Journal of Anesthesia & Clinical Research

Endo A et al., J Anesth Clin Res 2018, 9:12
DOI: 10.4172/2155-6148.1000871

Research Open Access

Preoperative Use of Continuous Positive Airway Pressure is related to Postoperative Respiratory Complications in Patients with Obstructive Sleep Apnea Undergoing Endoscopic Sinus Surgery

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Received date: December 10, 2018; **Accepted date:** December 24, 2018; **Published date:** December 31, 2018

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Abstract

Backgrounds: Patients with obstructive sleep apnea (OSA) undergoing endoscopic sinus surgery (ESS) are considered at risk of postoperative respiratory complications because postoperative nasal packing often delays resumption of preoperative continuous positive airway pressure (CPAP) therapy.

Our hospital implemented a policy in 2011 that all patients with OSA undergoing ESS be admitted to the intensive care unit (ICU) for at least 1 night for postoperative respiratory monitoring.

We conducted the present study to evaluate the policy by examining the incidence of postoperative respiratory complications and to identify risk factors for postoperative respiratory complications in these patients.

Methods: All patients with OSA scheduled for ESS from 2011 to 2015 were included in this retrospective chart review. Postoperative respiratory complication was defined as decrease of the percutaneous arterial oxygen saturation (SpO_2) greater than 3% from each baseline or apnea for more than 20 seconds. We examined the incidence of respiratory complications and conducted multiple logistic regression analysis to determine risk factors for those of complications.

Results: A total of 152 patients were analyzed. Postoperative respiratory complications were observed in 27 patients (17.8%) and the minimum value of SpO_2 was 84%. None of these patients experienced severe sequelae. Multiple logistic regression analysis showed that preoperative CPAP use was an independent risk factor for postoperative respiratory complications (odds ratio=4.1; 95% CI=1.1–14.7).

Conclusion: This retrospective study revealed a relatively high incidence of postoperative respiratory complications after ESS in patients with OSA. Our hospital policy of continuous respiratory monitoring in the ICU for at least 1 night postoperatively appears to be valid for these patients.

Keywords: Endoscopic sinus surgery; Obstructive sleep apnea; Postoperative respiratory complications

Introduction

Obstructive sleep apnea (OSA) is a common comorbidity in surgical patients [1]. It can lead to hypertension, cardiovascular disease, heart failure, and stroke [2,3]. Patients with OSA undergoing surgery are known to have a greater incidence of perioperative pulmonary complications such as requiring intubation or developing aspiration pneumonia, acute respiratory distress syndrome, or pulmonary embolism compared to those without [4]. Moreover, OSA can be a predisposing factor itself for perioperative death or anoxic brain injury due to respiratory arrest [5].

Continuous positive airway pressure (CPAP) is a major therapy for patients with moderate to severe OSA. It has been recommended that patients using preoperative CPAP resume it postoperatively because upper airway obstruction can be easily caused by remaining anesthetics and narcotics [6]. However, patients undergoing endoscopic sinus surgery (ESS) tend to delay resumption of CPAP therapy, owing to postoperative nasal packing.

After a patient with OSA who had undergone ESS experienced postoperative respiratory arrest on the ward in our institution, we implemented a hospital-wide policy in 2011, stating that all patients with documented or suspected OSA who undergo ESS are to be admitted to the intensive care unit (ICU) for at least 1 night for postoperative respiratory monitoring.

In the present study, we sought to validate our hospital policy by examining the incidence of postoperative respiratory complications in the ICU for patients with OSA undergoing ESS. In addition, we assessed possible risk factors for postoperative respiratory complications in these patients.

Patients and Methods

The Jikei University Institutional Review Board approval was obtained, with waiver of informed patient consent because of the retrospective nature of the study. All consecutive patients with OSA

who underwent ESS and were admitted to the ICU at The Jikei University hospital for postoperative respiratory monitoring during the period 2011 to 2015 were included in this study. The ICU database was used to identify patients with OSA who underwent ESS with subsequent transfer to the ICU. Medical and anesthesia records were reviewed to identify patient characteristics (age, sex, body mass index, presence or absence of preoperative CPAP use), preoperative respiratory function (assessed via spirometry), and anesthesia management (anesthesia time, amount of perioperative opioid used, in-out fluid balance). General anesthesia was induced with propofol, fentanyl, and rocuronium and maintained with desflurane, remifentanil, and rocuronium as needed. Before extubation, sugammadex was administered to reverse neuromuscular blockade.

The primary outcome measure was the incidence of postoperative respiratory complications. Postoperative respiratory complication was defined as the percutaneous arterial oxygen saturation (SpO_2) with NellcoreTM SpO_2 adhesive sensor (Medtronic, Dublin, Ireland) greater than 3% from baseline or apnea for more than 20 seconds [7]. The severity of desaturation was classified into three groups (lowest blood oxygen saturation [SpO_2] 80%–85%, 86%–90%, and 91%–95%). Data were obtained from the ICU database, which recorded all vital signs, such as heart rate, systemic blood pressure, SpO_2, and respiratory rate, by the minute.

Secondary outcome measures were incidences of intubation, aspiration pneumonia, and pulmonary embolism, obtained from the ICU database. We also collected information on how these complications were dealt with from the ICU database and medical charts.

Statistical analyses

Data are presented as mean and standard deviation or number and percent. Univariate analysis was performed by the Pearson chi-square test or Mann-Whitney U test to investigate the association between clinical variables and the presence of postoperative complications. A p value of <0.05 was considered statistically significant.

Multiple logistic regression analysis was performed to determine risk factors for postoperative respiratory complications using the following demographic parameters: age, male sex, body mass index, percent vital capacity (%VC), forced expiratory volume percent in 1 second ($FEV_{1\%}$), anesthesia time, amount of fentanyl, intraoperative fluid balance, and preoperative CPAP use. Results are presented as odds ratios with 95% CIs. A p value of <0.05 was considered statistically significant. A commercially available statistical package (SPSS® 20.0; IBM Corp., Armonk, NY) was used for all statistical analyses.

Results

For the study period, we identified 152 consecutive patients with OSA who underwent ESS in the ICU database, and complete information was available for all cases. Of these patients, 27 (17.8%) developed postoperative respiratory complications (Table 1) and the minimum value of SpO_2 was 84%. Univariate analysis revealed that patients who developed respiratory complications had a greater prevalence of preoperative CPAP use than those who did not develop respiratory complications (85.2% *vs.* 62.4%, P=0.03).

	Respiratory complication+ (n=27)	Respiratory complication- (n=125)	P value
Age (y)	51 ± 14	49 ± 13	0.38
Male, n (%)	26 (96.3)	118 (94.4)	0.16
Body mass index (kg/m^2)	27 ± 5	26 ± 4	0.1
%VC	108 ± 13	112 ± 14	0.25
$FEV_{1\%}$	74 ± 8	77 ± 8	0.1
Anesthesia time (min)	151 ± 71	166 ± 60	0.12
Fentanyl (μg/kg/h)	1 ± 0.8	0.7 ± 0.7	0.16
In-out fluid balance (mL/kg/h)	5.5 ± 3.1	4.9 ± 2.1	0.54
Preoperative CPAP use, n (%)	23 (85.2)	78 (62.4)	0.03

Values are expressed as mean ± standard deviation, with the exception of male sex and preoperative CPAP use (n [%]). %VC: Percent vital capacity;

CPAP: Continuous positive airway pressure; FEV1%: Forced expiratory volume percent in 1 second.

Table 1: Demographic characteristics of study patients with and without postoperative respiratory complications.

Table 2 shows outcomes for patients with and without preoperative CPAP use. Whereas 4 patients (7.8%) without preoperative CPAP developed postoperative respiratory complications, 23 patients (22.8%) with preoperative CPAP developed various degrees of desaturated episodes. All patients who developed respiratory complications were successfully treated with supplemental oxygen therapy, without sequelae. Intubation, aspiration pneumonia, or pulmonary embolism did not occur in any patients.

	CPAP+	CPAP−
Number of patients	101	51
Respiratory complications, n (%)	23 (22.8)	4 (7.8)
Desaturation to 91%-95%, n (%)	14 (13.9)	1 (2)
86%–90%, n (%)	3 (3)	1 (2)
80%–85%, n (%)	4 (4)	1 (2)
Apnea, n (%)	2 (2)	1 (2)

CPAP: Continuous positive airway pressure.

Table 2: Postoperative outcomes of patients with and without preoperative CPAP use.

Results of the multiple logistic regression analysis are shown in Table 3. Preoperative CPAP use was significantly correlated with postoperative respiratory complications (P=0.03), with an odds ratio of 4.1 (95% CI=1.1–14.7).

	Odds Ratio	P value
Age	0.99 (0.95-1.03)	0.6

Male	0.54 (0.05-5.79)	0.61
Body mass index	1.1 (0.99-1.24)	0.09
%VC	0.97 (0.94-1.01)	0.15
$FEV_{1\%}$	0.95 (0.89-1.01)	0.49
Anesthesia time	1 (0.99-1.01)	0.49
Intraoperative opioid use	1.21 (0.93-1.6)	0.16
In-out fluid balance	1.13 (0.91-1.42)	0.28
Preoperative CPAP use	4.08 (1.1-14.7)	0.03

Values are expressed as mean ± standard deviation.

%VC: Percent vital capacity; CPAP: Continuous Positive Airway Pressure; $FEV_{1\%}$: Forced expiratory volume percent in 1 second.

Table 3: Multiple logistic regression analysis for postoperative respiratory complications.

Other baseline characteristics, preoperative spirometry test results, and anesthesia management were not significantly correlated with postoperative respiratory complications. A forest plot shows the results of the multiple logistic regression analysis regarding risk factors for postoperative respiratory complications (Figure 1).

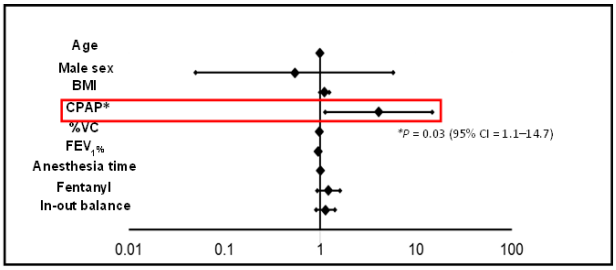

Figure 1: The relation between patient characteristics and postoperative respiratory events. Data were analyzed by multiple logistic regression analysis. A P value <0.05 was considered significant. %VC: % vital capacity; BMI: Body mass index; CPAP: Continuous positive airway pressure; FEV1%: Forced expiratory volume percent in 1 second.

Conclusion

We investigated the incidence of postoperative respiratory complications in patients with OSA undergoing ESS. Postoperative admission to the ICU allowed us to conduct continuous monitoring of respiratory rate and SpO2 as well as rapid and simple intervention for respiratory events. Our results showed that preoperative CPAP use was related to the development of postoperative respiratory complications in patients with OSA undergoing ESS.

OSA is a known independent risk factor for the development of perioperative respiratory complications [4]. One study reported that patients with OSA undergoing non cardiac surgery had a greater incidence of postoperative respiratory desaturation, respiratory failure, cardiac events, and ICU transfers than those without OSA [7]. Another reported that patients with OSA have a high incidence of postoperative respiratory complications requiring unexpected transfer to the ICU, with some patients requiring reintubation [7]. These results do not mean that every patient with OSA will require postoperative ICU admission. In fact, Goucham et al. concluded in their study of morbidly obese patients with OSA that continuous oxygen monitoring should be continued but routine admission to the ICU may not be necessary [8]. The results of the present study indicate that patients with OSA undergoing ESS might comprise a subgroup of high-risk patients who might benefit from being admitted to the ICU for tight surveillance for respiratory complications.

One plausible explanation why these patients should be considered at greater risk for postoperative respiratory complications is that nasal packing after ESS restricts access to CPAP therapy. For moderate or severe OSA, CPAP therapy has been proven effective; therefore, the American Society of Anesthesiologists guidelines recommend that patients with OSA use CPAP continuously after surgery [9]. Though there are studies reporting no significant difference in the incidence of postoperative adverse events between groups using CPAP and those not [10] the efficacy of postoperative CPAP use in patients with OSA is well known. Delayed resumption of CPAP may put patients with preoperative CPAP therapy at risk for developing respiratory complications [11]. In this regard, our hospital policy mandating that these potentially high-risk patients be admitted to the ICU postoperatively appears to be validated.

There are several limitations to the present study. First, data for patients without OSA undergoing ESS were not collected. Patients without OSA undergoing ESS are sent to the ward, where they receive standardized care including spot check of pulse oximetry and respiratory rate every 4 hours. Though it is possible that some of these patients experienced respiratory complications, during the study period, there were no catastrophic events documented for any of the patients undergoing ESS and managed on the ward.

Second, not all of the study patients with preoperatively diagnosed or suspected OSA underwent polysomnography; therefore, preoperative Apnea-Hypopnea Index (AHI) scores were not available for every patient. Thus, the association between AHI score and postoperative respiratory complications cannot be established. The preoperative AHI score was known for 84 patients, of whom 16 developed postoperative respiratory complications. Among the 84 patients with preoperative AHI scores, there was no significant relationship between preoperative AHI score and postoperative respiratory complications, preoperative CPAP use, or body mass index (data not shown). Preoperative AHI score has been reported to be significantly decreased compared to postoperative AHI score in the context of CPAP use during the postoperative period [10,12]. However, the association between preoperative AHI score and the postoperative outcome is not currently known. Future studies might warrant an assessment of the association between AHI score and postoperative respiratory complications in patients with OSA undergoing ESS.

Third, postoperative data were reviewed for only 1 day because all of the patients were transferred to the ward the next day. Though no catastrophic events were reported in our study patients, this does not necessarily mean that no patients experienced any respiratory complications on the ward from postoperative day 1 onward. Additional study of this issue is needed.

In conclusion, the findings of this single-institution, retrospective chart review suggests that patients with OSA undergoing ESS comprise a high-risk group for developing postoperative respiratory complications. Continuous respiratory monitoring in the ICU for at

least 1 night appears to be valid for these particular patients. Preoperative CPAP use is related to the development of postoperative respiratory complications in patients with OSA undergoing ESS.

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