

Case Study

Risk of Complications Among Patients with Obstructive Sleep Apnea Undergoing ENT-Surgery

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Introduction

The prevalence of Obstructive Sleep Apnea (OSA) ranges from 9% to 38% in the general population and has a higher prevalence in men [1]. The prevalence increases by age and level of body mass index (BMI) [1,2]. Morbidities associated with OSA are cardiovascular, neurocognitive, and metabolic disorders, as well as a higher prevalence of depression and obesity/weight-loss problems [1,2]. OSA and its comorbidities represent a risk of respiratory and cardiopulmonary complications during surgery in General Anesthesia (GA) [2-11]. Especially severe OSA (Apnea Hypapnae Index/AHI \geq 30), multi-morbidity, high age, and BMI \geq 35 are specifically identified as high-risk factors for peri-/ postoperative complications. A preoperative evaluation to identify high-risk patients are recommended in the literature [1-5,9-11].

Regarding upper airway surgery, OSA is reported to further increase the risk of peri- and postoperative complications, because of a conjunction of risk factors (5, 7-9,11). However specific data on peri- postoperative morbidity and mortality following upper airway surgery involving OSA patients is sparse [11-14] and the available data only covers a short follow-up period (from hours up to one week) [8,12-14].

The majority of Ear-Nose and Throat (ENT) surgeries are same-day interventions allowing discharge after a few hours of observation, except when the diagnosis of OSA is present. Here the field of ENT surgery/ the Danish Society of Otorhinolaryngology, Head and Neck

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Surgery (DSOHH) adheres to international recommendations for hospitalization of OSA patients undergoing surgery [3-4]. However, clinical observations questions whether the risk of peri-and postoperative complications among OSA patients justifies hospitalization or not. The economic consequences are evident.

The present study aimed to compare the incidence and the types of peri-and postoperative complications in OSA patients and non-OSA patients undergoing ENT surgery in GA. Furthermore, specific risk factors essential for developing complications were identified.

Patients and Methods

The study was a retrospective cohort study of all consecutive adult patients undergoing surgery in GA from May 1st to October 31st, 2019, at The Ear-nose and throat Department (ENT), Region Hospital West Jutland, Denmark. Data were retrieved from the Electronic Patient Record (EPR), and patient demographics, screening for OSA, type of surgery, hospitalization, status, comorbidities, postoperative peripheral saturation, and blood pressure, as well as postoperative complications up to 12 weeks after surgery, were registered. When the OSA diagnosis was not mentioned in the pre-operative ENT record but figured in the general list of diagnoses in the EPR-register, clarification of the diagnosis was investigated further in the EPR-register. If the diagnosis was established in primary health care settings and no exact AHI-score was present in the EPR, the patient was nevertheless included in the OSA group, but with missing data on AHI. All patients with a diagnosis of OSA within the first six months after surgery were included as they, plausible, were suffering from OSA at the time of surgery, and hence would be at a higher risk of complications.

The primary outcome included any deviation from an expected smooth course of surgery. All deviations were registered as peri-postoperative complications and were subsequently allocated to the following four categories: respiratory/airway, neurocognitive, cardiovascular, or infectious. Also, intensive care unit admission, hospital length of stay, any non-expected contact(s) to the hospital, and readmissions were listed. The secondary outcome was risk factors considered to have an association with an increased risk of complications: comorbidities, demographics, BMI, alcohol intake, active smoking status, type of surgery, and hospitalization status. Which were all available data in the EPR-register.

Definition of clinical assessments

Postoperative infection was considered when an ENT surgeon had diagnosed and prescribed systemic antibiotics as treatment.

Postoperative hypertension was defined by the latest measured value, by an electronic blood pressure device, either measured at the recovery room after surgery (when same-day) or at the ENT-ward the first postoperative morning (when hospitalized).

Desaturation was defined by the latest measured value and was defined as peripheral saturation of oxygen (SpO₂) <94% by pulse oximetry, either in the recovery room (when same-day) or at the ENT ward on the first postoperative morning (when hospitalized).

Unplanned contacts to the hospital covered contacts (virtual, phone, or physical meetings) to the hospital after discharge (3).

Statistical analysis

Differences in the characteristics between the OSA/non-OSA groups were compared using the T-test or Fischer exact test for continuous variables and Mann Whitney Wilcoxon signed-rank test for categorical variables. The groups were compared using logistic regression analysis of the risk of complications. Relative risk and confidence intervals were calculated.

P values < .05 were considered statistically significant.

Ethics

The study was performed per Good Clinical Practice, which follows the Helsinki declaration. It was approved by the local administration of the department. Data was stored in accordance with General Data Protection Regulation.

Results

A total of 699 patients were included. The gender ratio was 314 women: to 385 men, and the average age was 47.7 years (18-91 years). Eighty (11.4%) had an OSA diagnosis, but an exact AHI score could only be obtained in thirty (37.5%) of the OSA patients. Of the available AHI scores, 83.33% had moderate to severe OSA (Grouping of AHI; mild:16.67%, moderate: 36.67%, severe: 46.66%).

It was not possible to distinguish between patients in active treatment and those without treatment, as many in treatment stated to have low compliance. 619 were not diagnosed with OSA at the time of surgery or in the first six months after surgery. The baseline demographics are shown in Table 1.

The statistically significant OSA characteristics were BMI>35, more than 3 comorbid conditions, active smoking, and an increased alcohol intake.

Variables	Total N=699 % (number)	OSA (n=80) % (number)	Non-OSA (n=619) % (number)	p-value
Gender				
Male	55.0 (385)	62.5 (50)	54.12 (335)	0.189
Female	44.9 (314)	37.5 (30)	45.88 (284)	
Age (mean/SD)	47.67 (18.69)	49.41 (15.18)	47.44 (19.09)	0.2926
BMI (mean/SD)	26.65 /6.03 (*n=693)	32.34 /8.03 (*N=78)	25.93 /5.31 (*n=615)	<0.0001
Increased alcohol intake	5.16 (36) (*n=697)	13.7 (11)	4.05(25) (*n=617)	0.001
Smoker	22.27 (155) (*n=696)	38.75 (31)	20.13 (124) (*N=616)	<0.0001
Comorbidities	46.92 (328)	60 (48)	45.2 (280)	0.028
1-2 diagnosis	35.91 (251)	41.25 (33)	35.2 (218)	0.48
> 3 diagnoses	11.02 (77)	18.75 (15)	10.02 (62)	0.013
Diabetes	6.29 (44)	13.75 (11)	5.33 (33)	<0.0001

Hypertension	16.60 (116)	23.75 (19)	15.67 (97)	0.081
Cardiac diseases	22.46 (157)	35 (28)	7.29 (129)	0.006
Respiratory diseases	11.16 (78)	8.75 (7)	0.16 (71)	0.003
Psychiatric diseases	8.87 (62)	13.75 (11)	8.24 (51)	0.013
Renal comorbidity	1.57 (11)	1.25 (1)	1.61 (10)	1

Table 1: Baseline demographics.

Type of surgery	Total % (number)	OSA % (number)	Non-OSA % (number)	p-value
Rhinoplasty	30.47 (213)	55 (44)	27.30 (169)	<0.0001
Tonsils/adenoids	17.45 (122)	18.75 (15)	17.29 (107)	0.755
Malignant (oral, tonsil, pharyngeal)	12.59 (88)	3.75 (3)	13.73 (85)	0.011
Endoscopies	9.44 (66)	3.75 (3)		0.068
Otosurgery	8.15 (57)	5 (4)	10.18 (63)	0.193
Thyroid surgery	8.44 (59)	5 (4)	8.56 (53)	0.291
Parotid gland	5.44 (38)	3.75 (3)	8.89 (55)	0.608
Other surgery types	8.01 (56)	5 (4)	5.65 (35)	0.383
			8.40 (52)	
Hospitalization				
Same-day	81.40 (569)	38.75 (31)	86.91 (538)	<0.0001
Overnight	18.60 (130)	61.25 (49)	13.09 (81)	
Status				
Acute	2.43 (17)	0	2.75 (17)	0.242
Elective	97.57 (682)	100 (80)	97.75 (602)	
Screening for OSA before surgery	14.3 (100)	62.5 (50)	8.07 (50)	<0.0001

Table 2: Clinical characteristics.

Table 2 shows the clinical characteristics. There was a statistically significant difference between the OSA and non-OSA groups in rhino (p<0.0001) and malignant surgery (oral, tonsil, pharyngeal) (p=0.011).

Primary screening for OSA diagnosis before surgery was obtained in 14.3%, which captured 50 patients. Secondary screening of the EPR uncovered an additional 30 patients with a diagnosis of OSA. Within the OSA group (n=80), 61.25% were hospitalized for one night and 38.75% received same-day surgery.

Characteristics of perioperative complication rates

32.18% of the patients developed postoperative complications as shown in table 3. A statistically significant difference between the groups was found at two complications ($p=0.0001$).

Categories	In Total N=699 % (number)	OSA N=80 % (number)	Non-OSA N=619 % (number)	p-value
Total	32.18 (225)	43.75 (35)	30.69 (190)	
1 complication	24.46 (171)	26.25 (21)	24.23 (150)	0.6928
2 complications	7.15 (50)	17.5 (14)	5.81 (36)	0.0001
>3 complications	0.57 (4)	0	0.64 (4)	
Infections	13.79 (96)	22.5 (18)	12.60 (78)	0.024
Cardiovascular	8.93(60)			
Postoperative hypertension	8.40 (56) (*n=667)	20.83 (15) (*n=72)	6.89 (41) (*n=595)	<0.0001
Tachycardia	0.57 (4)	0	0.64 (4)	
Respiratory/airway	5.05	12.09	4.21	
DeSAT (<94%)	4.20 (29) (*n=691)	9.59 (7) (*n=73)	3.57 (22) (*n=617)	0.026
Difficult intubation				0.206
Difficult extubation	0.71 (5)	2.5 (2)	0.48 (3)	
Acute intensive-care unit	0	0	0	
	0.28 (2)	0	0.32 (2)	
Postoperative bleeding	5.43 (38)	2.5 (2)	5.82 (36)	0.298
Hematoma/seroma	1.14 (8)	0	1.28 (8)	
Unplanned contacts with the hospital for other reasons	19.17 (134)	21.25 (17)	18.90 (117)	0.651

Table 3: Per-postoperative complications and unplanned contacts to the hospitals.

Infection was the most common complication (13.79%). A statistically significant difference between OSA and non-OSA was found in the postoperative infection ($P=0.024$), postoperative hypertension ($p<0.000,1$), and postoperative desaturation<94% ($P=0.026$).

Multivariate analysis

Based on the findings in tables 1 to 3, a multivariate analysis was performed as shown in table 4.

OSA, two comorbidities, and increased BMI were found to be independent risk factors (Column-1) for developing peri- and postoperative complications. If OSA was present, both gender, age, comorbidity, increased alcohol intake, and smoking showed statistically significant differences (Column-2).

Overall, the complication rate was increased with comorbidity>3, but when adjusting for OSA versus non-OSA, there was a significant difference in the risk of developing postoperative complications between the groups, except when focusing on BMI (overweight). When adjusted for all other risk factors, only male gender and rhino/tonsil surgery were significant risk factors.

No difference was found between the diagnosis of OSA and the development of severe postoperative complications, unplanned transfer to ICU, or any early (or late) unplanned hospitalization due to cardiovascular, respiratory, or neurocognitive events 12 weeks after surgery.

Risk factor	RR, and p-value of the variable only*	RR for the effect of OSA w.r.t Non-OSA, and p-value for OSA group when adjusted for one of the other Risk factors**	RR, and p-value for each risk factor when adjusted for all the other risk factors (multiple regression model) ***
OSA (w.r.t. Non-OSA)	1.425 [1.082 1.877] $p=0.012$	-	1.239 [.911 1.685] $p=0.171$
Gender (w.r.t. male)	1.179 [.946 1.469] $p=0.142$	1.411 [1.072 1.857] $p=0.014$.801 [.643 .997] $p=0.047$
Comorbidity (w.r.t. no comorbidity)		1.381 [1.049 1.818] $p=0.021$	
Comorbidity=1	1.133 [.893 1.435] $p=0.302$	-	1.054 [.819 1.355] $p=0.681$
Comorbidity=2	1.468 [1.084 1.987] $p=0.013$	-	1.326 [.951 1.848] $p=0.095$
Type of surgery (w.r.t. nose and tonsils)	1.219 [.983 1.513] $p=0.071$	1.362 [1.028 1.805] $p=0.031$	1.313 [1.039 1.659] $p=0.022$
Age**** (per year increase in the age)	1.004 [.998 1.010] $p=0.134$	1.428 [1.087 1.876] $p=0.010$	1.005 [.998 1.012] $p=0.102$
BMI (overweight)	1.017 [1.001 1.033] $p=0.030$	1.342 [.994 1.813] $p=0.055$	1.009 [.992 1.025] $P=0.274$
Smoker	1.088 [.846 1.399] $p=0.510$	1.422 [1.075 1.882] $p=0.014$	1.029 [.794 1.333] $P=0.825$
Increased alcohol intake	.952 [.575 1.578] $p=0.851$	The test indicated evidence for the interaction between the OSA and alcohol consumption. Therefore, here we give the RR for OSA w.r.t. no-OSA within each alcohol group. RR if alcohol=0: 1.305 [.957 1.779] $p=0.091$ RR if alcohol=1: 3.977 [1.458 10.845] $p=0.007$.943 [.590 1.508] $P=0.808$

Table 4: Multivariate analysis.

*example: binreg complication i.OSA, rr

**example: binreg complication i.OSA i.Gender, rr, Note that the interaction between OSA and the other risk factor was checked and no evidence was found for the presence of any interaction effect.

*** binreg complication i.OSA i.CSA2 b1.Gender c.age I. Comorbidity I. Type of surgery_nosetons, cBMI i.smoker i-alcohol rr mu(ycap)

****Non-linear relationship between age and the log-risk was checked and no evidence was found. I.w.r.t.: with reference to

Discussion

We found a statistical difference between OSA and non-OSA patients in the postoperative complications: infection, postoperative hypertension, and desaturation. There was not found a significant difference between same-day vs. hospitalization within the OSA group, but a high-risk OSA profile was suggested.

Severe complications

The presence of OSA did not imply an increased risk of developing severe postoperative complications. However, the presence of OSA seemed to aggravate other risk factors. Only a few other studies have compared the incidence of peri- postoperative complications between OSA patients and non-OSA patients undergoing ENT surgery or surgery in the upper airways in GA [8,11-14].

Earlier studies all described a similar non-significant correlation between severe postoperative complications, the diagnosis of OSA, and ENT/upper airway surgery [12-15].

Postoperative infection

In total, 13.79% developed a postoperative infection. A significant difference between the groups showed a higher incidence in the OSA group (22.5% vs 12,6%, $P=0.024$). The high prevalence of postoperative infection has not earlier been identified in ENT-OSA literature, however, Rasmussen and Ovesen found in 2016 a postoperative infection rate of 11% after ENT surgery at a Danish university clinic [16]. Moreover, Al-Qurayshi, Walsh, Owen, et al. found a risk of surgical site infection of 1.5-6.0% of all Rhino surgery. They expected their findings to be underestimated because they only covered readmissions or infections discovered in immediate extension of surgery [15]. In our study rhino surgery constitutes 30,47% of the surgeries. In Rhino surgery the risk of postoperative infection is evident because of multiple tissue damage, especially of the mucous membranes of the nose, which lasts beyond weeks after surgery, and demands weeks of daily cleansing of the nose and also a certain degree of compliance at the patient. However, delayed wound healing related to OSA diagnosis was not described in earlier studies, the characteristics of the OSA profile containing; smoking increased alcohol intake, overweight and comorbidities are all coincident with a higher risk of delayed wound healing, risk of low compliance, and thereby also a greater risk of wound infection. Similarly, chronic hypertension has a possible impact on the vascularity and nutrition of the tissue.

Sadly, it was not possible to make an exhaustive analysis of the connection between risk factors and postoperative infection in this study. This could be a relevant focus of the further investigation. In continuation of a discussion of infection, the effect of prophylactic treatment of postoperative infection is a topic of interest in the ENT field [15-19] and in light of our findings could be a relevant topic in future research.

Postoperative hypertension

8.4% of the entire surgery group showed postoperative hypertension. There was a difference between the preoperative prevalence of diagnosed hypertension and the incidence of postoperative measured hypertension. Tests showed a statistically significant difference in the postoperative measured hypertension between the OSA and non-OSA group (20.83% vs 6,89% $P=<0.0001$), which points to a possible underdiagnosing of hypertension in the OSA group in general, which was substantiated in the literature by young et al. [2].

No cardiovascular events were documented, but as OSA patients seemed to have a higher risk of hypertension [1,2,4,6,9-11], there is a possible risk of cardiovascular events and postoperative bleeding. The clinical relevance is theoretical, and hence a relevant topic for future larger randomized research [5,6,9,10].

Desaturation

9.59% of the OSA group developed postoperative desaturation vs 3,57% among non-OSA patients ($p=0.026$). No patients developed more severe symptoms and were vastly stabilized. Earlier clinical studies found an association between the diagnosis of OSA and not-severe respiratory symptoms while in the Post Anesthesia Care Unit [12,13]. Contradictive, clinical reviews describe a more severe risk of a rebound in REM sleep 3-5 days after surgery, causing a risk of a decrease in arousal response and, hence a risk of 'late postoperative complication' [7,11]. When focusing on the risk concerning ENT surgery, this was not confirmed in this study, hence all patients were stabilized, and no further events were identified.

Same-day vs. hospitalization

In the OSA group, we found no substantial differences between receiving same-day surgery vs. hospitalization after surgery. Our findings were in line with other clinical studies, which found no incidence of postoperative complications in the ENT-OSA group, that could justify hospital admission or endanger the patients receiving same-day surgery [12-14].

Risk profile

A multivariate analysis was conducted to distinguish between patients who developed postoperative complications due to certain demographic characteristics. We found no evidence that age, smoking, alcohol intake, or type of surgery could be regarded as independent risk factors for postoperative complications in this study, but the tests indicated an interaction between OSA and several of the risk factors (table 4). Studies have suggested several screening tools for pre-surgical evaluation [4,5,9-13]. A systematic preoperative screening of OSA could help identify patients at high risk of developing complications.

Limitations

The study was retrospective, and the cohort was not equally paired in OSA/non-OSA. In the study, not all patients were screened for OSA, adding a risk of undiagnosed OSA in the non-OSA group. It is a weakness, that not all patients in the OSA group had an exact AHI score to clarify the severity of the diagnosis. Future studies need to consider the necessity of a sensitive screening tool for undiagnosed OSA before data collection. There were no prospective studies on the subject, which would be relevant to future research.

Conclusion

We found no increased risk of developing severe per-/postoperative complications for OSA patients. However, a high-risk OSA profile was suggested: Male, older age, smoking, increased BMI, increased alcohol intake, receiving rhino or malignant surgery. Infection was the most frequent complication. We suggest using specific screening tools for identifying OSA patients with an increased risk of peri- postoperative complications. Same-day ENT surgery in GA flow-risk OSA patients should be considered.

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Declaration of Conflicting Interests

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References

1. Senaratna CV, Perret JL, Lodge CJ, Lowe AJ, Campbell BE, et al. (2017) Prevalence of obstructive sleep apnea in the general population: A systematic review. *Sleep Med Rev* 34:70-81.
2. Young T, Peppard PE, Gottlieb DJ (2002) Epidemiology of obstructive sleep apnea: a population health perspective. *Am J Respir Crit Care Med* 165: 1217-1239.
3. Fahlenkamp A, Rossaint R, Coburn M, American Society of Anesthesiologists Task F. (2014) Perioperative management of patients with obstructive sleep apnea: update on the practice guidelines of the American Society of Anesthesiologists Task Force. *Anaesthesist* 63: 511-513.
4. Dickerson SC (2019) Perioperative Guidelines in Anesthesia. *Otolaryngol Clin North Am* 52: 981-993.
5. Fernandez-Bustamante A, Bartels K, Clavijo C, Scott BK, Kacmar R, et al. (2017) Preoperatively screened obstructive sleep apnea is associated with worse postoperative outcomes than previously diagnosed obstructive sleep apnea. *Anesth Analg* 125: 593-602.
6. Chan MTV, Wang CY, Seet E, Tam S, Lai HY, et al. (2019) Association of unrecognized obstructive sleep apnea with postoperative cardiovascular events in patients undergoing major noncardiac surgery. *JAMA* 321: 1788-1798.
7. Wolfe RM PJ, Miller DE, Weiss-Coleman R, Solomonides T (2016) Obstructive Sleep Apnea: Preoperative Screening and Postoperative Care. *J Am Board Fam Med* 29: 263-275
8. Ravesloot MJL, de Raaff CAL, van de Beek MJ, Benoist LBL, Beyers J, et al. (2019) Perioperative Care of Patients With Obstructive Sleep Apnea Undergoing Upper Airway Surgery: A Review and Consensus Recommendations. *JAMA Otolaryngol Head Neck Surg* 145: 751-760.
9. Holt NR, Downey G, Naughton MT (2019) Perioperative considerations in the management of obstructive sleep apnoea. *Med J Aust* .211: 326-332.
10. Lockhart EM, Willingham MD, Abdallah AB, Helsten DL, Bedair BA, et al. (2013) Obstructive sleep apnea screening and postoperative mortality in a large surgical cohort. *Sleep Med* 14: 407-415.
11. Vasu TS, Grewal R, Doghramji K (2012) Obstructive sleep apnea syndrome and perioperative complications: a systematic review of the literature. *J Clin Sleep Med* 8: 199-207.
12. Setaro J, Reinsel R, Brun D (2019) Preoperative Screening for Obstructive Sleep Apnea and Outcomes in PACU. *J Perianesth Nurs* 34: 66-73.
13. Woodling K, Fiorda-Diaz J, Otto BA, Barnes CA, Uribe AA, et al. (2018) A retrospective analysis on patients at high risk for obstructive sleep apnea undergoing ear, nose, and throat surgeries. *Laryngoscope Investig Otolaryngol* 3: 16-21.
14. Asha'ari ZA, Rahman JA, Mohamed AH, Abdullah K, Leman WI (2017) Association between severity of obstructive sleep apnea and number and sites of upper airway operations with surgery complications. *JAMA Otolaryngol Head Neck Surg* 143: 239-246.
15. Al-Qurayshi Z, Walsh J, Owen S, Kandil E (2019) Surgical Site Infection in Head and Neck Surgery: A National Perspective. *Otolaryngol Head Neck Surg* 161: 52-62.
16. Rasmussen S, Ovesen T (2014) Insufficient reporting of infections after ear, nose and throat surgery. *Dan Med J* 61: A4735.
17. Oppelaar MC, Zijtveld C, Kuipers S, Ten Oever J, Honings J, et al. (2019) Evaluation of Prolonged vs Short Courses of Antibiotic Prophylaxis Following Ear, Nose, Throat, and Oral and Maxillofacial Surgery: A Systematic Review and Meta-analysis. *JAMA Otolaryngol Head Neck Surg* 145: 610-616
18. Salmanov AG, Shkorbotun VO, Shkorbotun YV (2019) Antimicrobial resistance of staphylococcus aureus causing of surgical site infections in ear, nose and throat surgery. *Wiad Lek* 72: 154-158.
19. Haas CE, LeBlanc JM (2004) Acute postoperative hypertension: a review of therapeutic options. *Am J Health Syst Pharm* 61:1661-1673; quiz 1674-1675.



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