerta et al. looked prospectively at 1,067 patients who underwent RYGB; 420 were confirmed to have OSA and 159 of these were on CPAP. Out of a total of 15 postoperative anastomotic leaks, only 2 occurred in patients treated with CPAP, and no relationship was identified between CPAP use and anatomic disruption of RYGB [50, Class II]. Jensen et al. reported that CPAP or bi-level positive airway pressure (BiPAP) may be safely omitted in laparoscopic RYGB patients as long they are observed in a monitored non-ICU setting and their pulmonary status is optimized by aggressive incentive spirometry and early ambulation [51, Class III]. More recently, among patients undergoing laparoscopic bariatric surgery, noninvasive positive pressure ventilation was reported to improve lung function if initiated immediately after extubation, but there are few data on how this affects outcomes [52••, Class II].

Disclosure

No potential conflicts of interest relevant to this article were reported.

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have been highlighted as:
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