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Safety of Multilevel Surgery in Obstructive Sleep Apnea

A Review of 487 Cases

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Objective: To review the safety of multilevel surgery in patients with obstructive sleep apnea (OSA).

Design: Retrospective review.

Patients: A total of 487 consecutive patients with OSA and 1698 surgical procedures from January 2007 to May 2010.

Interventions: Multilevel OSA surgery comprising nasal surgery (endoscopic sinus surgery, septoplasty, and inferior turbinate reduction), palate surgery (traditional uvulopalatopharyngoplasty, expansion sphincter pharyngoplasty and anterior palatoplasty), and tongue surgery (hyoid suspension, radiofrequency tongue base, and tongue suspension suture).

Main Outcome Measures: Surgical complications.

Results: The overall complication rate was 7.1%, with 1 patient having an upper airway obstruction. Complications were as follows: (1) 6 patients had postoperative oxygen desaturation within 3 hours after extubation (these

patients had severe OSA [apnea-hypopnea index > 60 and lowest oxygen saturation level <80%]), (2) 15 patients had persistent hypertension (these patients had a history of hypertension), (3) 15 patients had secondary hemorrhage (7-12 days postoperatively), (4) there were 2 cases of negative pressure pulmonary edema, (5) 9 patients had tongue edema (following tongue surgery), and (6) 1 patient had upper airway obstruction requiring reintubation. Patients who had undergone tongue surgery were admitted routinely to the high-dependency unit (step-down care from the intensive care unit) overnight.

Conclusions: Routine postoperative admission to the intensive care unit for all patients with OSA is unnecessary. These patients should be closely monitored in the post-anesthesia care unit area after surgery, and based on the outcome of this period, they can be observed overnight in either the high-dependency unit or the general ward.

Arch Otolaryngol Head Neck Surg. 2012;138(4):353-357.

Published online March 19, 2012.

doi:10.1001/archoto.2012.130

SLEEP-DISORDERED BREATHING (SDB) is a spectrum of diseases that include snoring, upper airway resistance syndrome (UARS), and obstructive sleep apnea (OSA). These disorders generally have a collapsible airway. Obstructive sleep apnea is a common sleep disorder. Young et

profound effects on the cardiovascular and respiratory systems and on neurocognitive function. The Sleep Heart Health Study and the Wisconsin Sleep Cohort^{3,4} have demonstrated a strong link between SDB and hypertension. This is believed to be due to sleep fragmentation, nocturnal hypoxemia, and increased sympathetic tone.⁵ This increased sympathetic tone is manifested not only during the nocturnal hypoxic events but also during the day as systemic hypertension. There is convincing evidence of the association between SDB and cardiovascular disease.⁶ The physiologic changes that are the result of recurrent apneas and hypoxemia can cause acute thrombotic events, atherosclerosis, and cerebrovascular accidents. There is a higher mortality rate among patients with cardiovascular disease who also have SDB.

Surgical procedures performed in patients with sleep apnea have traditionally

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al¹ studied 602 state employees with a formal overnight polysomnogram (PSG) and found that the incidence of SDB was 24% in men and 9% for women. Most patients with SDB are undiagnosed, and it is estimated that up to 93% of females and 82% of males with moderate to severe OSA remain undiagnosed.² It is well documented that OSA has

been deemed as dangerous and potentially life threatening if not monitored with caution during the perioperative period. It is well accepted that patients with OSA are at higher risk for airway compromise in the postoperative period. Since the introduction of this type of surgery in the early 1970s, there have been reports of acute upper airway complications postoperatively. Katsantonis et al⁷ reviewed the efficacy of 35 patients with OSA who underwent a uvulopalatopharyngoplasty (UPPP) and found that 2 patients required oral intubation postoperatively owing to upper airway obstruction. Extensive effort has been directed toward identifying patients with OSA who are likely to have postoperative airway and respiratory complications, in the hope of directing resources and preventing complications. Riley et al⁸ noted that those patients with apnea index (AI) greater than 70 and lowest oxygen saturation less than 80% were at higher risk of postoperative complication. Terris et al⁹ suggested that postoperatively patients with OSA should be monitored closely for the first 2 hours, when complications are more likely to occur.

We reviewed the incidence of postoperative complications in patients with OSA undergoing upper airway surgery, in the hope of identifying patients at risk of developing complications and to emphasize the importance of perioperative monitoring.

METHODS

A retrospective review of 487 consecutive patients undergoing surgery for OSA, from January 2007 to May 2010, was performed. All these patients attended the snoring/sleep subspecialty clinic. A comprehensive preoperative assessment was conducted, including a thorough history and physical examination. Patients also completed the Epworth's Sleepiness Scale (ESS) and some questionnaires; height, weight, neck circumference, body-mass index (BMI) (calculated as weight in kilograms divided by height in meters squared), and blood pressure were also documented. All patients who had undergone some form of surgical procedure for OSA were included.

Examination included the documentation of soft palatal redundancy, uvula size and thickness, Mallampati grade, and adenoid and tonsillar size. Nasal cavity and laryngeal examination with a flexible fiber-optic nasoendoscopy was also performed. The Mueller maneuver was performed and graded on a 5-point scale, with attention paid to the level of collapse according to Fujita types I, II, and III.¹⁰

All patients underwent the Watch PAT 100 (Itamar Medical Ltd), ambulatory wrist-worn sleep diagnostic device.

All patients were offered and counseled on the use of continuous positive airway pressure (CPAP) and were strongly advised to participate in a free trial of CPAP, failing which, surgical options were discussed. The types of surgical interventions and number of procedures performed were as follows: septoplasty/submucous resection (for deviated nasal septum), 322; inferior turbinate reduction (bilateral) with the radiofrequency technique, 487; multilevel pharyngeal surgery in the form of the UPPP (Fairbanks technique), 41; expansion sphincter pharyngoplasty, 41; anterior palatoplasty, 487; and/or radiofrequency tongue base, 57; hyoid myotomy (which entails hitching the hyoid bone down inferiorly onto the thyroid cartilage lamina), 49; and the tongue suspension suture, 255 (the Repose tongue suspension suture kit was used through a transoral sublingual incision).

Intraoperatively, short-acting narcotics (mainly fentanyl and/or remifentanyl) were used for all patients. Anaesthesia was maintained with a mixture of gaseous nitrous oxide and oxygen, with an inhalational agent (either desflurane or sevoflurane). All 487 patients were intubated orally, no patients required nasal intubation during the elective surgery. All patients were administered intravenous dexamethasone, 8 mg, as a single dose at induction. Patients who underwent tongue surgery were also administered 8 mg of dexamethasone intravenously every 8 hours for the first postoperative day (POD 1).

Postoperatively, all patients were monitored in the recovery area for half an hour before they are sent to the respective units. In general, patients who had undergone only nose and palate surgery (group 1) were allowed to be discharged home after 6 hours of monitoring in the day surgical unit (provided there are no complications). Patients who had undergone nose, palate, and tongue surgery (group 2) were admitted routinely to the high-dependency unit (step-down care from the intensive care unit, which comprises 1 nurse monitoring 2 patients, with continuous electrocardiogram, pulse oximetry, and blood pressure monitoring) for an overnight observation, and were discharged home the next day. Complications and adverse events occurring postoperatively and during the patients' stay were documented and described. Specific parameters occurring during the complications were documented; these parameters included apnea-hypopnea index (AHI), preoperative lowest oxygen saturation (LSAT) on PSG, current medications, blood pressure measurements, narcotic and steroid use, and pulse oximetry postoperatively.

Exclusion criteria were age younger than 18 years, refusal of surgical intervention, treatment with CPAP with no surgical intervention, having oral appliance with no surgical intervention, not being fit for surgery, and having undergone previous airway surgery for any reason. The study was approved by the institution review board ethics committee in the institution.

RESULTS

The study population consisted of 487 patients, with a total of 1698 surgical procedures. There were 423 men and 64 women. The age range was from 22 to 65 years (mean [SD], 42.5 [9.4] years). The mean BMI was 24.6 (range, 19.3-34.8). About half the patients had a free trial of CPAP therapy for a minimum of 1 to 2 weeks. Some patients could tolerate the CPAP only for a couple of nights, while other patients refused the free trial of CPAP. The mean ESS score was 14.5 (8.1-17.2), and the mean neck circumference was 16.2 inches (range, 14.3-18.2 inches).

The mean AHI was 47.3 (range, 21.7-85.5), and the mean LSAT was 75.4% (range, 54.5%-91.0%). The 1698 procedures were performed as multiple procedures (nasal and palatal surgery or nasal, palatal, and tongue surgery) tailored to the site of obstruction. There were 175 patients in group 1 and 312 patients in group 2. All patients in group 2 stayed overnight in the high-dependency unit as a routine precaution for observation. Only 25 patients from group 1 stayed 1 night in the general ward facility, only on request by the patient.

The overall complication rate was 7.1%, with 1 patient having any an upper airway obstruction. The complications and numbers (percentages) of patients were classified as follows: (1) oxygen desaturation, 6 (1.2%); (2) persistent hypertension, 15 (3.1%); (3) negative pressure pulmonary edema, 2 (0.4%); (4) tongue swelling,

9 (1.8%); (5) airway obstruction 1 (0.2%); and (6) bleeding problems 15 (3.1%).

OXYGEN DESATURATION

Six patients (1.2%) had a single episode of postoperative oxygen desaturation while in the operating room recovery area. All 6 patients' desaturation occurred within 180 minutes postoperatively. Five patients experienced desaturation within the first 2 hours postoperatively, while 1 patient experienced an 85% desaturation approximately 2½ hours postoperatively. All 6 patients were given 100% oxygen by mask (for 1 hour) and recovered from the episode without further desaturations in the hospital. These 6 patients did not have desaturations below that of their preoperative LSAT level found on their sleep test. However, all these 6 patients had severe OSA, with a mean (SD) AHI of 66.7 (19.2), and a mean LSAT of 61% (15%).

HYPERTENSION

Fifteen patients had persistent postoperative hypertension. The systolic blood pressure ranged from 190 to 210 mm Hg, and diastolic blood pressure ranged from 100 to 125 mm Hg. These patients were given short-acting anti-hypertensive drugs (eg, labetalol) for control of their hypertension, followed by oral nifedipine (calcium channel blocker) on an as-needed basis. Intraoperatively, patients who had hypertension were given intravenous remifentanyl. Postoperatively, they were also given adequate analgesia for pain relief. According to their responsiveness to the medication, they were observed in the high-dependency unit or the general ward. None of them reported any chest discomfort, electrocardiogram changes, or any complaints of neurological deficits. Interestingly, all of these patients were known to have hypertension. All patients had moderate to severe OSA. There were no instances of cardiac arrhythmias noted in any of the patients.

NEGATIVE-PRESSURE PULMONARY EDEMA

Two patients had negative-pressure pulmonary edema during reversal of anesthesia. This was attributed to the patient biting on the endotracheal tube while taking an inspiration; this draws intravascular fluid into the alveoli and results in flooding of the lungs. Both patients were admitted to the high-dependency unit and administered a single dose of intravenous furosemide (a diuretic). One patient was discharged the following day because he was well, with no overnight desaturations, whereas the other patient stayed 1 more night in the high-dependency unit for observation. Both recovered well, with no long-term impact in their lives.

TONGUE EDEMA

The tongue suspension suture had resulted in floor of the mouth edema and bruising in 9 patients. This resolved within 2 to 3 days with intravenous dexamethasone over 24 hours and oral dexamethasone for 3 days subsequently. These 9 patients stayed a second night in hospital. No patients had any long-term complications

from the tongue suspension suture (the mean duration of follow-up was 26.5 months).

AIRWAY OBSTRUCTION

There was only 1 patient who had upper airway obstruction. This was a 32-year-old man who had undergone nose, palate, and tongue suspension; on POD 2, he coughed violently and started bleeding in the floor of the mouth, where the lingual frenulum incision was made in order to insert the tongue suspension. There was a hematoma that collected in the floor of the mouth region that tracked posteriorly into the base of tongue, and which subsequently caused airway obstruction. This patient required emergency nasoendotracheal intubation (while awake in the operating theater) and evacuation of the clot in the floor of his mouth. He was kept intubated for 3 days with intravenous sedation, propofol, and intravenous dexamethasone, 8 mg, every 6 hours. He recovered well and extubation 3 days was uneventful.

BLEEDING PROBLEMS

There were 15 instances of postoperative bleeding, none of which occurred in the hospital. The hemorrhages all occurred on PODs 7 to 15. All of the bleeding was from the tonsillar bed. Eight of the 15 patients required return to the operating room for examination under anesthesia and hemostasis, whereas the other 6 patients were admitted in the hospital for observation, and 1 patient required silver nitrate application to the bleeding tonsillar bed. No patients required blood transfusion. One patient admitted to having taken ginkgo biloba supplemental tablets over the past year, whereas another patient had actually taken aspirin for headaches, 3 doses, just 4 days preoperatively.

NASOPHARYNGEAL STENOSIS

Although this is not an immediate perioperative complication, nasopharyngeal stenosis was included for completeness. There were no patients with nasopharyngeal stenosis.

COMMENT

Many sleep specialists believe that patients with OSA have a higher incidence of postoperative airway complications compared with nonotolaryngologic procedures. This risk is more pronounced in patients with OSA because many of them have small mandibles, large tongues, and short, fat necks, adding to the challenge for the anesthesiologist to establish an artificial airway.¹¹

NARCOTICS AND THE AIRWAY

Respiratory depression and repetitive apneas may occur soon after extubation in patients with OSA.¹² Because patients with OSA are very sensitive to narcotics, the use of opioids might cause prolonged respiratory depression in these patients (up to 4-12 hours after administration).¹³ Our 6 patients with oxygen desaturation, which occurred within 3 hours after extubation, recovered un-

eventfully with supportive treatment and oxygen administration. We did not find as high an incidence of postoperative laryngeal edema as Katsantonis et al⁷ did (5.7%), likely due to the prophylactic administration of steroids in all our patients.

Ostermeier et al¹³ postulated that patients with OSA are at risk of developing respiratory complications postoperatively in the absence of pain. Most sleep specialists believe that pain prevents the rebound of REM (rapid eye movement) sleep and stages 3 and 4 sleep, which predisposes to collapse of the upper airway at around POD 3. Owing to preoperative anxiety and stress, patients' sleep quality would be poor. Hence, many patients would have REM rebound postoperatively and would be more prone to increased upper airway collapse during the periods of atonia (REM sleep). This phenomenon is mostly seen beyond POD 3 or 4,¹⁴ usually when the patient is discharged from the hospital and is at home. Therefore, there is a need to postoperatively identify patients who are likely to experience desaturation while in hospital. Similar to the findings of Terris et al,⁹ most of our patients who had oxygen desaturations experienced these within 2 to 3 hours after surgery. These oxygen desaturations were all no worse than their respective preoperative PSG LSAT level, and the patients all recovered uneventfully with supplemental oxygen therapy. Spiegel and Raval¹⁴ suggested that not all patients with OSA require a minimum of 1 night stay in hospital. Our data also found that multilevel surgery (ie, combined surgery to both the nose and palate) in patients with OSA can be safely performed on an outpatient basis.

SEVERITY OF OSA

Spiegel and Raval¹⁴ showed that the severity of OSA influences the risk of postoperative surgical complications in patients with OSA. Riley et al⁸ also reported a higher complication rate in patients with a preoperative AI greater than 70 events per hour, and a minimum oxygen saturation below 80%. Esclamado et al¹⁵ found that the frequency of apneas and reductions in oxygen saturations were predictors of complications. However, Gupta et al¹⁶ noted that even patients with mild OSA had a higher risk of perioperative complications after orthopedic surgical procedures. We found that in our 487 patients in this series, the 6 patients who had postoperative oxygen desaturations had severe OSA, with a mean (SD) AHI of 66.7 (19.2), and mean LSAT of 61% (15%). We did not find a statistically significant difference in the AHI or LSAT between this small group with these complications and the group without complications ($P > .05$). We recommend that the routine admission to an intensive care unit for all patients with OSA (or patients with severe OSA) is unnecessary. We suggest that all patients with OSA be monitored closely in recovery postoperatively.

HYPERTENSION

Hypertension as a postoperative complication was common in our 487 patients. We found that these complications ranged from mild, raised blood pressure to uncontrolled hypertension requiring intravenous

administration of a short-acting antihypertensive drug (labetolol) and/or oral nifedipine (calcium channel blocker). All these 15 patients with postoperative hypertension had a history of established hypertension preoperatively. Gal and Cooperman¹⁷ showed, in 1844 surgical patients, that the incidence of postoperative hypertension (defined as 2 consecutive readings of diastolic blood pressure >100 mm Hg or systolic blood pressure >190 mm Hg) was 3.3%, and that 58% of these patients had a preoperative history of hypertension.

Pain can also contribute to postoperative transient hypertension. The use of nonsteroidal anti-inflammatory drugs and/or cyclo-oxygenase 2 inhibitors is very helpful during this period. Narcotics must be used judiciously in patients with OSA, and continuous monitoring would be prudent.

PERIOPERATIVE CPAP

The use of CPAP may be more difficult in a patient with OSA than it is in a normal person; to wear a CPAP mask after oral or nasal surgery might be a huge feat for the patient. However, Powell et al¹⁸ proposed that perioperative use of CPAP might be helpful to overcome the unexpected upper airway edema postoperatively. The use of CPAP (pneumatic splint) has permitted the consideration of non-intensive methods of monitoring patients postoperatively, as the risk of obstruction is minimized. Jain and Dhand¹⁹ also support the use of perioperative CPAP therapy and suggest that patients with OSA should use CPAP before and after surgery. This practice has also been shown to reduce the risk of perioperative respiratory depression.²⁰

BLEEDING AND AIRWAY OBSTRUCTION

Surgery on the tongue in patients with OSA has traditionally been deemed to be dangerous, as these patients typically have small mandibles, large tongues, and a narrow retroglottal space; any form of bleeding or edema in this retroglottal area would be the clinician's nightmare and result in the patient's death. Typically, it is suggested that patients who have undergone tongue surgery would require a nasal airway postoperatively and be monitored in the high-dependency unit at least overnight. In our 1 patient (0.2%) who had floor of mouth bleeding and required reintubation, the high-dependency monitoring was, retrospectively, crucial in early detection of airway compromise and oxygen desaturation.

Nine of the 255 patients (3.5%) who underwent the tongue suspension suture had postoperative tongue edema in the floor of mouth region, presumably from the surgical access and manipulation during the insertion of the Prolene suture. Intravenous dexamethasone on a regular dosage for at least a day would be prudent for these patients, in order to prevent further swelling of the floor of the mouth area. None of these patients required reintubation or a prolonged hospital stay.

RECOMMENDATIONS

Patients with OSA typically have small retrognathic mandibles with difficult airways and, hence, present as dif-

difficult intubations to the anesthesiologists.²⁰ In addition, respiratory depression from anesthetic agents like muscle relaxants and narcotics are well documented in these patients. From this study, we conclude that

1. Patients with OSA are usually more sensitive to muscle relaxants and narcotics and may have higher incidence of postoperative respiratory compromise.

2. Prudence in treating patients with severe OSA (AHI>60 and LSAT<80%) is recommended because we found that they might be at higher risk of postoperative oxygen desaturation.

3. The routine postoperative admission to the intensive care unit for all patients with OSA might not be routinely necessary (including those with severe OSA).

4. All patients with OSA should be closely monitored in the recovery area or high-dependency area for at least 3 hours after surgery. Based on the clinical monitoring and outcome during this period, patients who had undergone only nasal and palate surgery with no clinically significant postoperative airway edema may be allowed to go home, whereas patients who had undergone nasal, palate, and tongue surgery should be kept in the ward for at least 1 night.

5. Postoperative hypertension, requiring oral or intravenous pharmacological intervention, is more likely in patients with a history of hypertension.

6. Adequate analgesia to ensure good pain control is essential in patients with OSA.

7. Perioperative use of CPAP, although not often tolerated, may reduce the incidence of postoperative respiratory compromise and complications, and is strongly recommended.

In conclusion, we strongly recommended that the clinician manage the patient with OSA with caution and prudence, with the understanding that these patients have a higher risk of airway compromise and respiratory depression intraoperatively and postoperatively.

Submitted for Publication: July 7, 2011; final revision received January 3, 2012; accepted January 30, 2012.

Published Online: March 19, 2012. doi:10.1001/archoto.2012.130

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Author Contributions: All authors had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. *Study concept and design:* Pang. *Acquisition of data:* Pang. *Analysis and interpretation of data:* Pang, Siow, and Tseng. *Drafting of the manuscript:* Pang. *Critical revision of the*

manuscript for important intellectual content: Pang, Siow, and Tseng. *Statistical analysis:* Pang. *Administrative, technical, and material support:* Tseng. *Study supervision:* Siow. **Financial Disclosure:** None reported.

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