Patients with Difficult Intubation May Need Referral to Sleep Clinics

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PURPOSE: Upper airway abnormalities carry the risk of obstructive sleep apnea (OSA) and difficult tracheal intubations. Both conditions contribute to significant clinical problems and have increased perioperative morbidity and mortality. We hypothesized that patients who presented with difficult intubation would have a very high prevalence of OSA and that those with unexpected difficult intubation may require referral to sleep clinics for polysomnography (PSG).

METHODS: Patients classified as a grade 4 Cormack and Lehane on direct laryngoscopic view, and who required more than two attempts for successful endotracheal intubation, were referred to the study by consultant anesthesiologists at four hospitals. Apnea-hypopnea index (AHI) data and postoperative events were collected. Patients with AHI >5/h were considered positive for OSA. Clinical and PSG variables were compared using *t*-tests and χ^2 test.

RESULTS: Over a 20-mo period, 84 patients with a difficult intubation were referred into the study. Thirty-three patients agreed to participate. Sixty-six percent (22 of 33) had OSA (AHI >5/h). Of the 22 OSA patients, 10 patients (64%) had mild OSA (AHI 5–15), 6 (18%) had moderate OSA (AHI >15/h), and 6 (18%) had severe OSA (AHI >30/h). Of the 33 patients, 11 patients (33%) were recommended for continuous positive airway pressure treatment. Between the OSA group and the non-OSA group, there were significant differences in gender, neck size, and the quality of sleep, but there were no significant differences in age and body mass index.

CONCLUSIONS: Sixty-six percent of patients with unexpected difficult intubation who consented to undergo a sleep study were diagnosed with OSA by PSG. Patients with difficult intubation are at high risk for OSA and should be screened for signs and symptoms of sleep apnea. Screening for OSA should be considered by referral to a sleep clinic for PSG.

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Obstructive sleep apnea (OSA) is characterized by recurrent episodes of hypopnea and apnea during sleep. Clinically, patients will present with loud snoring, daytime hypersomnolence and cognitive impairment. If untreated, OSA is associated with increased risk of hypertension,[1] cardiovascular complications,[2] motor vehicle accidents,[3] and premature death.[4]

The prevalence of OSA-hypopnea syndrome is present in 11%–24% and 7%–10% of men and women, respectively.[5,6] An estimated 82% of men and 93% of women with moderate to severe OSA syndrome have not been diagnosed.[7] Using the Berlin questionnaire[8] as a screening tool for OSA, our previous observations found a significant percentage of patients presenting to a preoperative clinic were at high risk of OSA.[9] Recognizing the importance of OSA as a disease entity, the American Society of Anesthesiologists (ASA) has recently developed guidelines recommending that anesthesiologists screen surgical patients for OSA in the preoperative assessment.[10]

One of the essential roles in the practice of anesthesiologists is airway management. Difficult intubation is a rare occurrence. Difficult laryngoscopy (as defined by a grade 3 or 4 views) is synonymous with difficult intubation in most patients.[11] The incidence of a grade 3 or 4 laryngoscopic view was reported to be 1.14%.[12] In the general surgical population, the prevalence of failed intubation is 0.04% (1 of 2230).[13] Inability to manage the difficult airway was responsible for 35% of deaths attributable to anesthesia.[14]

Upper airway abnormalities have been described in patients with OSA or difficult intubation. A short thick neck, limited head extension,[15] and reduced thyromental distance have been associated with difficult tracheal intubation. Oropharyngeal crowding with reduced upper airway caliber because of excess soft tissue and greater neck circumference have also been described in patients with OSA.[16,17]

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Patients who were diagnosed with OSA had a higher incidence of difficult intubations, 21.6% in OSA patients versus 2.6% in controls.[18–20] The upper airway abnormalities predisposing to difficult tracheal intubation may also predispose to OSA. In a small study, using an anesthesia department database, Hiremath et al. identified 15 patients who had a difficult intubation. Those patients were invited for a polysomnography (PSG). Eight of them (53%) were diagnosed with OSA (apnea-hyponea index [AHI] >10/h).[20] The purpose of the present prospective study was to assess the prevalence of OSA in patients with unexpected difficult intubation.

METHODS

Approval for the study was obtained from the hospital ethics committee. Patients 18 yr or older who were difficult to intubate were referred by the consultant anesthesiologists for the study from four hospitals (Toronto Western Hospital, Toronto General Hospital, Mount Sinai Hospital, and St. Joseph Health Centre, Toronto). Patients were considered to have a difficult intubation if on direct laryngoscopic view they were classified as grade IV (Cormack and Lehane scoring) and required more than two attempts for successful endotracheal intubation[11] (grade I, full view of glottis; grade II, only posterior commissure visible; grade III, only tip of epiglottis visible; grade IV, no glottis structure visible).

Patients with a predicted difficult intubation due to other causes, such as epiglottitis, laryngeal tumor, maxillary or mandibular injury in trauma patients, patients with obvious craniofacial or cervical abnormalities, and pregnant women, were excluded from the study. Patients with diagnosed OSA were also excluded. Patients were all intubated in a sniffing position with a pillow. A McGill size 3 blade was used as a standard intubating tool. All the intubations were done by consultant anesthesiologists. All patients were paralyzed with rocuronium as a neuromuscular blocker. Informed consent was obtained from the patients with difficult intubations for upper airway assessment and overnight PSG. The patient's PSG was scheduled 6–10 wk after their surgery to ensure adequate recovery and to avoid the effect of pain or pain medication on their PSG. During the overnight PSG study, body weight and height of patients were recorded. The body mass index was calculated as body weight (kg)/height^2 (m^2). The neck size was measured at the level of the cricothyroid membrane.

During the overnight PSG study, every patient went to bed at his or her usual bedtime and the study continued for the whole night. It involved a continuous collection of physiological sleep data using a standard montage consisting of an electroencephalogram, electro-oculogram, submental electromyogram, and electrocardiogram. Standard skin electrodes were attached to the head and body of the patient to record electrical activity from the brain and muscles. Ancillary channels were used to specifically document respiratory effort by thoracoabdominal excursion; respiratory inductive plethysmography and oronasal airflow by nasal airflow pressure transducers. Oxygen saturation was measured using a pulse oximeter.

The PSG was analyzed according to standardized scoring techniques.[21] The clinical diagnosis of OSA was defined as patients with repeated episodes of hypoventilation, desaturation, sympathetic arousal, and awakening, leading to fragmented sleep. The severity of OSA was determined by the AHI: mild AHI = 5–15, moderate AHI = 15–30, severe AHI >30. These criteria are based on the American Academy of Sleep Medicine practice parameters for the definition of OSA severity.[22] Apnea was defined as the cessation of airflow through the nose and mouth lasting 10 s or more. Hyponea was defined as a decrease in airflow of 50% or more accompanied by a decline in 3% or more in Sa_{O_2}. Stanford Sleepiness Scale,[23] Toronto Hospital Alertness Test (THAT),[24] and the ZOGIM-A[24] questionnaires were administered to all patients who underwent PSG.

Stanford Sleepiness Scale[23]: This is a self-rated 7-point scale designed to quantify the progressive stages of the alertness-sleepiness continuum.

THAT[24]: The THAT is a 10-item self-report index designed to measure perceived alertness during the past week.

ZOGIM-A[24]: The ZOGIM-A is a 10-item self-report scale designed to measure (a) the effect of various influences on subjective alertness (e.g., sleep loss, exercise, caffeine, vacation, forgetting worries), (b) the anticipated benefits of increased alertness (i.e., ability to organize day-to-day activities, completion of tasks, creativity, and frequency of mistakes), and (c) the proportion of daytime experience during which the respondent functions with a high level of alertness.

A standard definition of postoperative complications was used to identify any postoperative events (Appendix). Postoperative data were obtained by chart abstraction from hospital charts by a research fellow (BY). Data on readmission and number of visits to physicians were also obtained through medical records.

Data were entered into a specifically designed MS Access database. SAS 9.1 for Windows (SAS Institute, Cary, NC) was used for data analysis. Categorical data were presented as frequency and percentage. Statistical significance was checked by χ^2 test or Fisher's exact test. The quantitative data were presented as mean ± SD. The calculation of P value depended on the distribution of the data. If the data were in normal distribution, the P value from the t-test was used for the judgment of any statistical significance. Otherwise, the P value from the Wilcoxon's ranked sum test was used.

RESULTS

Eight-four patients with difficult intubation were referred to the study. Of the 84 patients, 3 already had

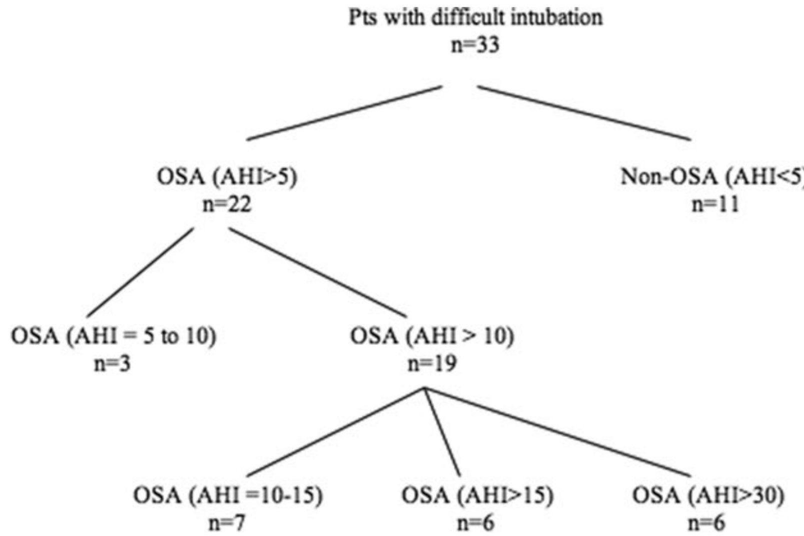

Figure 1. The distribution of patients with difficult intubation in relation to their AHI. OSA = obstructive sleep apnea; AHI = apnea-hyponea index.

a diagnosis of OSA without the knowledge of the referring anesthesiologist and were excluded from the study. Of the remaining 81 patients, 33 agreed to undergo an overnight PSG; 46 patients refused consent; 2 died before the invitation for the study. The deaths were related to their associated medical illness.

All the patients were intubated by consultant anesthesiologists. Of the 33 patients, 26 were solely intubated by consultant anesthesiologists. Residents, with 1–4 yr experience, attempted to intubate seven patients. These seven patients were successfully intubated by the consultant anesthesiologists and were considered as having a difficult intubation (Cormack and Lehane grade 4).

Figure 1 describes the distribution of patients in relation to their AHI. Of the 33 patients who underwent an overnight PSG, 22 (66%) had OSA (AHI >5/h). Of the 22 OSA patients, 3 patients had AHI values of 5–10 while 19 (58%) had an AHI >10. Of the 19 patients with an AHI >10, 7 had mild OSA (AHI 10–15), 6 (18%) had moderate OSA (AHI >15/h), and 6 (18%) had severe OSA (AHI >30/h).

The demographic data of patients who agreed to undergo the PSG are shown in Table 1. In the group of patients with OSA, males were more common than females. The neck size of patients with OSA was significantly larger than those who did not have OSA. There was no significant difference in body mass index between OSA and non-OSA patients. Twenty-seven percent (5 of 22) of patients with OSA had a neck size ≥44 cm, 4 were male and 1 was female. Of the non-OSA patients, none of them had a neck size ≥ to 44 cm. All patients (22 of 22) with OSA were ASA II, III, and IV versus 73% (8 of 11) in the non-OSA group ($P = 0.03$). Fifty percent (11 of 22) of patients with OSA had hypertension as an associated comorbid condition.

The absolute scores of the Stanford Sleepiness Scale, THAT, and ZOGIM-A in the two groups of patients are shown in Table 2. Patients with OSA had worse scores in alertness measures than non-OSA patients, but the differences did not reach statistical significance.

Table 1. Demographic Data

	OSA (AHI >5/h) (n = 22)	Non-OSA (AHI ≤5/h) (n = 11)
Age (yr)	60 ± 10	50 ± 17
Gender (male/female)	18/4*	5/6
BMI (kg/m^2)	32 ± 7	28 ± 8
Neck size (cm)	42 ± 4*	37 ± 4
ASA		
I	0	3
II	9	3
III	12	5
IV	1	0
Medical conditions		
Hypertension	11	3
Angina	1	0
Stroke or TIA	1	0
Obesity	4	1
Diabetes	5	2
GERD	3	0

Mean ± SD.

AHI = Apnea Hyponea Index; BMI = body mass index; TIA = transient ischemic attack; GERD = gastroesophageal reflux disease; OSA = obstructive sleep apnea.

* $P < 0.05$.

PSG results of the patients are detailed in Table 2. Patients with OSA had poor sleep patterns and significantly increased stage 1 (light) sleep ($P = 0.01$) and less stage 3 and 4 (slow-wave) sleep ($P = 0.067$). The mean AHI and AHI-rapid eye movement (REM) in patients with OSA was 26 ± 22/h and 33 ± 24/h and was significantly higher than those who were non-OSA. Patients with OSA had a significantly higher arousal index and AHI-REM than patients without OSA. Arousal index is defined as number of times a patient abruptly changes from sleep to wakefulness or from a “deeper” stage of non-REM sleep to a “lighter” stage per hour. The minimum oxygen saturation among patients with OSA was significantly lower than non-OSA (Table 3).

Table 2. Alertness Data

	OSA (AHI >5/h) (n = 22)	Non-OSA (AHI ≤5/h) (n = 11)
THAT		
Presleep	34 ± 10	32 ± 10
Postsleep	33 ± 14	34 ± 11
ZOGIM-A		
Presleep	35 ± 9	36 ± 6
Postsleep	35 ± 10	38 ± 7
Stanford Sleepiness Scale		
Presleep	3 ± 1	3 ± 1
Postsleep	2 ± 1*	4 ± 2

Mean ± SD.

THAT = Toronto Hospital Alertness Scale[27]; ZOGIM-A = Scale to measure alertness[27]; OSA = obstructive sleep apnea; AHI = apnea-hyponea index.

* $P < 0.05$.

Table 3. Polysomnography Data

	OSA (AHI >5/h) (n = 22)	Non-OSA (AHI ≤5/h) (n = 11)
Sleep stages (%)		
Wakefulness	16.2 ± 10	17.0 ± 15
Stage 1	9.9 ± 4*	6.5 ± 3
Stage 2	47.2 ± 9	49.1 ± 12
SWS (Stages 3 and 4)	8.6 ± 6†	13.4 ± 9
REM	15.6 ± 8	14.5 ± 5
AHI-TST	25.7 ± 22*	2.4 ± 1
AHI-REM	32.7 ± 24*	9.9 ± 10
Arousal index	31.6 ± 15*	15.6 ± 9
Min. SaO_2	79.0 ± 10*	90.1 ± 6

Mean ± SD.

SWS = slow wave sleep; REM = rapid eye movement sleep; AHI-TST = Apnea Hyponea Index-total sleep time; AHI-REM = Apnea Hyponea Index-rapid eye movement sleep; OSA = obstructive sleep apnea.

* $P < 0.05$; † $P = 0.0668$.

Postoperative complications among patients with difficult intubation are shown in Table 4. The overall incidence of postoperative events was 21% (7 of 33). Postoperative complications in patients with OSA were 27% (6 of 22) versus 9% in non-OSA patients. The majority of complications among patients with OSA occurred in the ward.

Respiratory difficulties were the most common complications among patients with difficult intubation, 6 of 7 complications (86%), Table 4. Respiratory complications in patients with OSA were 22.7% (5 of 22) versus 9% (1 of 11) in non-OSA patients. In the 5 OSA patients with respiratory complications, 1 patient had mild desaturation 90%–95% in the ward and 4 had severe desaturation ≤90%. In the 4 patients with severe desaturation ≤90%, 1 patient had severe desaturation in the postanesthesia care unit, 1 in intensive care unit (ICU) and 2 in the ward. In the non-OSA patient, mild desaturation occurred in the postanesthesia care unit. All the episodes of desaturation occurred in the absence of supplemental oxygen. There was no unplanned ICU admission among the patients studied (Table 4). Five patients with OSA were electively admitted into the ICU because of the

Table 4. Postoperation Complications

	OSA (AHI >5/h) (n = 22)	Non-OSA (AHI ≤5/h) (n = 11)
Postoperative complication		
Intraoperative	0	0
PACU	2	1
ICU	1	0
Ward	3	0
Total	6	1
Respiratory complication		
Mild desaturation (SaO_2 90%–95%)	1	1
Severe desaturation (SaO_2 ≤90%)	4	0
Total	5	1
Respiratory treatment		
Oxygen requirement in ward	7 (p = 0.0674)	0
Cardiac complication	0	0
Neurology complication		
Somnolence	1	0
Readmission within 7 d	1	0
Readmission within 8–30 d	1	0
Emergency visit within 30 d	1	0

OSA = obstructive sleep apnea; PACU = postanesthesia care unit; ICU = intensive care unit; AHI = apnea-hyponea index.

nature of their surgery. One patient returned to the emergency room within 7 days because of pain and was readmitted within 30 days for cystoscopy.

After the PSG, patients were invited to meet a sleep physician (CS). Of the 22 patients with OSA, 11 patients were recommended continuous positive airway pressure (CPAP), 2 were advised weight reduction and 2 patients did not need treatment. Seven patients did not return for an appointment with the sleep physician (CS).

DISCUSSION

This study demonstrated that 66% of patients with difficult intubation had OSA (AHI >5/h). We confirmed the findings of Hiremath et al.[20] In Hiremath et al.'s study, AHI >10 was used to define sleep apnea, the prevalence of patients with OSA was 53%. We defined sleep apnea as AHI >5/h as per American Sleep Disorders Association guidelines.[25] If we use AHI >10, the prevalence of OSA in our patients with difficult intubation would be 58%, similar to Hiremath et al.'s study. Our study demonstrated that patients with difficult intubations should be screened for signs and symptoms of sleep apnea. Anesthesiologists should consider referring patients who are difficult to intubate to a sleep clinic for a PSG.

Our study also illustrated the relationship between difficult intubation and undiagnosed OSA. OSA patients have increased postoperative complications.[26] In our study, 83% of complications among OSA patients were due to desaturation. The incidence of postoperative complication among OSA patients was 27%, which is similar to Liao et al.'s study, where the incidence was 32% among OSA patients.[26]

OSA is a serious condition that diminishes quality of life[27] and is also associated with many common comorbid conditions. Studies have documented increased incidences of coronary artery diseases, hypertension, congestive heart failure, cerebrovascular accidents, and gastroesophageal reflux disease in patients with OSA.[28,29] It is estimated that the average lifespan of an untreated OSA patient is 58 yr, much shorter than the average, which is 78 yr for men and 83 yr for women.[4] Referral for treatment will help the undiagnosed OSA patient. Anesthesiologists are increasingly expected to act as perioperative physicians. The ASA has recommended patient screening for OSA.[10] As anesthesiologists, we encounter patients with unexpected difficult intubation in our daily practice. This gives us a unique opportunity to screen patients with difficult intubation for signs and symptoms of OSA and to refer these patients for sleep studies. In our study, 33% of patients with difficult intubation were referred for CPAP treatment.

Our study is different from Hiremath et al.'s study. First, our study was prospective. We asked anesthesiologists to refer patients to us when they had difficult intubation and we were able to follow these patients for postoperative complications. Hiremath et al. recruited subjects from a 2-yr anesthesia department database if they were recorded as difficult to intubate by a consultant anesthesiologist.[15] The degree of sleep apnea may change over a period of time[30]; our study avoided this confounder as all patients underwent a PSG within 8 wk after their surgery. Patients in Hiremath et al.'s study were approached months later and might have taken longer to have a PSG done. This may account for the minor difference in our results: 58% versus 53% in Hiremath et al.'s study. We also defined sleep apnea as AHI >5/h as per American Sleep Disorders Association guidelines[25] and Hiremath et al.'s study used AHI >10 to define sleep apnea. Hiremath et al.'s study only had eight OSA patients and our study confirms their findings.

This study had some limitations. Only 40% of the patients with difficult intubation consented to PSG. There is a possibility that only those patients with some sleep symptoms agreed to PSG, which may have yielded an overall higher incidence of OSA in patients with difficult intubations. Nonetheless, the incidence of 66% is very significant. Even if we assume that 48 patients who refused PSG did not have OSA, the incidence of undiagnosed OSA among patients with difficult intubation would be 28% (22 of 79). If OSA is undiagnosed and untreated, the lifespan of these patients could be shortened by 20 yr.[4] Another limitation of this study is that we did not have a control group. Therefore, we do not know the incidence of OSA in patients who are not difficult to intubate. In Hiremath et al.'s study, a control group of 15 patients was used. Two patients were diagnosed with OSA, a prevalence of 13%.[20]

In conclusion, the prevalence of OSA among patients with difficult intubation was 66%. Of all the patients with difficult intubation, 30% had mild, 18% moderate, and 18% severe OSA. The incidence of postoperative complications among patients with difficult intubation was 21%. CPAP treatment was recommended to 33% of patients. Patients with difficult intubation are at high risk for OSA and should be screened for signs and symptoms of sleep apnea. These patients may need referral for PSG.

APPENDIX: Definition of Adverse Events

Adverse event	Definition
Desaturation	SaO_2 <90% at any time and/or cyanosis and/or Pao_2 <60 Torr
Hypercapnea	Respiratory rate <8/min and or $Paco_2$ >50 and/or $Etco_2$ >55
Respiratory failure	Need for mechanical ventilation
Myocardial infarction	The evolving changes in the ST-T segement, new Q waves, or both on an electrocardiogram; symptoms of ischemia plus abnormal serum levels of cardiac enzymes; or symptoms of ischemia plus left bundle branch block
Myocardial ischemia	New or more severe chest pain diagnosed as ischemia and requiring treatment
Congestive heart failure	New pulmonary edema on a chest radiograph or a diagnosis of congestive heart failure
Clinically significant arrhythmia	New or worsening disturbance of heart rhythm requiring new treatment or a change in treatment
Transient ischemic attack	Abrupt onset of a focal neurologic deficit lasting <24 h and resulting from cerebrovascular ischemia
Unanticipated admission	Patient who admitted to the hospital/ICU instead of being shifted to home/ward. Reasons for unanticipated admission, medical, surgical, anesthesia and social reasons were collected
Readmission within 7 d and within 30 d	Patients have to be readmitted to hospital within 7 and 30 d of day surgery. Medical, surgical and anesthesia reasons are documented
Somnolence	Unable to be aroused >30 min postawakening

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