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Admission After Sleep Surgery Is Unnecessary in Patients Without Cardiovascular Disease

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Objective/Hypothesis: Evidence is lacking to guide whether patients with obstructive sleep apnea (OSA) require mandatory postoperative monitoring when undergoing multilevel sleep surgery. The purpose of this study was to examine the respiratory complication rate following OSA surgery and identify which patients benefit from monitoring after surgery.

Study Design: A prospective study was conducted.

Methods: Fifty patients (age 45.4 ± 12.4; male 39, female 11), with sleep study-proven OSA (apnoea/hypopnoea index [AHI] 24.3 ± 22.2) underwent multilevel sleep surgery. All patients had the St. Joseph's OSA risk score calculated preoperatively and then again within the postanesthesia care unit (PACU). The patients were then stratified into two categories: safe for same-day discharge and requiring admission for overnight O2 saturation monitoring. Groups were compared across age, sex, AHI, body mass index, mean O2 saturation, minimum O2 saturation, length of time in PACU, narcotic use, smoking, surgery type, and other comorbidities. The St. Joseph's OSA Risk Tool was applied.

Results: Seventy-eight percent of patients met criteria for same-day discharge, and 22% required admission. For the discharged patients, we had a 0.0% readmission or complication rate for OSA-specific reasons. For the admitted patients, we had no OSA-specific complications while admitted to hospital. No variables consistently predicted complications or need for admission.

Conclusions: The incidence of respiratory events requiring intervention following multilevel sleep surgery is very low. Most patients with OSA undergoing surgery can be safely discharged home without any subsequent respiratory complications. In addition, those patients admitted for monitoring after surgery do not benefit from their admission.

Key Words: Sleep Medicine, surgical treatment of obstructive sleep apnea, obstructive sleep apnea.

Level of Evidence: 2b.

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INTRODUCTION

Surgery for obstructive sleep apnea (OSA) under general anesthetic poses a theoretical increased risk of postoperative respiratory complications for patients. In the recent past, OSA surgery was carried out with planned postoperative intensive care monitoring.[1] There has been a contemporary trend toward less intensive postoperative-care environments or even to outpatient surgery. This trend, however, was confounded by the 2006 OSA perioperative management guidelines published by the American Society of Anesthesiology, as well as by the 2014 subsequent revision, suggesting that the incidence of respiratory complications after OSA surgery was relatively high (> 10%) and that patients undergoing surgery for OSA should have postoperative, continuous overnight oxygen-saturation monitoring.[2] The authors of the guidelines explicitly recognized that the historical literature was insufficient to offer advice regarding which patients with OSA could be safely managed on an outpatient basis as opposed to an inpatient basis.[2]

Modern evidence does not support this admission practice. Published research from our institution and others has shown that the rate of any adverse respiratory event following OSA surgery is far lower than the historical literature indicated; most respiratory events are only simple desaturations.[3] Moreover, those adverse respiratory events that do occur overwhelmingly tend to occur within a few hours after surgery, suggesting that in many cases overnight monitoring may be neither necessary nor beneficial.[3–13] A recently performed systematic literature review further demonstrated that the modern risk of severe adverse postoperative events is far lower than predicted by historical literature and is estimated at less than 2%.[7] Therefore, after being monitored in the postanesthetic care unit (PACU) after surgery without respiratory events and meeting other discharge criteria as appropriate, a large proportion of patients undergoing surgery for OSA could likely be considered safe for same-day discharge home.[8]

A significant disparity now exists between current perioperative practice guidelines and modern scientific

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TABLE I.
St. Joseph's OSA Risk Tool (SORT).

Patient Is Admitted for Monitoring After OSA Surgery If Any of the Following Apply
• Unable or unwilling to wear continuous positive-airway pressure appliance if planned to do so
• While breathing room air, evidence of witnessed apnea, oxygen desaturation to less than 90%, or airway obstruction
• Unexpectedly complex narcotic analgesic requirements

CPAP = continuous positive airway pressure; OSA = obstructive sleep apnea.

evidence. The result is a large number of patients potentially being admitted to the hospital unnecessarily, with associated patient inconvenience, resource utilization, and cost implications. Building on our prior data as well as the work of others, we hypothesized that many patients can be safely sent home if no concerns were noted in the postanesthesia care unit (PACU), and they would suffer no clinically significant adverse respiratory events after leaving the hospital. The goal of the current study was to screen patients undergoing multilevel sleep surgery as being safe for same-day discharge or requiring overnight monitoring based on a risk assessment score—and then determine the complication rate in each group.

MATERIALS AND METHODS

A prospective observational cohort study was conducted of consecutive patients with OSA undergoing multilevel sleep surgery at St. Joseph's Health Centre (London, Ontario), a tertiary care academic teaching center. The study was conducted from June 2011 until September 2013. The project received ethical approval from the research ethics board (REB) at Western University (REB 18302E). Study participation was voluntary, no remuneration was offered, and all patients who agreed to take part signed an informed consent document. The same surgeon (B.W.R.) operated on all patients. Any patient undergoing upper airway surgery specifically to treat OSA was eligible for inclusion. Patients who required postoperative hospital admission for reasons other than OSA were excluded. Also excluded were patients undergoing major tongue-base surgery (e.g., lingual tonsillectomy, submucosal resection) who would have had a risk of postoperative lingual swelling and resultant airway compromise, or those with cardiovascular comorbidities (resistant hypertension, heart failure, cor pulmonale, arrhythmia), both of which groups were deemed as requiring mandatory overnight observation. The types of surgeries performed fell in to three main categories: 1) septoplasty ± turbinoplasty, 2) palatal surgery ± tonsillectomy, and 3) tongue-base radiofrequency ablation. All patients had a preoperative level 1 polysomnographic sleep study (demonstrating at least mild sleep apnea) performed within 1 year of the surgery. Drug-induced sleep endoscopy is not commonly employed in Canada (due to operating room resource restrictions); therefore, it was not done on this patient population. Instead, airway assessment was performed by in-clinic awake endoscopy and Mueller maneuver.

At project inception, the team reviewed scientific literature pertaining to the OSA perioperative care to identify clinical predictors of OSA-specific complications. Because a growing body of literature suggests that patients who develop these problems can be predicted by early postoperative findings in PACU,[4,7–9] only predictive factors that could be identified within that time frame were emphasized. These factors were well defined in the literature and included items relating to patient history, morphologic features, OSA severity, comorbid disease, and narcotic use. [4,7–9] Once the list was drafted and approved by the research group, other allied health services and point-of-care workers were asked to prioritize the list of proposed clinical predictive criteria. These criteria were then utilized to draft the postoperative assessment table, to be used by the bedside PACU nurse within a 4-hour postoperative time period. In order to simplify its administration, the list was winnowed down to what were deemed to be the essential admit/discharge criteria. The wording of each item was left deliberately broad in order to err on the side of safety and allow for individual nursing judgment. Finally we established construct and content validity by having the tabular criteria reviewed by an external group of experts (three surgeons and three anesthesiologists) for independent opinions. After this, the tool was finalized as the St. Joseph's OSA Risk Tool (SORT) (see Table I).

Following surgery, all patients were observed in the recovery room for 4 hours, where they received routine postoperative care. Pain and nausea medications were provided and individualized as required for comfort. In the recovery room, the SORT was applied. A decision regarding overnight hospitalization versus discharge was made. All patients discharged home on the same day as surgery received a standardized phone call on the first postoperative day to assess if there were any OSA-specific complications causing unexpected hospitalizations or readmissions after discharge. The phone call was standardized in order to minimize the introduction of any bias into the respondents' answers. In addition, the patient's hospital record was examined to ensure that there were no unexpected hospital visits for respiratory concerns during the first postoperative week. All patients who screened for admission by SORT criteria were transferred to our institution's sleep apnea overnight-monitoring room for 24 hours of continuous observation. Complications, if any, were recorded as per the protocol of our previous study (see Table II).[3]

Data collected included demographics (age, sex), preoperative apnea hypopnea index (AHI), medical history including relevant comorbidities that may have lengthened their course in the hospital (body mass index [BMI], smoking status, cardiovascular disease, diabetes), surgical procedures performed, intraoperative and postoperative narcotics, mean O_2 saturation, minimal O_2 saturation, and length of time in PACU. The data was then analyzed to determine if any risk factors consistently predicted admission and may be used to guide which patients were safe for same-day discharge following sleep surgery.

Comparisons of means on continuous variables were conducted using Student's *t* test. Associations between dichotomous variables were conducted using the chi-square test, whereas associations between continuous variables were conducted using the Pearson correlation. All data were presented as frequencies of occurrence for dichotomous variable and means and standard deviations for continuous variables where applicable. Because the primary outcome was rate of major complications, and our hypothesis was that those who screen negative (i.e., safe for discharge) would have no such complications, a sample size was calculated to within 10% using the logistic transformation formula (N = 3/0; 10 = 30 negative screens). Consequently, the study was designed to continue until 30 negative screens had been identified. Statistical analysis was calculated using SPSS version 18 software (SPSS, Chicago, IL) and was performed by a trained biostatistician.

RESULTS

A total of 50 consecutive patients who met inclusion criteria presented for OSA surgery over the study

TABLE II.
Nursing Intervention Codes Performed by the Trained Nurse in the Step-Up Unit in Response to the Complications of OSA.

Code	Action
0	No nursing actions outside of normal care
1	Noise from monitor woke up patient
2	RN woke up patient (e.g., verbally, physically)
3	Called RT due to respiratory problems
4	Called MD due to respiratory problems
5	Required supplemental oxygen (e.g., nasal prongs, face mask)
6	Required supplemental CPAC
7	Required oral/nasal airway insertion
8	Required bag mask ventilation
9	Required intubation
10	Required transfer to higher level care (e.g., ICU)
11	Hypertension requiring intravenous medications
12	Cardiac arrhythmia requiring intervention (e.g., called MD, called ECG, intravenous medication, defibrillated, called code blue. Please specify: _____)
13	Other (please specify:_____)

Nursing intervention code variables were the primary outcome measure of the study.

CPAP = continuous positive airway pressure; ECG = electrocardiogram; ICU = intensive care unit; MD = medical doctor; OSA = obstructive sleep apnea; RN = registered nurse; RT = respiratory therapist.

duration. The study included 39 males and 11 females, with an average age of 45.4 ± 12.4. The mean BMI was 30.4 ± 5.6. All included patients had sleep study-confirmed OSA, with a mean preoperative AHI of 24.4 ± 12.2. Surgeries performed included 36 palatal procedures (uvulopalatal flap or expansion sphincteroplasty), 15 tonsillectomies, 20 septoplasties + turbinoplasties, and 14 radiofrequency tongue-base ablations. Eleven of the patients underwent multilevel surgery, meaning they had more than one procedure during the same operation. There were no surgical complications in the study population. The modal American Society of Anesthesiologists (ASA) physical status classification was 2 for this population, with only nine patients being deemed a 3 based on their OSA severity. No patients in this study were rated a 4.

Of the 50 patients in the study population, 39 (78%) met criteria for same-day discharge, and 11 (22%) were admitted based on the SORT protocol. Of the 39 discharged patients, the AHI was 24.3; for the 11 admitted patients, the mean AHI was 28.1, with no significant difference between the two groups on t testing ($P = 0.096$). For the patients deemed appropriate for same-day discharge home, there was a 0.0% readmission or OSA-specific complication rate, and neither the patient nor their family noted any respiratory concerns during the postoperative phone interview. For the admitted patients, there were no OSA-specific complications while admitted to hospital. All 11 patients were admitted secondary to desaturations below 90% on room air within the PACU. Only one admitted patient was given continuous positive airway pressure (CPAP) use after surgery as a new prescription. This was secondary to witnessed upper-airway obstruction while sleeping (the patient had previously refused CPAP, and the new prescription was initiated by the overnight respiratory therapist). All patients were discharged from hospital postoperative day 1.

When comparing the group demographics (age, sex, BMI, preoperative AHI, smoking status, narcotic use in PACU, surgical procedures, and medical comorbidities), none of the tests of means were significant between the two groups [$t(45 \text{ to } 47) = 0.078$ to 1.835; $P = \text{ns}$]. In addition, no significant correlations were seen between preoperative AHI and postoperative mean or minimum O_2 saturation. In other words, based on the data collected from the cohort, we could not identify any specific risk factor that would favor admission over discharge: This was a "negative" study.

DISCUSSION

Surgery for obstructive sleep apnea has historically been considered to be associated with a high postoperative rate of adverse cardiorespiratory events. Complications such as postobstructive pulmonary edema; cardiac arrhythmia; and apnea causing airway obstruction, as well as potential death, were quoted to be as high as 13% to 25%.[6,8] In 2006 (and updated in 2014), the American Society of Anesthesiology published OSA perioperative management guidelines based on historical studies and expert opinion. These guidelines suggested that the incidence of respiratory complications after OSA surgery was relatively high ($> 10\%$) and that all patients undergoing surgery for OSA should have postoperative continuous overnight oxygen saturation monitoring.[2] However, contemporary literature does not support this contention, and recent studies have shown that this level of postoperative monitoring is excessive when considering all patients. In the current study we have demonstrated that, in carefully screened patients undergoing multilevel OSA surgery, 78% were safely discharged from PACU without any overnight adverse event at home; and of the remaining 11% that were admitted, no adverse complications beyond desaturations were noted. Because desaturations are not a new problem in a patient population with long-standing OSA, in theory the entire cohort could have been safely discharged home from PACU. Admission to the hospital for monitoring was not of benefit to the patients in this study.

Our data has further emphasized that the modern postoperative respiratory complication rate in patients undergoing sleep surgery is far lower than historically noted. In our study, the adverse respiratory event rate was 22%; and if simple desaturations were not included, the rate would actually have been zero, which is striking in comparison to the 10% complication rate quoted in the ASA guidelines. This is in line with recent work from our center wherein we examined 121 patients with sleep study-proven OSA (AHI 31.9 ± 22.7) who underwent multilevel sleep apnea surgery. The incidence of nursing intervention in response to respiratory complications was 3.4%, which was significantly less than quoted

by the ASA guidelines.[3] An even more recent review by Pang's group in Singapore demonstrated a low 1.8% incidence of respiratory complications in 487 patients, with eight of the nine complications being noted within 3 hours of surgery while still in PACU, and six of nine being simple desaturations with no adverse consequences.[10] These low rates are in keeping with other recent retrospective reviews.[4,11–13] The stark contrast between the complication rates in the modern versus historical literature may be related to the evolution of both the surgical and anesthetic techniques. Because both the surgical and anesthetic techniques have advanced tremendously in recent years, it is no longer an apt comparison to relate modern data to that of the historical literature. That being the case, the data noted in recent studies should form the contemporary benchmark for OSA surgery complication rates; the more historical data no longer accurately reflects the current safe status of OSA surgery.

Historically, risk factors for perioperative complications included low preoperative oxygen saturation by polysomnograph, high respiratory disturbance index, high body weight, high use of narcotics, and history of cardiac disease.[3] In our study, we were unable to demonstrate any factor that could predict OSA-related complications because the groups were similar across all variables. Within the study patients, no significant correlations between AHI and mean O_2 saturation or minimum O_2 saturations were seen. It is possible covariates were not identified that may have been predictive, but this is unlikely considering the wide range of data collected. The sample was powered to detect the most likely problematic variables. Another possibility is that those in a population like this routinely experience desaturation overnight at home. As a result, a postoperative desaturation should not necessarily be considered a complication of surgery because it may be leading to overtreatment. This is an issue worthy of further study; much of the literature regarding OSA surgery complications hinges on the issue of desaturations.

Numerous studies have identified that patients at risk of respiratory complications are likely to declare themselves in the first few hours following surgery.[3–5,13] In a study by Rotenberg et al., all four patients with respiratory events had oxygen desaturations shortly after surgery.[3] Other authors have found similar results, with two retrospective studies finding that respiratory complications generally emerge within 2 hours after surgery.[4,5] A nationwide review performed by Mokhlesi et al. examined patients with sleep disordered breathing and obstructive sleep apnea in the perioperative period. They found that, in a subgroup of patients requiring emergent reintubation, those with sleep disordered breathing required it significantly earlier compared to those in the control group, most frequently within the first postoperative day.[14] Thus, after appropriate monitoring in the recovery room, with no oxygen desaturations, certain patients may be candidates for same-day discharge.

There are several limitations to this study. First, the study population was relatively small at 50 patients and was not homogenous in OSA severity; our study sample may not have been representative of the OSA population as a whole. Although the number of negative screens obtained in fact exceeded the sample size calculation, the corollary may be that the number of positive screens may have been insufficient to identify predictive factors. Despite almost doubling our sample size, we likely did not have the number of patients needed to statistically determine which factors may need to be more closely scrutinized. This does imply however that if the complication rate is so low, and a much larger study is needed to capture meaningful events, that the OSA-specific complication issue is no longer as significant as once thought. Second, we specifically excluded patients with known cardiovascular comorbid disease from our study population. Had this group been included, the results may well have been different. Therefore, it is important to state that our results should not be applied to that particular OSA patient subgroup. A more global assessment of complications could have been performed, including a 30-day readmission and visits to the emergency room or clinic within the immediate 30-day period to better assess total possible complications that would not present within the first day. However, the farther out from the surgery, the less directly this could have been attributable directly to the procedure. Moreover, cardiorespiratory complications of OSA surgery (the focus of our study) are more likely to have presented earlier.

CONCLUSION

By applying modern evidence in construction of the SORT list, we have identified that the majority of our patients undergoing multilevel surgery for OSA could be safely discharged home from the PACU. Through our data, we were unable to identify specific factors that could predict postoperative complications; however, the incidence of respiratory events requiring intervention following multilevel sleep surgery was nonetheless significantly less than historically predicted. Those patients who are admitted for monitoring after OSA surgery did not seem to benefit from their admission. If patients are not benefitting from current perioperative guidelines of routine postoperative monitoring, this routine practice should be reevaluated and potentially be disinvested.

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