

A retrospective analysis of airway management in patients with obstructive sleep apnea and its effects on postanesthesia care unit length of stay

Claire A Brousseau BSc, Gregory R Dobson MD FRCPC, Andrew D Milne MD MSc FRCPC PEng

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Obstructive sleep apnea (OSA) is a form of sleep-disordered breathing characterized by periods of partial or complete obstruction of the upper airway during sleep, resulting in oxygen desaturations. Symptoms and risk factors for OSA are of particular importance in the management of OSA patients in the perioperative setting. The present study collected data regarding the intraoperative airway management of OSA patients and their course in the postanesthesia care unit (PACU) over a six-month period. A total of 86 patients underwent general anesthesia, 63 of whom were intubated by direct laryngoscopy. Of these, 43% were classified as a grade 1 view by direct laryngoscopy, 43% were grade 2 and 14% were classified as grade 3. Apnea events or periods of desaturation in the PACU were observed in 27% of cases. Length of stay was significantly longer for cases in which PACU nurses had indicated that OSA had affected the individuals' postoperative course of treatment. Overall, OSA patients had an increased frequency of grade 3 views compared with the general population, and adjuncts were commonly used to help secure the airway in OSA patients. Symptomatic OSA patients placed increased demands on the PACU in terms of length of stay and hospital resources.

Key Words: *Difficult airway; PACU complications; Sleep apnea*

Obstructive sleep apnea (OSA) is a form of sleep-disordered breathing that has become increasingly prevalent in contemporary society. OSA is characterized by periods of partial or complete obstruction of the upper airway during sleep, resulting in oxygen desaturations (1), which can lead to angina, cardiac arrhythmias, and both systemic and pulmonary hypertension (2). Various daytime symptoms are also associated with OSA, including excessive daytime sleepiness, morning headaches, fatigue, irritability and personality changes (3). Although the pathophysiology of OSA depends primarily on pharyngeal anatomy and stage of sleep (4), there are several factors that can contribute to the development of OSA. Obesity, craniofacial and upper airway structure, older age, sex (hormonal differences) and genetics can all contribute to the likelihood of an individual developing OSA (5). These risk factors and symptoms are of particular importance when preparing to manage OSA patients in the perioperative setting in terms of securing the airway, as well as in postoperative discharge planning. The prevalence of OSA in the general surgical population is reported to be 20% to 24%, of which 90% is undiagnosed (6), highlighting the importance of recognizing the common symptoms and risk factors in these patients.

During general anesthesia, definitive airway management is crucial to maintain ventilation and oxygenation throughout the surgical procedure. The combination of physical properties, such as obesity, craniofacial and pharyngeal abnormalities, along with a decreased airway patency and increased obstructive response to anesthetics and analgesic medications can all contribute to making OSA patients

Analyse rétrospective de la prise en charge des voies respiratoires chez des patients atteints d'apnée obstructive du sommeil ainsi que de ses effets sur la durée d'hospitalisation dans une unité de soins postanesthésiques

L'apnée obstructive du sommeil (AOS) est une forme de trouble respiratoire du sommeil caractérisée par des périodes d'obstruction partielle ou complète des voies respiratoires supérieures pendant le sommeil, qui provoque des désaturations en oxygène. Les symptômes et facteurs de risque d'AOS revêtent une importance particulière pour la prise en charge des patients atteints d'AOS en milieu périopératoire. La présente étude a permis de colliger, sur une période de six mois, des données sur la prise en charge intraopératoire et l'évolution des voies supérieures des patients atteints d'AOS à l'unité de soins postanesthésiques (USPA). Au total, 86 patients ont subi une anesthésie générale. De ce nombre, 63 ont été intubés par laryngoscopie directe, dont 43 % ont obtenu une vue de classe 1, 43 %, une vue de classe 2 et 14 %, une vue de classe 3. Dans 27 % des cas, les chercheurs ont observé des épisodes d'apnée ou de désaturation à l'USPA. La durée d'hospitalisation était beaucoup plus longue dans les cas où, selon les infirmières de l'USPA, l'AOS avait nui à l'évolution postopératoire du traitement. Dans l'ensemble, les patients atteints d'AOS présentaient davantage de vues de classe 3 que la population générale, et il fallait souvent utiliser des accessoires pour sécuriser leurs voies respiratoires. À l'USPA, les patients symptomatiques atteints d'AOS étaient hospitalisés plus longtemps et mobilisaient plus de ressources hospitalières.

potentially more difficult to intubate and manage (7,8). The Cormack-Lehane (CL) score is a common grading system used to quantify the ease or difficulty of intubation based on the extent of glottic structures apparent on direct laryngoscopy. Typically, grade 3 (only the epiglottis visible) or grade 4 (no glottic structures visible) views are considered to be 'difficult' intubations (9,10). Considering the loss of elasticity in the airway anatomy and excess adipose tissue around the neck that is characteristic of OSA patients, it is plausible that these patients can be more difficult to intubate (11).

Previous studies have shown an association between OSA and difficult intubation (7,8,11-14). Hiremath et al (7) observed 15 patients who were difficult to intubate and found that eight (53.3%) had OSA compared with only two (13.3%) in the control group. Chung et al (12) also investigated a cohort of patients who were unexpectedly difficult to intubate and found that 66% had OSA. Similarly, Siyam and Benhamou (13) found that difficult intubation occurred in 21.9% of OSA patients compared with 2.6% of control patients, and Bolden et al (14) reported that 15% of their OSA cohort experienced difficult intubations. However, Neligan et al (15) reported that OSA was not linked to CL airway grade nor difficult intubation in bariatric patients.

The present study examined the airway management techniques and relative difficulty of intubation of OSA patients in a large teaching institution. As a secondary outcome, the postanesthesia care unit (PACU) data for these patients were analyzed for PACU length of stay (LOS), apneas or related complications observed, and the effect of OSA on the PACU LOS.

Department of Anesthesia, Pain Management and Perioperative Medicine, Dalhousie University, Queen Elizabeth II Health Sciences Centre, Halifax, Nova Scotia

Correspondence: Ms Claire A Brousseau, Dalhousie University, 2109 Beech Street, Halifax, Nova Scotia B3L 2X7.

Telephone 902-449-5233, e-mail claire.brousseau@dal.ca

TABLE 1
Demographic data of postoperative obstructive sleep apnea patients

	Male (n=66)	Female (n=25)	P
Age, years	56.9±12.5	54.8±8.7	0.42
Body mass index, kg/m ²	34.3±7.1	39.2±9.9*	0.01*

Data presented as mean ± SD unless otherwise indicated. *Statistically significant

TABLE 2
Admission status, surgical type and anesthetic method of postoperative obstructive sleep apnea patients

Surgical details	n/n (%)
Outpatient	21/91 (23)
Same-day admission	57/91 (63)
Inpatient	13/91 (14)
Airway related	14/91 (15)
Intra-abdominal/thoracic	32/91 (35)
Major joint/arthroplasty	7/91 (8)
Minor/peripheral surgery	38/91 (42)
General anesthetic	86/91 (95)
Spinal/regional anesthetic	5/91 (5)

METHODS

Research ethics board approval was obtained for the present study. The demographic and postoperative PACU LOS data were collected prospectively as a part of a quality control bed utilization project, and the intraoperative airway management data were extracted retrospectively from an anesthesia intraoperative management system (Saturn Information System, Draeger Medical, USA). Data collection occurred over a six-month period (July to December 2009) at the Queen Elizabeth II Health Centre (Halifax, Nova Scotia). During this time period, nurses in the PACU monitored postoperative patients with either sleep testing-confirmed or suspected OSA (based on the patients' history and clinical symptoms) (16). For these patients, intraoperative information regarding airway management and anesthetic strategies were collected in addition to any available OSA history. A standardized form was used for documentation of patient demographics, ambulatory and admission status, PACU admission and discharge times, desaturation or apnea events in the PACU, and continuous positive airway pressure (CPAP) use, if applicable, and if reported by the patient. PACU nurses were asked to indicate on the data collection form whether the patients' OSA had affected their postoperative LOS and course of treatment. Nursing staff were also allowed to write in any comments that they believed were pertinent to the patients' OSA and PACU stay. Intraoperative data were analyzed for ease of intubation and airway grade obtained, as well as airway management issues encountered and techniques used.

Statistical analyses were performed using ANOVA with Holm-Sidak post hoc comparisons. All statistical calculations were performed using SigmaPlot version 12.0 (Systat Software Inc, USA). Interval data were expressed as mean ± SD; the level of significance was set at P<0.05.

RESULTS

A total of 91 adult patients were included in the study over the six-month period (66 men, 25 women [Table 1]). The majority of patients had a formal diagnosis of OSA confirmed by testing (63% [n=57]) versus highly suspected OSA (37% [n=34]) based on clinical symptoms. Women had a significantly higher body mass index (BMI) compared with men (Table 1). Most patients underwent an outpatient or same-day surgical procedure, and the majority underwent general anesthesia (Table 2).

Only two cases of difficult bag-mask ventilation (BMV) were documented, whereas 45 (of the 86 total general anesthesia cases) were

TABLE 3
Method used to secure and manage the airway in surgical obstructive sleep apnea patients undergoing general anesthesia

Airway method	n/n (%)
Direct laryngoscopy	63/86 (73)
Cormack-Lehane grade 1	27/63 (43)
Cormack-Lehane grade 2	27/63 (43)
Cormack-Lehane grade 3	9/63 (14)
Cormack-Lehane grade 4	0/63 (0)
Laryngeal mask airway	15/86 (17)
Glidescope (Verathon Inc, USA)	5/86 (6)
Lightwand	2/86 (2)
Awake fiberoptic bronchoscope	1/86 (1)

reported as 'easy' to bag-mask ventilate. Airway management data were extracted for 86 of the patients (Table 3). Intubation by direct laryngoscopy was the most common method of airway management for patients undergoing general anesthesia. A supraglottic airway device (laryngeal mask airway) was used in 17% of cases, and alternative intubation techniques, such as a Glidescope (Verathon Inc, USA) or lightwand, were used in 8% of cases. There was one awake fiberoptic bronchoscope-assisted intubation.

Overall, mean (± SD) PACU LOS for men was 187±118 min, and 156±90 min for women. Apnea events or periods of desaturation in the PACU were observed in 27% of cases. When these events were observed, the PACU LOS was significantly increased compared with individuals without documented desaturation or apnea events (LOS with apnea/desaturation = 270±135 min versus LOS without apnea/desaturation = 143±78 min; P<0.002). For cases in which the PACU nurses had indicated that the patient's OSA status had impacted their course in PACU, the LOS was also significantly longer (OSA did impact LOS = 253±111 min versus OSA did not impact LOS = 148±98 min; P<0.024). However, PACU LOS was not significantly different between the confirmed and suspected OSA groups (confirmed OSA = 159±101 min versus suspected OSA = 210±123 min; P=0.27). For patients with confirmed OSA, 13% used their CPAP machines postoperatively in the PACU, while 6% left their CPAP machine at home. Finally, there were no immediate deaths or severe complications noted in any cases.

DISCUSSION

A total of 91 patients were included in the present study, the majority of whom were men (Table 1). This is consistent with the ratio of men and women with OSA that has been previously reported in the general surgical population (17).

Previous studies have shown that OSA patients are more difficult to intubate (7,8,11-13,14), while other studies have reported no correlation between OSA and difficult intubation or postoperative complications (15,18). The present study attempted to clarify, and further classify the methods and difficulty of OSA airway management in a large teaching hospital. For the general surgical population, the overall reported frequencies of each CL airway grade are: grade 1 – 99%; grade 2 – 1%; grade 3 – 1 per 2000; grade 4 – <1 per 100,000 (10). The results of the present study yielded 43% of patients with a grade 1 view, 43% with grade 2, 14% with grade 3 and no grade 4 views. The increased prevalence of grade 3 views, as found in the present cohort, supports previous work suggesting that OSA patients can be more difficult to intubate. Bolden et al (14) found that 15% of their OSA cohort was reported to be difficult intubations, which correlates well with the findings from our study, which had 14% of patients with a grade 3 airway view. A more limited view of the airway due to excess neck tissues, as commonly encountered in OSA patients, could result in more difficulty or even failed attempts at intubation (11).

Furthermore, 9% of patients in our cohort required some other adjunct or airway method to facilitate intubation (Glidescope, lightwand, awake fiberoptic bronchoscope).

The relationship between obesity and OSA has often been discussed in the literature. O'Keefe and Patterson (19) found that OSA occurs independently of BMI. Generally, however, the consensus is that patients with OSA have a higher BMI, on average, than individuals without OSA (20,21). According to Chung et al (22), a BMI $>35\text{kg/m}^2$ is the screening cut-off for OSA patients when using the STOP questionnaire. Both the male and female OSA groups in the present study approached or exceeded a BMI of 35kg/m^2 , which would be considered obese, and with both upper limits of the CIs reaching $>40\text{kg/m}^2$, which is considered to be clinically severe obesity (2).

Difficult BMV has also been reported in obese patients due to excessive adipose tissue, and restricted chest and lung anatomy (5). In some patients, difficult BMV could further compound airway management in the setting of a predicted difficult intubation. A previous study by Plunkett et al (23) found that difficult BMV was suggestive of undiagnosed OSA. Our study found only two documented cases of 'difficult' BMV, and 45 of the 86 general anesthetic cases (52%) were reported to be 'easy' to BMV. However, some patients may not have had any BMV performed as part of their induction (ie, rapid sequence induction intubations or direct laryngeal mask airway insertion without BMV), and the documentation of ease of BMV is inconsistent among anesthesia staff when describing the airway method in our institutional anesthesia information management system. Despite this, it is interesting to note the frequency of 'easy' BMV in our cohort, given the reported difficulty in laryngoscopy, and may be an area for future investigation.

The secondary outcomes of the present study relating to postoperative PACU events are in agreement with the previous literature. It has been shown that OSA patients experience more frequent postoperative complications (21). The present study was able to provide even more insight into the immediate postoperative period in the PACU and how OSA may adversely affect LOS. In particular, the results showed that LOS was significantly increased in cases for which the nurses reported that OSA had, in some form, impacted the LOS and course of treatment in the PACU. The PACU stay may have been negatively impacted by OSA through various different mechanisms, including delayed discharge due to limited intermediate care bed availability for overnight monitoring, delayed home discharge due to apnea events or lack of a home CPAP machine, variability in analgesic and opioid administration for concerns over apnea or desaturation events, and delays awaiting CPAP delivery in patients who left their machines at home. This may direct how OSA patients are handled with regard to PACU care, discharge planning versus overnight admission and in preparation for surgical procedures. For example, only 13% of patients used their CPAP machines postoperatively, and 6% of patients had not brought their CPAP machines with them (despite the institutional policy that all patients are to bring their own CPAP, even for ambulatory procedures). However, we were unable to quantify through the present retrospective study how many patients diagnosed with OSA actually owned and used CPAP machines at home. Postoperative CPAP use is an area in which potential changes could be made to improve the course of PACU results for OSA patients.

Apnea and desaturation events were noted in 27% of the present cohort, and have been previously reported as a common adverse event for postoperative OSA patients (21). Although the recording of apnea and desaturation events were left to the clinical discretion of the PACU nursing staff, they routinely assess postoperative patients for apnea or desaturations, and typically consider a desaturation as reading $<90\%$. This reference level is generally accepted in the OSA literature (14,24). These adverse respiratory events resulted in significantly longer PACU stays than in patients who did not experience apnea or desaturations. The current institutional guideline for PACU monitoring of ambulatory OSA patients at the QEII Health Centre is 4 h (240 min). Patients who experienced apnea and desaturations, and patients whose

course in the PACU were noted by nursing staff to have been adversely affected, both had PACU stays beyond the institutional guidelines (270 ± 135 min and 253 ± 111 min, respectively). This is a considerable issue because OSA patients are placing increased and prolonged demands on PACU beds and staff. Again, use of CPAP postoperatively in the PACU could be beneficial in reducing LOS and additional stress on hospital resources. In addition, close monitoring and careful anesthetic management of these patients may help reduce the number of apnea and desaturation events in the PACU.

One other significant concern surrounding OSA in the literature relates to the need for preoperative diagnosis (19,20). The present study, however, found that a confirmed diagnosis of OSA had no effect on the PACU LOS compared with the suspected OSA group without a confirmed diagnosis. Although no significant difference was found, a confirmed diagnosis of OSA – or careful preoperative screening – may help in preparation for potentially difficult intubation or airway management and postoperative management and, therefore, should still be taken into consideration.

The present study had some potential limitations. First, it is possible that there was an incomplete capture of all OSA patients processed through the PACU within the study time frame. Although measures were taken to create as complete a dataset as possible, there may have been some cases that were missed if a confirmed or suspected OSA diagnosis had not been elicited by the anesthesiologist or nurse. Further research in this area with larger study groups would help to support the findings of the present study. In addition, there may be an unintentional bias in delaying PACU discharge due to a known or suspected OSA diagnosis. There may be a tendency to retain OSA patients in the PACU for longer periods of time, especially because the potential for an adverse event is common.

CONCLUSION

The present study observed surgical OSA patients in terms of method and ease of airway management, as well as PACU LOS and OSA-related adverse events. OSA patients had more difficult airway views compared with the rates reported for the general population. Symptomatic OSA patients placed increased demands on the PACU in terms of LOS and hospital resources. Postoperative CPAP use was limited and apnea or desaturation in the PACU was common. This resulted in increased PACU LOS, often beyond the institutional guideline of 4 h (240 min).

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